Department of Computer Science & Engineering ■■■■■■ ■■■■■■■■■ ■■■■■■■■■■■■ ■■■■■■■ ■■■■■(■■■■■■■■■ ■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Welcome to Department of Computer Science & Engineering Department by the Numbers 26 Faculty 503 Journal Publications 715 Conf. Publications 50 Research Projects 125 PhD Awarded Latest News About the Department Department of Computer Science & Engineering came into existence in 1994. The first degree program offered by the Department was B.E. (Computer Engineering) in affiliation with the University of Rajasthan. The first batch graduated in 1998. Another degree programme B.E. (Information Technology) was initiated in 2001. In January 2004, first admissions to Ph.D. programme took place. In 2008, M.Tech. (Computer Science & Engineering) programme was initiated whereas, M.Tech. (Computer Science & Information Security) was started in 2016. At present, Computer Science & Engineering Department is offering following degree programmes:B.Tech. (Computer Science & Engineering)M.Tech. (Computer Science & Engineering)M.Tech. (Computer Science & Information Security)Ph.D.Faculty at Computer Science & Engineering believes in open interaction with students who are encouraged to participate in academic, research and extra-curricular activities. Students have never misplaced trust put in them by department and have done well in academic and industry alike. Vision To be a Centre of Excellence in Computer Science and Engineering domain and work with industry on cutting edge technology to address current and emerging challenges in global perspective for the development of society. Mission To impart quality engineering education, enhance problem solving skills, foster research and innovation, encourage entrepreneurship and mold students of integrity and ethics to provide leadership with social sensitivity for the betterment of the country and humanity as a whole. Contact Information Dr. Namita MittalHead, Department of Computer Science & EngineeringMalaviya National Institute of TechnologyJLN Marg, Jaipur-3020170141-2713340hod.cse@mnit.ac.in Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: 18773518 Department of Computer Science & Engineering ■■■■■■ ■■■■■■■■■ ■■■■■■■■■■■■ ■■■■■■■ ■■■■■(■■■■■■■■■ ■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Welcome to Department of Computer Science & Engineering Department by the Numbers 26 Faculty 503 Journal Publications 715 Conf. Publications 50 Research Projects 125 PhD Awarded Latest News About the Department Department of Computer Science & Engineering came into existence in 1994. The first degree program offered by the Department was B.E. (Computer Engineering) in affiliation with

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NosProjector:1 Nos Computer Network Lab Details Of Equipment / Computer System:Processor Pentium Core i7 RAM 4GB 500 GB HDDSoftware Installed:OS Ubuntu Gcc Python, MatLABNo. of System:30 NosProjector:1 Nos Minsky Research Lab Details Of Equipment / Computer System:Workstation Supermicro Intel Xeon Silver 4110 CPU@2.10 GHz x32 , 96 GB RAM, 04 TB SSD DISK Graphics: GeForce RTX 2080/Ti/PCIe/SSE2, 27" MonitorSoftware Installed:OS UbuntuNo. of System:06 Nos Software Design Lab Details Of Equipment / Computer System:HP Elite Desktop 800 G1 SFF, I-7 (4770-3.4 GHz), 4 GB DDR3 RAM, 500 GB Sata HDD, with 18.5" lCD MonitorSoftware Installed:Ubuntu 20.04 LTSNo. of System:29 NosProjector:1 Nos10 KVA UPS:1 Nos Real Time Embedded System Lab Universal microcontroller Development (UMD) Board : 15Zig bee Technology Trainer Kit :5GSM development Board : 5SENSOR MODULES and Other Interfaces :5Bluetooth Trainer Kit : 2Smart Phone Trainer Kit : 2Object Detection and tracking using Tracked Robo Kit using Raspberry Pi / AVR / ARM/ Arduino : 1 Digital System Lab Digital Lab Trainer (Bread Board Model ME1154 With Complimentary Ready to Use Model) : 258085 Microprocessor Trainer - Micro 85EB-LCD - : 258086 Microprocessor Trainer - Micro 86 LCD – : 25Keyboard & Display Interface Board (VBMB 001)- : 102 Channel DAC Interface Board (VBMB-002) : 108 Channel ADC Interface Board (VBMB 003) : 108251 & 8253 Interface Board (VBMB 004) : 108259 Interface Board (VBMB - 007) : 108255 Interface Board (VBMB 008) : 10DC Motor Speed Measurement : 10Digital Storage Oscilloscope, High Performance With DVM &Wavegen; Agilent DSOx2014A with DSOX2000-DVM & DSO2000-001 all media & Manuals analog BW 100MHz, 4 Digital Channels , Built in Function generator 20 Mhz& Digital Volt Meter 3 Digit Enabled (30) & DSOX2MSO –MSO Upgrade -8 Channel for 2000 X-Series Oscilloscope (05) : 30Atlys Spartan 6 FPGA Development Kit : 18NetSim Academic version v12.2 perpetual and floating l : 30 users licenseNetSim Standard version and Emulator version v12.2 perpetual and floating : 05 users license IOT Lab Universal embedded mother board: 5Arduino YUN daughter boards: 5ARM 7 Daughter Board: 5Raspberry Pi development board: 5GSM Interfacing Module: 5Bluetooth Interfacing Module: 5RFID Interfacing Module: 5XBEE Interfacing Module: 5Temp. measurement sensor module: 5Tmote Sky Dev. Sensor Board: 5Wireless Modem: 5BeagalBone Black: 5Pressure measurement sensor module: 5Stepper motor interface module: 2IoT Training Kit: 2 ISEA Lab (Information Security Lab) Details Of Equipment / Computer System:Dell OptiPlex 7440 (AIO) Processor : - Intel(R) Core(TM) i5- 6500 @ 3.20GHz RAM :- 4.0 GB Hard Disk : - 500GB Network Card : - 10/10/1000 MbpsSoftware Installed:OS Ubuntu GCC, PythonNo. of System:20 Nos Details Of Equipment / Computer System:Dell OptiPlex 9020 Processor : - Intel(R) Core(TM) i5-4590 @ 3.30GHz RAM :- 16.0 GB Hard Disk : - 500GB Network Card : - 10/10/1000 Mbps 19.5TFTSoftware Installed:OS Ubuntu GCC, PythonNo. of System:14 NosProjector (Casio XJ-V2):01 NosAPC-Smart UPS RT-5000, 5KVA:02 Nos Ramanujan Lab Details Of Equipment / Computer System:Wipro Pentium i3 RAM 4GB 500 GB HDDSoftware Installed:OS UbuntuNo. of System:35 Nos Kalam Research Lab Details Of Equipment / Computer System:Single Intel Xeon 16 Core, 2.10 GHz, 22 MB cache, 960 GB SSD, 2No NVIDIA Quadro RTX 6000 with 24GB DDR6, 2TB 7200 RPM Enterprise SATA Hard Drive.Software Installed:Ubuntu 18, Python, tensor flow, PytorchNo. of System:01 Nos Details Of Equipment / Computer System:Intel Xeon, 2.10 GHz,1No NVIDIA Titan V with 12GB, 1TB Hard DriveSoftware Installed:Ubuntu 18, Python, tensor flow, PytorchNo. of System:01 Nos Miscellaneous Six UG/PG Labs; Six Research Labs; One Server roomDFB room; office with reprographic facility, telephone and fax, printer available for students/facultyIndividual faculty rooms with Computing, Internet, telephoneSeminar hall – equipped with overhead LCD projector, computer, Internet connectivity Committee room – equipped with overhead LCD projector, computer, Internet connectivityTwo Tutorial roomsRecord room –Reports, BooksDepartmental Store room Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: 18773525 Department of Computer Science & Engineering (Committee) [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Committee Department Under-Graduate Committee (DUGC) Department Post-Graduate Committee (DPGC) Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: 18773527 Department of Computer Science & Engineering (Publications) [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Publications Journal Publications (503) 2025 A. K. Prajapati, E. S. Pilli, R. B. Battula, V. Varadharajan, A. Verma, and R. C. Joshi, "A Comprehensive Survey on RPL Routing-based Attacks, Defences and Future Directions in Internet of Things" , Computers and Electrical Engineering Volume :125 / / 2025 Anil Kumar Prajapati, Emmanuel S Pilli, Ramesh Babu Battula, Vijay Varadharajan, Abhishek Verma, RC Joshi, "A comprehensive survey on RPL routing-based attacks, defenses and future directions in Internet of Things" , Computers and Electrical Engineering Volume :123 / / 2025 Akash Yadav, Mushtaq Ahmed, "A Framework for efficiently parallelizing loops for many core systems" , SN Computer Science Volume :6 / / 2025 Idris Afzal Shah, Mushtaq Ahmed, "An Optimized Load Balancing Probabilistic Protocol for Delay Tolerant Networks accepted" , SN Computer Science Volume :24 / 22 / 2025 ISBN: SNCS-D-24-04592R1 Kamakhya Bansal , Ashish Kumar Tripathi, "Automated floating debris monitoring using optical satellite imagery and artificial intelligence: Recent trends, challenges and opportunities" , Remote Sensing Applications: Society and Environment Volume :37 / 101475 / 2025 Ravi Nahta, Ganpat Singh Chauhan, Yogesh Kumar Meena, Dinesh Gopalani , "CF-MGAN: Collaborative filtering with metadata-aware generative adversarial networks for top-N recommendation" , Information Sciences Volume :689 / / 2025 Deepti Sharma, Ramesh Babu Battula, "CNN based Hybrid Precoding Framework using Dual-Phase Shifter in MIMO Systems" , International Journal of Ad Hoc and Ubiquitous Computing Volume :48 / / 2025 Abhishek Upadhyay, Yogesh Kumar Meena, Satyendra Singh Chouhan, "EJMACC: Emotion Aided a Joint Learning Approach for Multi-aspect Crisis Event Classification" , Expert System and Applications Volume :282 / 127597 / 2025 Monika Choudhary, Satyendra Singh Chouhan, "Enhancing credibility assessment in online social networks using multimodal deep learning" , Applied Soft Computing Volume :171 / 112796 / 2025 Sachin Gupta, Ashish Kumar Tripathi, "Flora-NET: Integrating dual coordinate attention with adaptive kernel based convolution network for medicinal flower identification" , Computers and Electronics in Agriculture Volume :230 / 109834 / 2025 Rohit Lohar, Meenakshi Tripathi, Hossein Shirazi, "Free-Phish: detecting phishing websites hosted on free web hosting domains." , International Journal of Computers and Applications Volume :47 (2) / 162-168 / 2025 Sachin Gupta, Ashish Kumar Tripathi, Nkenyereye Lewis, "Pre-trained noise based unsupervised GAN for fruit disease classification in imbalanced datasets" , Pattern Analysis and Applications Volume :28 / / 2025 Abhishek Narwaria, Arka Prokash Mazumdar, "SD-MoMa: ANN-based mobility prediction and adaptive handover management in SDWSN" , Cluster Computing Volume :Accepted / / 2025 Idris Afzal Shah, Mushtaq Ahmed, "Survey on Protocols in MANETs, WSNs and DTNs" , International Journal of System Engineering and Management Volume :31 / / 2025 Shreerudra Pratik, Pallabi Sharma, Deepak Ranjan Nayak, Bunil K Balabantaray, "WMCF-Net: Wavelet pooling-based multiscale contextual fusion network for polyp classification" , Biomedical Signal Processing and Control Volume :107 / / 2025 2024 Rukhsar Sultana, Jyoti Grover, Meenakshi Tripathi, Manhar Singh Sachdev, Sparsh Taneja , "Detecting Sybil Attacks in VANET: Exploring Feature Diversity and Deep Learning Algorithms with Insights into Sybil Node Associations." , Journal of Network and Systems Management Volume :32 / / 2024 Geetanjali Singh, Namita Mittal, and Satyendra Singh Chouhan, "A deep learning framework for multi-document summarization using LSTM with improved Dingo Optimizer (IDO)" , Multimedia Tools and Applications Volume :1 / 1-23 / 2024 Kamakhya Bansal, Ashish Kumar Tripathi, Varun G. Menon, Venki Balasubramanian, "A Federated Generative Adversarial Network With SSIM-PSNR Based Weight Aggregation for Consumer Electronics Waste" , IEEE Transactions on Consumer Electronics Volume :Early Acce / -- / 2024 Jyoti Nagpal, Lavika Goel, P.S. Shekhawat, "A hybrid deep learning neural network for early plant disease diagnosis using a real-world Wheat■Barley vision dataset: challenges and solutions" , International Journal of Data Science and Analytics Volume :0 / 1-22 / 2024 Mahipal Jadeja, Rahul Muthu and Ravi Goyal , "A New Characterisation of Total Graphs" , Palestine Journal of Mathematics Volume :13(4) / / 2024 Prem Shanker Yadav, Dinesh Kumar Tyagi, Santosh Kumar Vipparathi, "A Novel Approach for Image Retrieval in Remote Sensing Using Vision-Language-Based Image Caption Generation" , Multimedia Tools and Applications Volume :Xx / / 2024 Neeraj Garg, Sneha Garg, Mahipal Jadeja, Yogesh Kumar Meena, Dinesh Gopalani and Ganpat

Singh Chauhan, "A novel dominating set and centrality based graph convolutional network for node classification" , Multimedia Tools and Applications Volume :NA / / 2024 Abhishek Narwaria, Keshav Soni, Arka Prokash Mazumdar, "A position and energy aware multi-objective controller placement and re-placement scheme in distributed SDWSN" , The Journal of Supercomputing Volume :80 / 12062■12090 / 2024 Aga Basit Iqbal, Idris Afzal Shah, Injila, Assif Assad, Mushtaq Ahmed, and Syed Zubair Shah, "A Review of Deep Learning Algorithms for Modeling Drug Interactions" , Multimedia Systems Volume :30 / 45 / 2024 Pallabi Sharma, Deepak Ranjan Nayak, Bunil K. Balabantaray, M. Tanveer, Rajashree Nayak, "A survey on cancer detection via convolutional neural networks: Current challenges and future directions" , Neural Networks Volume :169 / 637-659 / 2024 Subba Rao Peram, Ramesh Babu Battula and B. Tarakeswara Rao, "A survey on wireless networks to balancing the load in wireless mesh" , International Journal of Advanced Intelligence Paradigms Volume :29 / / 2024 Lavika Goel, Nilarnab Debnath, Sanskar Mundaniya, "A Visual Question and Answering System with Support for Compound Emotions using Facial Landmark Identification with MediaPipe and CNN classifier" , Neurocomputing Volume :588 / 127623 / 2024 Dipankar Das, Deepak Ranjan Nayak, Ram B. Pachori, "AES-Net: An adapter and enhanced self-attention guided network for multi-stage glaucoma classification using fundus images" , Image and Vision Computing Volume :146 / / 2024 Kamakhya Bansal, Ashish Kumar Tripathi, "An explainable MHSA enabled deep architecture with dual-scale convolutions for methane source classification using remote sensing" , Environmental Modelling & Software Volume :181 / 106178 / 2024 Vikas Kumar Jain, Meenakshi Tripathi , "An integrated deep learning model for Ethereum smart contract vulnerability detection" , International Journal of Information Security Volume :23 / 557-575 / 2024 Aishwarya Mishra, Lavika Goel, "An Ocean Water Current Inspired Geo Science-Based Optimization Algorithm" , International Journal of Information Technology Volume :16(4) / 2619-2633 / 2024 Nirnai Rai, Jyoti Grover, "Analysis of crypto module in RIOT OS using Frama-C" , The Journal of Supercomputing Volume :35 / / 2024 Faisel Mushtaq , Saunak Bhattacharjee , Sandeep Mandia , Kuldeep Singh , Satyendra Singh Chouhan, Rajesh Kumar, Priyanka Harjule, "Artificial intelligence for computer aided detection of pneumoconiosis: A succinct review since 1974" , Engineering Applications of Artificial Intelligence Volume :133 / / 2024 Sachin Gupta, Ashish Kumar Tripathi, V Parameswaran, "Attention Transfer-Based Deep Distilled Architecture for 6G Driven-Smart Vehicle Transportation System" , IEEE Transactions on Intelligent Transportation Systems Volume :Early Acce / 1-10 / 2024 Monika Choudhary, Satyendra Singh Chouhan, Santosh Singh Rathore, "Beyond Text: Multimodal Credibility Assessment Approaches for Online User-Generated Content" , ACM Transactions on Intelligent Systems and Technology Volume :15 / / 2024 Praveen Singh Thakur, Mahipal Jadeja, Satyendra Singh Chouhan, "CBReT: A Cluster-Based Resampling Technique for Dealing with Imbalanced Data in Code Smell Prediction" , Knowledge Based Systems Volume :286 / 1-47 / 2024 ISBN: 0950-7051 Shivani Rohilla, Mahipal Jadeja, Emmanuel S Pilli, Pranshu Vyas and Pranjal Gehlot, "CC-GCN: A novel Graph-based approach for Identification and Detection of Autism Spectrum Disorder" , Multimedia Tools and Applications Volume :NA / / 2024 S.

Rohilla, M. Jadeja, E. S. Pilli, P. Vyas, and P. Gehlot, "CC-GCN: A novel Graph-based approach for Identification and Detection of Autism Spectrum Disorder" , Multimedia Tools and Applications Volume :83 / 1-22 / 2024 D. Das, D. R. Nayak, S. V. Bhandary, U. R. Acharya, "CDAM-Net: Channel Shuffle Dual Attention Based Multi-Scale CNN for Efficient Glaucoma Detection Using Fundus Images" , Engineering Applications of Artificial Intelligence Volume :0 / / 2024 Rahul Saxena, Pranjal Paira and Mahipal Jadeja , "CLUS-BET: Improving Influence Propagation and Classification in Networks using a Novel Seed Selection Technique" , Social Network Analysis and Mining Volume :14 / / 2024 Mayank Kumar Jain, Dinesh Gopalani, Yogesh Kumar Meena, "ConFake: fake news identification using content based features" , Multimedia Tools and Applications Volume :83 / / 2024 Rukhsar Sultana, Jyoti Grover, Meenakshi Tripathi, "Cooperative approach for data-centric and node-centric misbehavior detection in VANET" , Vehicular Communications Volume :50 / 100855 / 2024 Ravi Nahta, Dinesh Gopalani, Yogesh Kumar Meena, Ganpat Singh Chauhan, "Deep learning with the generative models for recommender systems: A survey" , Computer Science Review Volume :53 / / 2024 A. Seetha, S. S. Chouhan, E. S. Pilli, V. Raychoudhury, and S. Saha, "DiEvD-SF : Disruptive Event Detection using Continual Machine Learning with Selective Forgetting" , IEEE Transaction on Computational Social Systems Volume :11 / 4189 - 4201 / 2024 A. Seetha, S. S. Chouhan, E. S. Pilli, V. Raychoudhury and S. Saha, "DiEvD-SF: Disruptive Event Detection Using Continual Machine Learning With Selective Forgetting" , IEEE Transaction on Computational Social Systems Volume :11 / 4189-4201 / 2024 A. Seetha, S. S. Chouhan, E. S. Pilli, V. Raychoudhury, "DiEvD: Disruptive Event Detection from Dynamic Datastreams using Continual Machine Learning: A Case Study with Twitter" , IEEE Transactions on Emerging Topics in Computing Volume :12 / 727 - 738 / 2024 Kamakhya Bansal, Ashish Kumar Tripathi, "Dual level attention based lightweight vision transformer for streambed land use change classification using remote sensing" , Computers & Geosciences Volume :191 / 105676 / 2024 Praveen Singh Thakur, Satyendra Singh Chouhan and Mahipal Jadeja, "Enhancing Software Code Smell Detection with Modified Cost-Sensitive SVM" , International Journal of System Assurance Engineering and Management Volume :NA / / 2024 Megha Sharma, Namita Mittal, Anukram Mishra, and Arun Gupta, "Ensemble learning for prominent feature selection and electric power prediction in agriculture sector" , Multimedia Tools and Applications Volume :1 / 1-28 / 2024 Parvati Bhurani, Satyendra Singh Chouhan, and Namita Mittal, "Exbcil: an exemplar-based class incremental learning for intrusion detection system" , International Journal of Machine Learning and Cybernetics Volume :00 / / 2024 Dipankar Das, Deepak Ranjan Nayak, "FJA-Net: A Fuzzy Joint Attention Guided Network for Classification of Glaucoma Stages" , IEEE Transactions on Fuzzy Systems Volume :00 / / 2024 Sachin Gupta, Ashish Kumar Tripathi, "Fruit and vegetable disease detection and classification: Recent trends, challenges, and future opportunities" , Engineering Applications of Artificial Intelligence Volume :133 / 108260 / 2024 Tapas K. Dutta, Deepak Ranjan Nayak, Ram B. Pachori, "GT-Net: global transformer network for multiclass brain tumor classification using MR images" , Biomedical Engineering Letters Volume :14 / / 2024 G Singh, N Mittal, S S Chouhan, "HindiSumm: A Hindi Abstractive Summarization benchmark dataset" , ACM

Transactions on Asian and Low-Resource Language Information Processing Volume :00 / / 2024 Lavika Goel, Pankaj Patel, "Improving YOLOv6 using Advanced PSO optimizer for weight selection in Lung Cancer Detection and Classification" , Multimedia Tools and Applications Volume :0 / 1-34 / 2024 Hitesh Verma, Smita Naval, Balaprakasa Rao Killi, P Vinod, "Indoor localization using device sensors: A threat to privacy" , Microprocessors and Microsystems Volume :106 / 105041 / 2024 Gopal Behra, Neeta Nain, Ravindra Kumar Soni, "Integrating User-Side Information Into Matrix Factorization to Address Data Sparsity of Collaborative Filtering" , Multimedia Systems Volume :30 (64) / 1-18 / 2024 Rukhsar Sultana, Jyoti Grover, Meenakshi Tripathi, "Intelligent defense strategies: Comprehensive attack detection in VANET with deep reinforcement learning" , Pervasive and Mobile Computing Volume :103 / / 2024 Rukhsar Sultana, Jyoti Grover, Meenakshi Tripathi, Prinkle Sharma , "LA-DETECTS: Local and Adaptive Data-Centric Misbehavior Detection Framework for Vehicular Technology Security" , IEEE OPEN JOURNAL OF VEHICULAR TECHNOLOGY Volume :6 / 145-169 / 2024 Meghna Raj, NB Harshini, Shashank Gupta, Mohammed Atiquzzaman, Oshin Rawlley, Lavika Goel, "Leveraging Precision Agriculture Techniques using UAVs and Emerging Disruptive Technologies" , Energy Nexus Volume :0 / 100300 / 2024 Abhishek Verma, Sachin Kumar Verma, Avinash Chandra Pandey, Jyoti Grover, Girish Sharma, "Li-MSD: A lightweight mitigation solution for DAO insider attack in RPL-based IoT" , Future Generation Computer Systems Volume :159 / / 2024 Idris Afzal Shah, Mushtaq Ahmed, "Load Propagation Balancing Strategy for Wireless Sensor Networks" , journal Tehnicki glasnik/Technical Journal Volume :19 / / 2024 ISBN: TG-20240316121244 M. Choudhary, S. Patil, S. S. Chouhan, E. S. Pilli, "MmDs: Multimodal Benchmark Dataset for Suspicious Profile Detection on Twitter Social Network" , Social Network Analysis and Mining Volume :14 / 1-9 / 2024 Siddhi Kumari Sharma, Lavika Goel, Namita Mittal, "Nature■Inspired Optimization Techniques for Heart Disease Detection: A Comprehensive Survey" , Neural computing and applications Volume :0 / 1-32 / 2024 Richa Kumari, Dinesh Kumar Tyagi , Ramesh B. Battula, "NEIL: aN EfficIent cLuster-based device discovery for D2D communication in B5G" , Peer-to-Peer Networking and Applications Volume :18 / 1-25 / 2024 ISBN: 1936-6442 Richa Kumari, Dinesh Kumar Tyagi, Ramesh Babu Battula, "NEIL: aN EfficIent cLuster-based device discovery for D2D communication in B5G" , Peer-to-Peer Networking and Applications Volume :17 / / 2024 D. Mumtaz, Sadbhawna, V. Jakhetiya, B. N. Subudhi and W. Lin,, "Non-Subsampled Contourlet Transform and Ground-Truth Score Generation Based Quality Assessment for DIBR-Synthesized Views" , IEEE Transactions on Multimedia Volume :26 / / 2024 Aishwarya Mishra, Lavika Goel, "Optimizing Artificial Neural Network for Demography Based Crop Recommendation: An Ocean Water Current Inspired Approach in Precision Agriculture" , International Journal of Information Technology Volume :0 / 1-18 / 2024 Avuthu Avinash Reddy, Ramesh Babu Battula, Dinesh Gopalani, "Performance analysis of ML models on 5G sub-6 GHz bands: An experimental study" , Cluster Computing Volume :27 / 14283■14294 / 2024 Sachin Gupta, Ashish Kumar Tripathi, Avinash Chandra Pandey , "Potcapsnet: an explainable pyramid dilated capsule network for visualization of blight diseases" , Neural Computing and Applications Volume :Early Acce / / 2024 Abhishek Vyas, Po-Ching Lin, Ren-Hung

Hwang, Meenakshi Tripathi, "Privacy-Preserving Federated Learning for Intrusion Detection in IoT Environments: A Survey" , IEEE Access Volume :12 / 127018 - 127050 / 2024 Babita, Deepak Ranjan Nayak, "RDTNet: A residual deformable attention based transformer network for breast cancer classification" , Expert Systems With Applications Volume :249 / / 2024 Riti Kushwaha, Gaurav Singal, Neeta Nain, "Rediscovering Minutiae Matching through One Shot Learning■s Siamese Framework in Poor Quality Footprint Images" , IEEE Transactions on Biometrics, Behavior, and Identity Science Volume :May 2024 / 1-11 / 2024 Akash Yadav, Mushtaq Ahmed, "Robust Block-Based Watermarking Algorithm with Parallelization Using Multi-Level Discrete Wavelet Transformation" accepted" , Journal of Real-Time Image Processing Volume :21 / 15 / 2024 Atul Kumar Verma, Mahipal Jadeja and Saurabh Jayaswal, "RW-HeCo: A Random Walk and Network Centrality based Graph Neural Network for Community Detection in Heterogeneous Networks" , Multimedia Tools and Applications Volume :NA / / 2024 Abhishek Upadhyay, Yogesh Kumar Meena, Ganpat Singh Chauhan, "SatCoBiLSTM: Self-attention based hybrid deep learning framework for crisis event detection in social media" , Expert Systems With Applications Volume :249 / / 2024 Vivek Sharma, Ashish Kumar Tripathi, Himanshu Mittal, Lewis Nkenyereye , "SoyaTrans: A novel transformer model for fine-grained visual classification of soybean leaf disease diagnosis" , Expert Systems With Applications Volume :260 / 125385 / 2024 Rojo Kurian Daniels, Vikas Kumar, Satyendra Singh Chouhan, Aneesh Prabhakar, "Thermal runaway fault prediction in air-cooled lithium-ion battery modules using machine learning through temperature sensors placement optimization" , Applied Energy Volume :355 / 122352 / 2024 ISBN: 0306-2619 Kuldeep Marotirao Biradar,Murari Mandal, Sachin Dube , Santosh Kumar Vipparthic , Dinesh Kumar Tyagi, "Triplet-set Feature Proximity Learning for Video Anomaly Detection" , Image and Vision Computing Volume :Volume 150 / / 2024 ISBN: ISSN 0262-8856 Kamakhya Bansal, Ashish Kumar Tripathi, "WasteNet: A novel multi-scale attention-based U-Net architecture for waste detection in UAV images" , Remote Sensing Applications: Society and Environment Volume :35 / 101220 / 2024 2023 Lavika Goel, Satyansh Mishra, "A Hybrid of Modified YOLOv3 with BBO/EE Optimizer for Lung Cancer Detection" , Multimedia Tools and Applications Volume :83 / 52219-52251 / 2023 Jitendra Parmar, Satyendra Singh Chouhan, Vaskar Raychoudhury, "A machine learning based framework to identify unseen classes in open-world text classification" , Information Processing and Management Volume :60 / 1-18 / 2023 Lavika Goel, Giriraj Vaishnav, Siddharth Chand Ramola, Tushar Purohit, "A Modified Ant Colony Optimization Algorithm with Pheromone Mutations for Dynamic Travelling Salesman Problem" , IETE Technical Review Volume :0 / 1-16 / 2023 Manojkumar Pal, ML Mittal, Gunjan Soni, SS. Chouhan, Manish Kumar, "A multi-agent system for FJSP with setup and transportation times" , Expert Systems With Applications Volume :216 / / 2023 Ashish Kumar Tripathi, Avinash Chandra Pandey, Nikhil Sharma , "A new electricity theft detection method using hybrid adaptive sampling and pipeline machine learning" , Multimedia Tools and Applications Volume :XX / / 2023 Ashish Kumar Tripathi, K. Akul Krishnan, Avinash Chandra Pandey, "A Novel Blockchain and Internet of Things-Based Food Traceability System for Smart Cities" , Wireless Personal

Communications Volume :129 / / 2023 Megha Sharma, Namita Mittal, Anukram Mishra, Arun Gupta, "A TIME-SERIES FORECASTING OF POWER CONSUMPTION AND FEATURE EXTRACTION IN AGRICULTURE SECTOR USING MACHINE LEARNING" , International Journal of Power and Energy Systems Volume :43 (10) / 1-11 / 2023 Ritu Sharma, Dinesh Gopalani, Yogesh Kumar Meena, "An anatomization of research paper recommender system: Overview, approaches and challenges" , Engineering Applications of Artificial Intelligence Volume :118 / / 2023 Shikha Mundra, Jaiwanth Reddy, Ankit Mundra, Namita Mittal, Ankit Vidyarthi, Deepak Gupta , "An Automated Data-driven Machine Intelligence Framework for Mining Knowledge To Classify Fake News Using NLP" , ACM Transactions on Asian and Low-Resource Language Information Processing Volume :1 / 1-20 / 2023 P. K. Keserwani, M. C. Govil, E. S. Pilli , "An Effective NIDS Framework based on a Comprehensive Survey of Feature Optimization and Classification Techniques" , Neural Computing and Applications Volume :35 / 4993-5013 / 2023 Deepti Sharma, Ramesh Babu, "An efficient and optimized cooperative indoor localization for B5G communication" , International Journal of Communication Systems Volume :37 / / 2023 Megha Sharma, Namita Mittal, Anukram Mishra, Arun Gupta, "An efficient approach for load forecasting in agricultural sector using machine learning" , e-Prime-Advances in Electrical Engineering, Electronics and Energy Volume :6 / 1-11 / 2023 Rahul Saxena, Spandan Pankaj Patil, Atul Kumar Verma, Mahipal Jadeja, Pranshu Vyas, Vikrant Bhateja, and Jerry Chun-Wei Lin, "An Efficient Bet-GCN Approach for Link Prediction" , International Journal of Interactive Multimedia and Artificial Intelligence (IJIMAI) Volume :8(1) / 38-52 / 2023 Soumya Ranjan Nayak, Deepak Ranjan Nayak, Utkarsh Sinha, Vaibhav Arora, Ram Bilas Pachori, "An Efficient Deep Learning Method for Detection of COVID-19 Infection using Chest X-ray Images" , Diagnostics Volume :13 / 00-00 / 2023 Jitendra Goyal, Mushtaq Ahmed, Dinesh Gopalani, Neelu Pandey, Faisal Ahmed, "An Efficient Fuzzy-Based Vaccine Distribution Using Blockchain Technology" , International Journal of Computing and Digital Systems Volume :14 / 12 / 2023 ISBN: 2210-142X Akash Yadav, Mushtaq Ahmed, Bhavna Ambudkar, Deepak Kumar, "An Energy-Efficient Routing Protocol for a Modified Fat-Tree Topology in System-on-Chip Design" , Mathematical Modelling of Engineering Problems (Scopus) Volume :10 / 2149-2157 / 2023 Vikas Kumar Jain, Meenakshi Tripathi, "An integrated deep learning model for Ethereum smart contract vulnerability detection" , International Journal of Information Security Volume :94 / / 2023 Tapas K Dutta, Deepak Ranjan Nayak, Yu-Dong Zhang, "ARM-Net: Attention-guided Residual Multiscale CNN for Multiclass Brain Tumor Classification using MR Images" , Biomedical Signal Processing and Control Volume :00 / / 2023 Ganpat Singh Chauhan, Ravi Nahta, Dinesh Gopalani, Yogesh Kumar Meena, "Aspect based sentiment analysis using deep learning approaches: A survey" , Computer Science Review Volume :49 / / 2023 A. Sharma, E. S. Pilli and A. P. Mazumdar, "BD-Trust: Behavioural and Data Trust Management Scheme for Internet of Things" , Journal of Ambient Intelligence and Humanized Computing Volume :14 / 16195 - 16207 / 2023 Atul Kumar Verma, Rahul Saxena, Mahipal Jadeja, Vikrant Bhateja and Jerry Chun-Wei Lin, "Bet-GAT: An Efficient Centrality based Graph Attention Model for Semi Supervised Node Classification" , Applied Sciences (Special Issue: Integrated

Artificial Intelligence in Data Science) Volume :13 / / 2023 A. Sharma, E. S. Pilli and A. P. Mazumdar, "BLAST-IoT: BLockchain Assisted Scalable Trust in Internet of Things" , Computers and Electrical Engineering Volume :109 / / 2023 Dipankar Das, Deepak Ranjan Nayak, Ram B. Pachori, "CA-Net: A Novel Cascaded Attention-based■Network for Multi-stage Glaucoma Classification using Fundus Images" , IEEE Transactions on Instrumentation and Measurement. Volume :0 / / 2023 Sakshi Parashar, Namita Mittal, Parth Mehta, "CASRank: A ranking algorithm for legal statute retrieval" , Multimedia Tools and Applications Volume :83 / 1-18 / 2023 Atul Kumar Verma and Mahipal Jadeja, "CB-SAGE: A novel centrality based graph neural network for floor plan classification" , Engineering Applications of Artificial Intelligence, Elsevier Volume :126 / / 2023 Vivek Sharma, Ashish Kumar Tripathi, Purva Daga, Nidhi M., Himanshu Mittal, "ClGanNet: A novel method for maize leaf disease identification using ClGan and deep CNN" , Signal Processing: Image Communication Volume :120 / 117074 / 2023 Gopal Behra and Neeta Nain, "Collaborative Filtering with Temporal Features for Movie Recommendation System" , Procedia Computer Science Volume :218 / 1366-1373 / 2023 Mayank Kumar Jain, Dinesh Gopalani, Yogesh Kumar Meena, "ConFake: fake news identification using content based features" , Multimedia Tools and Applications Volume :83 / 8729-8755 / 2023 Aditi Seetha, Satyendra Singh Chouhan, Emmanuel S. Pilli, and Vaskar Raychoudhury, "DiEvD: Disruptive Event Detection from Dynamic Datastreams using Continual Machine Learning: A Case Study with Twitter" , IEEE Transaction on Emerging Topics in Computing, 2023 Volume :2023 / / 2023 Vivek Sharma, Ashish Kumar Tripathi, Himanshu Mittal, "DLMC-Net: Deeper lightweight multi-class classification model for plant leaf disease detection" , Ecological Informatics Volume :75 / / 2023 Mushtaq Ahmed, Bhavna Ambudkar, Akash Yadav, "Efficient Power Estimation for 3D-Mesh Optic Communication Network (Accepted)" , Ingenierie Des Systemes D-Information (Scopus) Volume :29 / 27-34 / 2023 Vijay Kumar Sharma, Namita Mittal, Ankit Vidyarthi, Deepak Gupta, "Exploring Web-based Translation Resources Applied to Hindi-English Cross-Lingual Information Retrieval" , ACM Transactions on Asian and Low-Resource Language Information Processing Volume :22(8) / 1-19 / 2023 Nidhi, Jyoti Grover, "Federated learning analysis for vehicular traffic flow prediction: evaluation of learning algorithms and aggregation approaches" , Cluster Computing Volume :- / / 2023 Idris Shah, Mushtaq Ahmed, "Fuzzy K-Means Clustering Routing Algorithm for Load Balancing in Wireless Sensor Networks" , Wireless Personal communications Volume :28 / 13 / 2023 Lavika Goel, Jyotishree Kanhar, Vij Patel, Aishwary Vardhan, "Hybrid nature-inspired techniques for Natural Scene Character Recognition" , Soft Computing Volume :0 / 1-17 / 2023 Aditya Kumar Singh, Jyoti Grover, Sumita Mishra, "Integration of Blockchain in VANET Using gRPC for Privacy Preservation of Vehicles" , SN Computer Science Volume :5(1) / / 2023 Himanshu K. Gajera, Deepak Ranjan Nayak, Mukesh A. Zaveri, "M 2 CE: Multi-CNN ensemble approach for improved multiclass classification of skin lesion" , Expert Systems Volume :0 / / 2023 Megha Sharma, Namita Mittal, Anukram Mishra, Arun Gupta, "Machine Learning-Based Electricity Load Forecast for the Agriculture Sector" , International Journal of Software Innovation Volume :1 / 1-21 / 2023 Aishwarya Mishra, Lavika Goel, "Nature Inspired Metaheuristic Algorithms in Smart farming:

Analytical Survey" , IETE Technical Review Volume :0 / 1-20 / 2023 Jitendra Parmar, SS Chouhan, Vaskar Raychoudhury, Santosh S Rathore, "Open-world Machine Learning: Applications, Challenges, and Opportunities" , ACM Computing Surveys Volume :55 / 1-42 / 2023 Y Zhang, J. M. Gorriz, D. R. Nayak, "Optimization Algorithms and Machine Learning Techniques in Medical Image Analysis" , Mathematical Biosciences and Engineering Volume :20 / / 2023 Idris Shah, Mushtaq Ahmed, Ragavendra Singh, "Pentago SnW: An improved Spray and Wait protocol for Delay Tolerant Wireless Sensor Networks" , (Accepted) China Communications Volume :20 / / 2023 Akash Yadav, Mushtaq Ahmed, Alina Khan, "Performance Analysis of Parallel Implementations of Global Sequence Alignment Methods for DNA Sequencing" , International Journal of Computing and Digital Systems Volume :14 / 12 / 2023 ISBN: 2210-142X Girish Sharma, Jyoti Grover, Abhishek Verma, "Performance evaluation of mobile RPL-based IoT networks under version number attack" , Computer Communications Volume :197 / 12-22 / 2023 Geetu Dhawan, Arka P. Mazumdar, Yogesh K. Meena, "PoSif: A Transient Content Caching and Replacement Scheme for ICN-IoT" , Wireless Communications and Mobile Computing Volume :2023 / / 2023 L. Sadineni, E. S. Pilli, R. B. Battula, "ProvLink-IoT: A Novel Provenance model for Link-Layer Forensics in IoT Networks" , Forensic Science International: Digital Investigation Volume :46 / 1-16 / 2023 Lakshminarayana Sadineni, Emmanuel S Pilli, Ramesh Babu Battula, "ProvLink-IoT: A novel provenance model for Link-Layer Forensics in IoT networks" , Forensic science international digital investigation Volume :46 / / 2023 Girish Sharma, Jyoti Grover, Abhishek Verma, "QSec-RPL: Detection of version number attacks in RPL based mobile IoT using Q-Learning" , Ad Hoc Networks Volume :142 / 103118 / 2023 Kamakhya Bansal, Ashish Kumar Tripathi, Avinash Chandra Pandey, Vivek Sharma, "RfGanNet: An efficient rainfall prediction method for India and its clustered regions using RfGan and deep convolutional neural networks" , Expert Systems With Applications Volume :235 / 121191 / 2023 Satya Narayan, Arka Prokash Mazumdar, Santosh Kumar Vipparthi, "SBI-DHGR: Skeleton-based intelligent dynamic hand gestures recognition" , Expert Systems With Applications Volume :232 / 120735 / 2023 ISBN: 0957-4174 Abhishek Narwaria, Arka Prokash Mazumdar, "Software-Defined Wireless Sensor Network: A Comprehensive Survey" , Journal of Network and Computer Applications Volume :215 / 103636 / 2023 Megha Sharma, Namita Mittal, Anukram Mishra, Arun Gupta , "Survey of Electricity Demand Forecasting and Demand Side Management Techniques in Different Sectors to Identify Scope for Improvement" , Smart Grids and Sustainable Energy Volume :8 / 9 / 2023 Vikash Kumar, Ditipriya Sinha, "Synthetic attack data generation model applying generative adversarial network for intrusion detection" , Computers & Security Volume :125 / 103054 / 2023 Gopal Behra and Neeta Nain, "The State-of-the-Art and Challenges on Recommendation System■s: Principle, Techniques and Evaluation Strateg" , SN Computer Science Volume :4(5) / 1-10 / 2023 Arpita Srivastava, Ditipriya Sinha, Vikash Kumar, "WCGAN-GP based synthetic attack data generation with GA based feature selection for IDS" , Computers & Security Volume :134 / 103432 / 2023 2022 Himanshu K. Gajera, Deepak Ranjan Nayak, Mukesh A. Zaveri, "A Comprehensive Analysis of Dermoscopy Images for Melanoma Detection via Deep CNN Features" , Biomedical Signal Processing and

Control, Elsevier Volume :79 / 00-00 / 2022 Ganpat Singh Chauhan, Yogesh Kumar Meena, Dinesh Gopalani, Ravi Nahta, "A mixed unsupervised method for aspect extraction using BERT" , Multimedia Tools and Applications, Springer Volume :81 / 31881-31906 / 2022 Anamika Satrawala, Arka Prokash Mazumdar, and Santosh Kumar Vipparthi, "A multilane traffic and collision generator for IoV" , Simulation Modelling Practice and Theory Volume :2022 / 102588 / 2022 Raju Pal, Ashish Kumar Tripathi, Avinash Chandra Pandey, Mohammad Ayoub Khan, Varun G. Menon, Himanshu Mittal, "A N2CNN-Based Anomaly Detection Method for Cardiovascular Data in Cyber-Physical System" , IEEE Transactions on Network Science and Engineering Volume :EA / 1-10 / 2022 Himanshu Mittala, Ashish Kumar Tripathi, Avinash Chandra Pandeyc, Mohammad Dahman Alshehrid, Mukesh Saraswata, Raju Pal, "A new intrusion detection method for cyber■physical system in emerging industrial IoT" , Computer Communications Volume :190 / 24-35 / 2022 Lavika Goel, "A novel approach for Face Recognition using Biogeography Based Optimization with Extinction and Evolution (accepted)" , Multimedia Tools and Applications, Springer Volume :81(8) / 10561-88 / 2022 ISBN: 1573-7721 Himanshu Mittal1, Ashish Kumar Tripathi, Avinash Chandra Pandey, P. Venu, Varun G. Menon, Raju Pal, "A novel fuzzy clustering-based method for human activity recognition in cloud-based industrial IoT environment" , Wireless Networks Volume :EA / / 2022 Ankur Gupta, Meenakshi Tripathi, Samya Muhuri, Gaurav Singal, NeerajKumar, "A secure and lightweight anonymous mutual authentication scheme for wearable devices in Medical Internet of Things" , Journal of Information Security and Applications Volume :68 / 103259 / 2022 Pawan Lahoti, Namita Mittal, G Singh, "A Survey on NLP resources, tools and techniques for Marathi Language Processing" , ACM Transactions on Asian and Low-Resource Language Information Processing Volume :1 / 1-34 / 2022 Vivek Sharma, Ashish KumarTripathi, "A systematic review of meta-heuristic algorithms in IoT based application" , Array Volume :14 / 1-6 / 2022 Lavika Goel, Jyoti Nagpal, "A Systematic Review of Recent Machine Learning Techniques for Plant Disease Identification and Classification" , IETE Technical Review Volume :0 / 1-17 / 2022 Avinash Reddy, Ramesh Babu Battula, Dinesh Gopalan, "An efficient spectrum sensing over n-mu fading on sub 6 GHz bands: A real-time implementation on USRP RIO." , Wireless Networks Volume :28 / / 2022 Avinash Reddy Avuthu, Ramesh Babu Battula, Dinesh Gopalani, "An efficient spectrum sensing over n-mu fading on sub 6 GHz bands: A real-time implementation on USRP RIO" , Wireless Networks Volume :28 / / 2022 Praveen Kumar Chandaliya and Neeta Nain, "AW-GAN: face aging and rejuvenation using attention with wavelet GAN" , Neural Computing and Applications Volume :s00521-022 / 1-15 / 2022 ISBN: 10.1007/s00521-02 Avani Sharma, Emmanuel Shubhakar Pilli, Arka Prokash Mazumdar, "BD-Trust: behavioural and data trust management scheme for internet of things" , Journal of Ambient Intelligence and Humanized Computing Volume :2022 / 1-13 / 2022 Praveen Kumar Chandaliya and Neeta Nain, "ChildGAN: Face aging and rejuvenation to find missing children" , Pattern Recognition Volume :129 / 108761 / 2022 Shikha Mundra, Namita Mittal, "CMHE-AN: Code mixed hybrid embedding based attention network for aggression identification in hindi english code-mixed text" , Multimedia Tools and Applications, Springer Volume :82 / 11337-11364 / 2022 Vinesh Kumar Jain, Aarka Prokash

Mazumdar, Parvez Faruki, Mahesh Chandra Govil, "Congestion control in Internet of Things: Classification, challenges, and future directions" , Sustainable Computing: Informatics and Systems Volume :35 / 100678 / 2022 Vinesh Kumar Jain, Aarka Prokash Mazumdar, Mahesh Chandra Govil, "Congestion Prediction in IoT Network using Temporal Convolutional Network" , Defence Science Journal Volume :72 / 810-823 / 2022 A. K. Mishra, E. S. Pilli, and M. C. Govil , "CONTAIN4n6: A Systematic Evaluation of Container Artifacts" , Journal of Cloud Computing Volume :11 / 1-12 / 2022 Sadbhawna, V. Jakhetiya, B. N. Subudhi, S. P. Jaiswal, L. Li and W. Lin, "Context Region Identification Based Quality Assessment of 3D Synthesized Views" , IEEE Transactions on Multimedia Volume :25 / / 2022 Vijay Kumar Sharma, Namita Mittal, Ankit Vidyarthi, "Context-based translation for the out of vocabulary words applied to hindi-english cross-lingual information retrieval" , IETE Technical Review Volume :39 / 276-285 / 2022 G. Sharma, A. M. Joshi and E. S. Pilli , "DepML: An Efficient Machine Learning-Based MDD Detection System in IoMT Framework" , SN Computer Science, Springer Volume :3 / 1-8 / 2022 A. K. Mishra, M. C. Govil, E. S. Pilli, and A. Bijalwan, "Digital Forensic Investigation of Healthcare Data in Cloud Computing Environment" , Journal of Healthcare Engineering Volume :2022 / 1-11 / 2022 A. Choudhary, M. C. Govil, G. Singh, L. K. Awasthi, and E. S Pilli, "Energy-Aware Scientific Workflow Scheduling in Cloud Environment" , Cluster Computing Volume :25 / 1-18 / 2022 Rukhsar Sultana, Jyoti Grover, Jitesh Meghwal, Meenakshi Tripathi, "Exploiting machine learning and deep learning models for misbehavior detection in VANET" , International Journal of Computers and Applications Volume :44 / 1024-1038 / 2022 Shikha Mundra, Namita Mittal, "FA-Net: fused attention-based network for Hindi English code-mixed offensive text classification" , Social Network Analysis and Mining Volume :12 / 100 / 2022 Saurabh Ranjan Srivastva, Yogesh Kumar Meena, Girdhari Singh, "Forecasting on Covid-19 infection waves using a rough set filter driven moving average models" , Applied Soft Computing, Elsevier Volume :131 / / 2022 Roop Singh, Mukesh Saraswat, Alaknanda Ashok, Himanshu Mittal, Ashish Tripathi, Avinash Chandra Pandey, RajuPal, "From classical to soft computing based watermarking techniques: A comprehensive review" , Future Generation Computer Systems Volume :Accept / / 2022 Santosh Singh Rathore, Satyendra Singh Chouhan, Dixit Kumar Jain, and Aakash Gopal Vachhani, "Generative Oversampling Methods for Handling Imbalanced Data in Software Fault Prediction" , IEEE Transactions on Reliability, 2022 Volume :71 / 747 - 762 / 2022 Gopal Behra and Neeta Nain, "GSO-CRS:Grid Search Optimization For Collaborative Recommendation System" , Sadhana Volume :48 / 1-10 / 2022 ISBN: 0256-2499 Gopal Behra, Neeta Nain, "Handling data sparsity via item metadata embedding into deep collaborative recommender system" , Journal of King Saud University-Computer and Information Sciences Volume :2022 / 1-15 / 2022 Kapil Pareek, Arjun Choudhary, Ashish Tripathi, KK Mishra, Namita Mittal, "Hate and Aggression Detection in Social Media Over Hindi English Language" , International Journal of Software Science and Computational Intelligence Volume :14 / 1-20 / 2022 Vikash Kumar, Ditipriya Sinha, "Hybrid Approach Using Deep Autoencoder and Machine Learning Techniques for Cyber-Attack Detection" , International Journal of Ambient Computing and Intelligence Volume :13 / 1-21 / 2022 Subham Kumar Gupta, Meenakshi Tripathi, Jyoti Grover, "Hybrid optimization and deep learning based intrusion detection system" , Computers and Electrical Engineering Volume :100 / 107876 / 2022 Avinash Chandra Pandey, Ankur Kulhari, Himanshu Mittal, Ashish Kumar Tripathi, Raju Pal, "Improved exponential cuckoo search method for sentiment analysis" , Multimedia Tools and Applications, Springer Volume :Accepted / / 2022 ML Joshi, N Mittal, N Joshi, "Improving the Performance of Semantic Graph-Based Keyword Extraction and Text Summarization Using Fuzzy Relations in Hindi Wordnet" , Journal of Intelligent & Fuzzy Systems Volume :43 (3) / 3771-3788 / 2022 Sumita Mishra, Ritvik Maheshwari, Jyoti Grover, V Vaishnavi, "Investigating the performance of a vehicular communication system based on visible light communication (VLC) https://doi.org/10.1007/s41870-021-00834-4" , International Journal of Information Technology Volume :14 / 1-9 / 2022 Amogh M Joshi, Deepak Ranjan Nayak, Dibyasundar Das, Yu-Dong Zhang, "LiMS-Net: A Lightweight Multi-Scale CNN for COVID-19 Detection from Chest CT Scan" , ACM Transactions on Management Information Systems (Accepted) Volume :00 / 00-00 / 2022 Amogh M Joshi, Deepak Ranjan Nayak, "MFL-Net: An Efficient Lightweight Multi-Scale Feature Learning CNN for COVID-19 Diagnosis from CT Images" , IEEE Journal of Biomedical and Health Informatics (Formerly known as IEEE Transactions on Information Technology in Biomedicine) Volume :26 / 5355 - 5363 / 2022 HImashu K Gajera, Mukesh A Zaveri, Deepak Ranjan Nayak, "Patch based Local Deep Feature Extraction for Automated Skin Cancer Classification" , International Journal of Imaging Systems and Technology Volume :00 / 00-00 / 2022 Sadbhawna, V. Jakhetiya, S. Chaudhary, B. N. Subudhi, W. Lin and S. C. Guntuku, "Perceptually Unimportant Information Reduction and Cosine Similarity-Based Quality Assessment of 3D-Synthesized Images" , IEEE Transactions on Image Processing Volume :31 / / 2022 Praveen Kumar Chandaliya and Neeta Nain, "PlasticGAN: Holistic generative adversarial network on face plastic and aesthetic surgery" , Multimedia Tools and Applications, Springer Volume :2022/4/12 / 1-22 / 2022 Surendra Singh Gangwar, Santosh Singh Rathore, Satyendra Singh Chouhan, and Sanskar Soni, "Predictive Modeling for Suspicious Content Identification on Twitter" , Social Network Analysis and Mining Volume :12 / 1-22 / 2022 L. Sadineni, E. S. Pilli, R. B. Battula, "ProvNet-IoT: Provenance based network layer forensics in Internet of Things" , Forensic Science International: Digital Investigation Volume :43 / 1-10 / 2022 ISBN: 2666-2817 Sandeep Kumar Gupta, Seid Hassan Yusuf, Neeta Nain, "Real-Time Gender Recognition for Juvenile and Adult Faces" , Computational Intelligence and Neuroscience Volume :2022 / 1-15 / 2022 ISBN: Article ID 150318 Jyoti Grover, "Security of Vehicular Ad Hoc Networks using blockchain: A comprehensive review" , Vehicular Communications Volume :34 / 100458 / 2022 Sadbhawna, V. Jakhetiya, D. Mumtaz, B. N. Subudhi and S. C. Guntuku, "Stretching Artifacts Identification for Quality Assessment of 3D-Synthesized Views" , IEEE Transactions on Image Processing Volume :31 / / 2022 Vivek Sharmaa, Ashish KumarTripathi, Himanshu Mittal, "Technological revolutions in smart farming: Current trends, challenges & future directions" , Computers and Electronics in Agriculture Volume :201 / / 2022 Sanskar Soni, Satyendra Singh Chouhan, Santosh Singh Rathore, "TextConvoNet: A Convolutional Neural Network based Architecture for Text Classification" , Applied Intelligence Volume :00 / 1-20 / 2022 P. K.

Keserwani, M. C. Govil, and E. S. Pilli, "The Web Ad Click Fraud Detection Approach for Supporting to the Online Advertising System" , International Journal of Swarm Intelligence Volume :7 / 3-24 / 2022 P. Mishra, A. Gupta, P. Aggarwal, E. S. Pilli, "vServiceInspector :Introspection-Assisted Evolutionary Bag-of-Ngram Approach to Detect Malware in Cloud Servers" , Adhoc Networks Volume :132 / 1-18 / 2022 Vivek Sharma, Ashish Kumar Tripathi, Himanshu Mittal, Abhishek Parmar, Ashutosh Soni, Rahul Amarwal, "WeedGan: a novel generative adversarial network for cotton weed identification" , The Visual Computer Volume :Accepted / / 2022 2021 Si-Yuan Lu, Deepak Ranjan Nayak, Shui-Hua Wang, Yu-Dong Zhang, "A Cerebral Microbleed Diagnosis Method via FeatureNet and Ensembled Randomized Neural Networks" , Applied Soft Computing Volume :109 / 1-11 / 2021 Partha Pratim Sarangi, Deepak Ranjan Nayak, Madhumita Panda, Banshidhar Majhi, "A Feature-Level Fusion based Improved Multimodal Biometric Recognition System using Ear and Profile Face" , Journal of Ambient Intelligence and Humanized Computing Volume :0 / 00-01 / 2021 Ravi Nahta, Yogesh Kumar Meena, Dinesh Gopalani, Ganpat Singh Chauhan, "A hybrid neural variational CF-NADE for collaborative filtering using abstraction and generation" , Expert Systems with Applications Volume :179 / 115047 / 2021 Himanshu Mittal, Avinash Chandra Pandey, Raju Pal, Ashish Tripathi, "A new clustering method for the diagnosis of CoVID19 using medical images" , Applied Intelligence, Springer Volume :51 / 2988-3011 / 2021 Ashish Kumar Tripathi, Himanshu Mittal, Pranav Saxena, Sidharth Gupta, "A new recommendation system using map-reduce-based tournament empowered Whale optimization algorithm" , Complex & Intelligent Systems Volume :7 / 297-309 / 2021 Lavika Goel, Rajat Jain, "A Plate-Tectonics Based Neighborhood Search Optimizer and Its Application for Fault Monitoring in IoT Systems" , Knowledge Based Systems Volume :234 / 1-17 / 2021 ISBN: 0950-7051 Vikash Kumar, Ditipriya Sinha, "A robust intelligent zero-day cyber-attack detection technique" , Complex & Intelligent Systems Volume :7 / 2211■2234 / 2021 P. K. Keserwani, M. C. Govil, E. S. Pilli, P. Govil, "A smart anomaly-based intrusion detection system for the Internet of Things (IoT) network using GWO-PSO-RF model" , Journal of Reliable Intelligent Environments Volume :7 / 3-21 / 2021 ISBN: 2199-4668 Kuntal Gaur, Anshuman Kalla, Jyoti Grover, Mohammad Borhani, Andrei Gurtov, Madhusanka Liyanage, "A survey of Virtual Private LAN Services (VPLS): Past, present and future" , Computer Networks Volume :196 / 108245 / 2021 Geetanjali Singh, Namita Mittal, SS Chouhan, "A Systematic Review of Deep Learning Approaches for Natural Language Processing in Battery Materials Domain" , IETE Technical Review Volume :39 (5) / 1046-1057 / 2021 Geetanjali Singh, Namita Mittal, Satyendra Singh Chouhan, "A Systematic Review of Deep Learning Approaches for Natural Language Processing in Battery Materials Domain" , IETE Technical Review Volume :0 / 1-12 / 2021 Divya Bairathi, Dinesh Gopalani, "An improved salp swarm algorithm for complex multi-modal problems" , Soft Computing Volume :25 / 10441–10 / 2021 P. K. Keserwani, M. C. Govil, E. S. Pilli, P. Govil , "An Optimal NIDS for VCN Using Feature Selection and Deep Learning Technique: IDS for VCN" , International Journal of Digital Crime and Forensics (IJDCF) Volume :13 / 1-25 / 2021 Soumya Ranjan Nayak, Deepak Ranjan Nayak, Utkarsh Sinha, Vaibhav Arora, Ram Bilas Pachori, "Application of Deep Learning

Techniques for Detection of COVID-19 Cases using Chest X-ray Images: A Comprehensive Study" , Biomedical Signal Processing and Control Volume :64 / 1-12 / 2021 Monika Choudhary, Satyendra Singh Chouhan, Emmanuel S. Pilli, Santosh Kumar Vipparthi, "BerConvoNet: A deep learning framework for fake news classification" , Applied Soft Computing Volume :110 / 1-11 / 2021 ISBN: 1568-4946 S. S. Chauhan, E. S. Pilli, and R. C. Joshi , "BGSA: Broker Guided Service Allocation in Federated Cloud" , Sustainable Computing: Informatics and Systems. Volume :32 / 1-11 / 2021 S. S. Chauhan, E. S. Pilli, and R. C. Joshi, "BSS: A Brokering Model for Service Selection using Integrated Weighting approach in Cloud Environment" , Journal of Cloud Computing: Advances, Systems and Applications (JoCCASA) Volume :10 / 1-20 / 2021 ISBN: 2192-113X S. Wang, Deepak Ranjan Nayak, D. S. Guttery, X. Zhang, Y. Zhang, "COVID-19 Classification by CCSHNet with Deep Fusion using Transfer Learning and Discriminant Correlation Analysis" , Information Fusion Volume :68 / 131-148 / 2021 Deepak Ranjan Nayak, Dibyasundar Das, Banshidhar Majhi, Sulatha V. Bhandary, U. Rajendra Acharya, "ECNet: An evolutionary convolutional network for automated glaucoma detection using fundus images" , Biomedical Signal Processing and Control Volume :67 / 01-09 / 2021 Ravi Nahta, Yogesh Kumar Meena, Dinesh Gopalani, Ganpat Singh Chauhan, "Embedding metadata using deep collaborative filtering to address the cold start problem for the rating prediction task" , Multimedia Tools and Applications Volume :80 (12) / 18553-1858 / 2021 Satyendra Singh Chouhan and Santosh Singh Rathore, "Generative Adversarial Networks based Imbalance Learning in Software Aging-Related Bug Prediction" , IEEE Transactions on Reliability Volume :70 / 1-16 / 2021 Himanshu Mittal, Ashish Tripathi, Avinash Chandra Pandey, Raju Pal , "Gravitational search algorithm: a comprehensive analysis of recent variants" , Multimedia Tools and Applications Volume :80 / 7581-7608 / 2021 Vedant Parikh, Vidit Mathur, Parth Mehta, Namita Mittal, Prasenjit Majumder, "LawSum: A weakly supervised approach for Indian Legal Document Summarization" , arXiv preprint arXiv:2110.01188 Volume :1 / 1-22 / 2021 Manu Shrivastava, Satyabrata Roy, Krishna Kumar, Chirag Vinodkumar Pandey, Jyoti Grover, "LICCA: a lightweight image cipher using 3-D cellular automata" , Nonlinear Dynamics Volume :106 / 2679-2702 / 2021 T. Chawla, G. Singh, and E. S. Pilli, "MuSe- A Multi-Level Storage Scheme for Big RDF Data Using MapReduce" , Journal of Big Data Volume :8 / 1-20 / 2021 Ankita Jiyani, Mehul Mahrishi, Yogesh Meena, Girdhari Singh, "NAM: a nearest acquaintance modeling approach for VM allocation using R-Tree" , International Journal of Computers and Applications Volume :42 / 218-225 / 2021 Divya Bairathi, Dinesh Gopalani, "Numerical optimization and feed-forward neural networks training using an improved optimization algorithm: multiple leader salp swarm algorithm" , Evolutionary Intelligence Volume :14 (3) / 1233-1249 / 2021 Smita Naval, Akanksha Pandey, Shivam Gupta, Gaurav Singal, Vignesh Vinoba, Neeraj Kumar, "PIN Inference Attack: A Threat to Mobile Security and Smartphone-controlled Robots" , IEEE Sensors Journal Volume :1 / 1-10 / 2021 ISBN: 10.1109/JSEN.2021 Rahul Saxena, Mahipal Jadeja and Vikrant Bhateja, "Propagation Analysis of COVID 19: An SIR Model-Based Investigation of the Pandemic" , Arabian Journal for Science and Engineering Volume :47 / - / 2021 Sarfaraj Alam Ansari, Kunwar Pal, Mahesh

Chandra Govil, Mushtaq Ahmed, Tanvi Chawla, Anita Choudhary, "Score-based Incentive Mechanism (SIM) for live multimedia streaming in peer-to-peer network" , Multimedia Tools and Applications Volume :80 / 19263-290 / 2021 Rukhsar Sultana, Jyoti Grover, Meenakshi Tripathi, "Security of SDN-based vehicular ad hoc networks: State-of-the-art and challenges" , Vehicular Communication (Impact Factor: 6.910) Volume :27 / 100284 / 2021 Vijay Kumar Sharma, Namita Mittal, Ankit Vidhyarthi, "Semantic morphological variant selection and translation disambiguation for cross-lingual information retrieval" , Multimedia Tools and Applications Volume :1 / 1-16 / 2021 Manju Lata Joshi, Namita Mittal, Nisheeth Joshi, "SGAKE: Semantic Graph-based Automatic Keyword Extraction from Hindi Text Documents" , International Journal of Computing and Digital System Volume :12(1) / 367-381 / 2021 Manju Lata Joshi, N Joshi, Namita Mittal, "SGATS: Semantic Graph-based Automatic Text Summarization from Hindi Text Documents" , ACM Transactions on Asian and Low-Resource Language Information Processing Volume :20(6) / 1-32 / 2021 T. Chawla, G. Singh, E. S. Pilli, M. C. Govil, "Storage, partitioning, indexing and retrieval in Big RDF frameworks: A survey" , Computer Science Review Volume :38 / 1-41 / 2021 Saurabh Ranjan Srivastva, Yogesh Kumar Meena, Girdhari Singh, "The landscape of soft computing applications for terrorism analysis: A review" , Applied Soft Computing Volume :113 / 107977 / 2021 Vinesh K. Jain, Arka P. Mazumdar, and Mahesh C. Govil, "Towards Adaptive Range for Parallel Connections in CoAP" , Arabian Journal of Science and Engineering Volume :46 / 3595-3611 / 2021 Ravi Nahta, Yogesh Kumar Meena, Dinesh Gopalani, Ganpat Singh Chauhan, "Two-step hybrid collaborative filtering using deep variational Bayesian autoencoders" , Information Sciences Volume :562 / 136-154 / 2021 ISBN: 0020-0255 Vikash Kumar, Ayan Kumar Das, Ditipriya Sinha, "UIDS: a unified intrusion detection system for IoT environment" , Evolutionary Intelligence Volume :14 (3) / 47-59 / 2021 2020 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, Ram Bilas Pachori, Yudong Zhang, "A deep stacked random vector functional link network autoencoder for diagnosis of brain abnormalities and breast cancer" , Biomedical Signal Processing and Control Volume :58 / 1-11 / 2020 Nikunja Bihari Kar, Deepak Ranjan Nayak, Korra Sathya Babu, Yu-Dong Zhang, "A Hybrid Feature Descriptor with Jaya Optimized Least Squares SVM for Facial Expression Recognition" , IEEE/IET Image Processing Volume :0 / 00-01 / 2020 P. Majumdar, T. De, "A non-backtracking spectrum allocation algorithm in a large under dynamic traffic grooming" , Journal of Computer Networks Volume :186 / / 2020 Ashish Kumar Tripathi, Kapil Sharma, Manju Bala, Akshi Kumar, Varun G. Menon, Ali Kashif Bashir, "A Parallel Military-Dog-Based Algorithm for Clustering Big Data in Cognitive Industrial Internet of Things" , IEEE Transactions on Industrial Informatics Volume :17 / 2134 - 214 / 2020 ISBN: 1551-3203 Ankur Gupta, Meenakshi Tripathi, Aakar Sharma, "A provably secure and efficient anonymous mutual authentication and key agreement protocol for wearable devices in WBAN" , Computer Communications Volume :160 / 311-325 / 2020 Riti Kushwaha and Neeta Nain, "A Texture Feature Based Approach for Person Verification using Footprint Bio-metric" , Artificial Intelligence Review Volume :54 / 1-31 / 2020 ISBN: 10462-020-09887-6 Ganpat Singh Chauhan, Yogesh Kumar Meena, Dinesh Gopalani, Ravi Nahta, "A two-step hybrid unsupervised model with attention mechanism for aspect extraction" , Expert Systems with Applications Volume :161 / 113673 / 2020 ISBN: ISSN 0957-4174 Monu Verma, Santosh Kumar Vipparthi, Girdhari Singh, "AffectiveNet: Affective-Motion Feature Learning for Micro Expression Recognition" , IEEE Multimedia Volume :0 / 1-9 / 2020 Lavika Goel, "An Extensive Review of Computational Intelligence Based Optimization Algorithms: Trends and Applications (https://doi.org/10.1007/s00500-020-04958-W)" , Soft Computing Volume :24 / 16519–49 / 2020 Vikash Kumar, Ditipriya Sinha, Ayan Kumar Das, Subhash Chandra Pandey, Radha Tamal Goswami, "An integrated rule based intrusion detection system: analysis on UNSW-NB15 data set and the real time online dataset" , Cluster Computing Volume :23 / 1397-1418 / 2020 P. K. Keserwani, M. C. Govil, E. S. Pilli , "An Optimal Intrusion Detection System using GWO-CSA-DSAE Model" , Cyber-Physical Systems Volume :0 / 1-24 / 2020 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Automated diagnosis of multi-class brain abnormalities using MRI images: A deep convolutional neural network based method" , Pattern Recognition Letters Volume :138 / 385-391 / 2020 Deepak Ranjan Nayak, Ratnakar Dash, Xiaojun Chang, Banshidhar Majhi, Sambit Bakshi, "Automated diagnosis of pathological brain using fast curvelet entropy features" , IEEE Transactions on Sustainable Computing Volume :5 / 416-427 / 2020 Prakash Choudhary, Neeta Nain, "CALAM: Model-Based Compilation and Linguistic Statistical Analysis of Urdu Corpus" , Sadhana Volume :45 / 20 / 2020 ISBN: 0256-2499 Jyoti Gajrani, Vijay Laxmi, Meenakshi Tripathi, Manoj Singh Gaur, Akka Zemmari, Mohamed Mosbah, Mauro Conti, "Chapter Three - Effectiveness of state-of-the-art dynamic analysis techniques in identifying diverse Android malware and future enhancements" , Advances in Computers Volume :119 / 73-120 / 2020 Yudong Zhang, Deepak Ranjan Nayak, Xin Zhang, Shui-Hua Wang, "Diagnosis of Secondary Pulmonary Tuberculosis by an Eight-layer Improved Convolutional Neural Network with Data Augmentation and Stochastic Pooling" , Journal of Ambient Intelligence and Humanized Computing Volume :0 / 00-01 / 2020 Avinash Reddy, Ramesh Babu Battula, Dinesh Gopalani, Chaitanya Kurra , "DISCERN: enhanced Dynamic noISe varianCe based EneRgy seNsing for cognitive radio using usrp at wi-fi bands (Accepted)" , International Journal of Communication Systems Volume :33 / 1-15 / 2020 Avuthu Avinash Reddy, Ramesh Babu Battula, Dinesh Gopalani, Kurra Chaithanya, "DISCERN: Enhanced Dynamic noISe varianCe based EneRgy sensing for cognitive radio using USRP at Wi■Fi bands" , International Journal of Communication Systems Volume :33 / 4550 / 2020 Jyoti Gajrani, Umang Agarwal, Vijay Laxmi, Bruhadeshwar Bezawada, Manoj Singh Gaur, Meenakshi Tripathi, Akka Zemmari, "EspyDroid+: Precise Reflection Analysis of Android Apps" , Computers and Security Volume :90 / 101688 / 2020 Dibyasundar Das, Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, Yudong Zhang, "H-WordNet: A holistic convolutional neural network approach for handwritten word recognition" , IEEE/IET Image Processing Volume :0 / 00-01 / 2020 Ved Mitra, Mahesh C. Govil, Girdhari Singh, Sanjeev Agrawal, "High Throughput and Resource Efficient Pipelined Decoder Designs for Projective Geometry LDPC Codes" , Periodica Polytechnica Electrical Engineering and Computer Science Volume :64 / 179-191 / 2020 Lavika Goel, Abhilash Neog, Ashish Aman, Arshveer Kaur, "Hybrid Nature-Inspired Optimization Techniques in Face Recognition" , LNCS Transactions on Computational Science XXXVI Volume :12060 / 99-126 / 2020 Chaosheng Tang, Deepak Ranjan Nayak, Shuihua Wang, "Least-square support vector machine and wavelet selection for hearing loss identification" , Computer Modeling in Engineering & Sciences Volume :125 / 299-313 / 2020 Dibyasundar Das, Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "MJCN: Multi-Objective Jaya Convolutional Network for Handwritten Optical Character Recognition" , Multimedia Tools and Applications Volume :0 / 00-01 / 2020 Sandeep Kumar Gupta and Neeta Nain, "REVIEW: SINGLE ATTRIBUTE AND MULTI ATTRIBUTE FACIAL GENDER AND AGE ESTIMATION" , Multimedia Tools and Applications Volume :80 / 1-20 / 2020 ISBN: 01324 Jay Dave, Avijit Dutta, Parvez Faruki, Vijay Laxmi, Manoj Singh Gaur, "Secure Proof of Ownership Using Merkle Tree for Deduplicated Storage" , Automatic Control and Computer Sciences Volume :54 / 358-370 / 2020 Rukhsar Sultana, Jyoti Grover, Meenakshi Tripathi, "Security of SDN-Based Vehicular Ad Hoc Networks: State-of-the-Art and Challenges" , Vehicular Communications Volume :27 / 100284 / 2020 ISBN: 2214-2096 Shweta Bhandari, Frederic Herbreteau, Vijay Laxmi, Akka Zemmari, Manoj Singh Gaur, Partha S. Roop, "SneakLeak+: Large-scale klepto apps analysis" , Future Generation Computer Systems Volume :109 / 593-603 / 2020 Jay Dave, Parvez Faruki, Vijay Laxmi, Akka Zemmari, Manoj Singh Gaur, Mauro Conti, "SPARK: Secure Pseudorandom Key-based Encryption for Deduplicated Storage" , Computer Communications Volume :154 / 148-159 / 2020 Mithlesh Arya, Namita Mittal and Girdhari Singh , "Three segmentation techniques to predict the dysplasia in cervical cells in the presence of debris" , Multimedia Tools and Applications Volume :79 / 24157-2417 / 2020 A. Sharma, E. S. Pilli, A. P. Mazumdar, and P. Gera, "Towards trustworthy Internet of Things: A survey on Trust Management applications and schemes" , Computer Communications Volume :160 / 475-493 / 2020 Anugrah Jain, Vijay Laxmi, Meenakshi Tripathi, Manoj Singh Gaur, Rimpy Bishnoi, "TRACK: An algorithm for fault-tolerant, dynamic and scalable 2D mesh network-on-chip routing reconfiguration" , Integration Volume :72 / 92-110 / 2020 Abhinav Agarwal, Namita Mittal, "Using CNN for facial expression recognition: a study of the effects of kernel size and number of filters on accuracy" , The Visual Computer Volume :36 / 405-412 / 2020 P. Mishra, V. Varadharajan, E. S. Pilli, and U. Tupakula, "VMGuard: A VMI-based Security Architecture for Intrusion Detection in Cloud Environment" , IEEE Transactions on Cloud Computing Volume :8 / 957-971 / 2020 Jyoti Gajrani, Meenakshi Tripathi, Vijay Laxmi, Gaurav Somani, Akka Zemmari, Manoj Singh Gaur, "Vulvet: Vetting of Vulnerabilities in Android Apps to Thwart Exploitation" , Digital Threats: Research and Practice Volume :1 / 1-25 / 2020 2019 P. Mishra, E. S. Pilli, V. Varadharajan, and U. Tupakula, "A Detailed Investigation and Analysis of using Machine Learning Techniques for Intrusion Detection" , Communications Surveys and Tutorials Volume :21 / 686-728 / 2019 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, Yudong Zhang, "A hybrid regularized extreme learning machine for automated detection of pathological brain" , Biocybernetics and Biomedical Engineering Volume :39 / 880-892 / 2019 Ankur Gupta, Meenakshi Tripathi, Tabish Jamil Shaikh, Aakar Sharma, "A lightweight anonymous user authentication and key establishment scheme for wearable devices" , Computer Networks Volume :149 / 29-42 / 2019 P. Majumdar, T. De, "An alternative minimum cost route setup algorithm in a large eon for long-haul traffic under dynamic traffic grooming" , Journal of Network and Computer Applications Volume :140 / / 2019 Dibyasundar Das, Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "An empirical evaluation of extreme learning machine: Application to handwritten character recognition" , Multimedia Tools and Applications Volume :78 / 19495-19523 / 2019 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, U. Rajendra Acharya, "Application of fast curvelet Tsallis entropy and kernel random vector functional link network for automated detection of multiclass brain abnormalities" , Computerized Medical Imaging and Graphics Volume :77 / 1-10 / 2019 Manish Jain, Dinesh Gopalani, "Aspect-Oriented Approach for Testing Software Applications and Automatic Aspect Creation" , International Journal of Software Engineering and Knowledge Engineering Volume :29 / 1379-1402 / 2019 ISBN: 1793-6403 Deepak Ranjan Nayak, Dibyasundar Das, Ratnakar Dash, Snehashis Majhi, Banshidhar Majhi, "Deep extreme learning machine with leaky rectified linear unit for multiclass classification of pathological brain images" , Multimedia Tools and Applications Volume :79 / 1-16 / 2019 Sonu Lamba and Neeta Nain, "Detecting anomalous crowd scenes by orientedTracklets’ approach in active contour region" , Multimedia Tools and Applications Volume :78 / 1-20 / 2019 ISBN: s11042-019-07806- A. Choudhary, M. C. Govil, G. Singh, L. K. Awasthi, E. S. Pilli, "Energy-efficient fuzzy-based approach for dynamic virtual machine consolidation" , International Journal of Grid and Utility Computing Volume :10 / 308-325 / 2019 Vineeta Jain, Vijay Laxmi, Manoj Singh Gaur, Mohamed Mosbah, "ETGuard: Detecting D2D attacks using wireless Evil Twins" , Computers and Security Volume :83 / 389-405 / 2019 Ashish Kumar Tripathi, Kapil Sharma, Manju Bala, "Fake Review Detection in Big Data Using Parallel BBO" , International Journal of Information Security and Privacy (IJISP) Volume :13 / 106-122 / 2019 ISBN: 1930-1650 Kunwar Pal, Mahesh Chandra Govil, Mushtaq Ahmed, "FLHyO: fuzzy logic based hybrid overlay for P2P live video streaming" , Multimedia Tools and Applications Volume :78 / 33679-3370 / 2019 Monu Verma, Santosh Kumar Vipparthi, Girdhari Singh, "HiNet: Hybrid Inherited Feature Learning Network for Facial Expression Recognition" , IEEE LETTERS OF THE COMPUTER SOCIETY Volume :2 / 36-39 / 2019 Shivam Anand, Amit Kumar, Meenakshi Tripathi, Manoj Singh Gaur, "Human Face Detection Enabled Smart Stick for Visually Impaired People" , Data Science and Big Data Analytics Volume :16 / 277-289 / 2019 ISBN: 978-981-10-7640-4 Lavika Goel, Sundaresan Raman, Subham Swastik Dora, Anirudh Bhutani, Aditya A.S, Abhinav Mehta, "Hybrid Computational Intelligence Algorithms and their Applications to detect Food Quality" , Artificial Intelligence Review Volume :53 / 1415-1440 / 2019 Monu Verma, Santosh Kumar Vipparthi, Girdhari Singh, Subrahmanyam Murala, "LEARNet: Dynamic Imaging Network for Micro Expression Recognition" , IEEE Transaction on Image Processing (IEEE-TIP) Volume :29 / 1618 - 162 / 2019 ISBN: 1057-7149 Deepak Ranjan Nayak, Yudong Zhang, Dibyasundar Das, Subinita Panda, "MJaya-ELM: A Jaya algorithm with mutation and extreme learning machine based approach for sensorineural hearing loss detection" , Applied Soft Computing Volume :83 / 1-10 / 2019 Divya Bairathi, Dinesh Gopalani, "Numerical optimization and feed-forward neural networks training using an improved optimization algorithm: multiple leader salp swarm algorithm" , Evolutionary Intelligence Volume :131 / 1-17 / 2019 ISBN:

1864-5917 Riti Kushwaha and Neeta Nain, "PUG-FB : Person-verification using geometric and Haralick features of footprint biometric" , Multimedia Tools and Applications Volume :79 / 1-31 / 2019 ISBN: 2671–2701(2020) Vijay Sharma, Namita Mittal, "Refined stop-words and morphological variants solutions applied to Hindi-English Cross-lingual Information Retrieval" , Journal of Intelligent and Fuzzy Systems Volume :36(3) / 2219-2227 / 2019 Anugrah Jain, Vijay Laxmi, Meenakshi Tripathi, Manoj Singh Gaur, Rimpy Bishnoi, "S2DIO: an extended scalable 2D mesh network-on-chip routing reconfiguration for efficient bypass of link failures" , The Journal of Supercomputing Volume :75 / 1-27 / 2019 ISBN: 0920-8542 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "Secret sharing scheme based on binary trees and Boolean operation" , Knowledge and Information Systems Volume :60 / 1377-1396 / 2019 Sonu Lamba and Neeta Nain, "Segmentation of Crowd Flow by Trajectory Clustering in Active Contours" , The Visual Computer Volume :1432 / 1-12 / 2019 ISBN: 0178-2789 Ajay Nehra, Menakshi Tripathi, Manoj Singh Gaur,, Ramesh Babu Battula, Chagan Lal , "SLDP: A secure and lightweight link discovery protocol for software defined networking" , Computer Networks Volume :150 / 102-116 / 2019 M. Singh, M. C. Govil, E. S. Pilli, and S. K. Vipparthi, "SOD-CED: Salient Object Detection for Noisy Images Using Convolutional Encoder Decoder" , Computer Vision Volume :13 / 578-587 / 2019 Anil Saini, Manoj Singh Gaur, Vijay Laxmi, Mauro Conti, "You click, I steal: analyzing and detecting click hijacking attacks in web pages" , International Journal of Information Security Volume :18 / 481-504 / 2019 2018 Ashish Kumar Tripathi, Kapil Sharma, Manju Bala, "A Novel Clustering Method Using Enhanced Grey Wolf Optimizer and MapReduce" , Big data research Volume :14 / 93-100 / 2018 ISBN: 2214-5796 Sonu Lamba and Neeta Nain, "A Texture based Mani-fold Approach for Crowd Density Estimation using Gaussian Markov Random Field" , Multimedia Tools and Applications Volume :11042 / 1-20 / 2018 ISBN: 10.1007/s11042-01 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "An improved pathological brain detection system based on two-dimensional PCA and evolutionary extreme learning machine" , Journal of Medical Systems Volume :42 / 1-15 / 2018 Vijay Sharma, Namita Mittal, "An Improvement in Statistical Machine Translation in Perspective of Hindi-English Cross-Lingual Information Retrieval" , Computacion Y Sistemas Volume :22 (4) / 1-12 / 2018 T. Goyal, R. Rathi, V. K. Jain, E. S. Pilli and A. P. Mazumdar, "Big Data Handling Over Cloud for Internet of Things" , International Journal of Information Technology and Web Engineering Volume :13 / 37-47 / 2018 S. S. Chauhan, E. S. Pilli, R. C. Joshi, G. Singh, and M. C. Govil, "Brokering in Interconnected Cloud Computing Environments: A Survey" , Journal of Parallel and Distributed Computing Volume :133 / 193-209 / 2018 M. Singh, M. C. Govil, E. S. Pilli, "CHACT: Convex Hull enabled Active Contour Technique for salient object detection" , IEEE Access Volume :6 / 2441-2451 / 2018 Ramesh Babu B, Manoj Singh Gaur, D Gopalani, K Naidu, "CHAMPIoN: Dynamic CHAnnel Selection for Token Medium Access Control Protocol in CRWMN (*)" , IEEE Transactions on Mobile Computing Volume :17 / 1-14 / 2018 Mithlesh Arya, Namita MIttal, Girdhari Singh, "Clustering Techniques on Pap smear Images for the Detection of Cervical cancer" , Journal of Biology and Todays World Volume :1 / 30-35 / 2018 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, Shuihua Wang, "Combining extreme learning machine with modified sine cosine algorithm for pathological brain detection" , Computers & Electrical Engineering Volume :68 / 366-380 / 2018 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Development of pathological brain detection system using Jaya optimized improved extreme learning machine and orthogonal ripplet-II transform" , Multimedia Tools and Applications Volume :77 / 22705-2273 / 2018 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Discrete ripplet-II transform and modified PSO based improved evolutionary extreme learning machine for pathological brain detection" , Neurocomputing Volume :282 / 232-247 / 2018 Ashish Kumar Tripathi, Kapil Sharma, Manju Bala, "Dynamic frequency based parallel k-bat algorithm for massive data clustering (DFBPKBA)" , International Journal of System Assurance Engineering and Management Volume :9 / 866-874 / 2018 ISBN: 09764348 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "Efficient and secure multi secret sharing schemes based on boolean XOR and arithmetic modulo" , Multimedia Tools and Applications Volume :77 / 89-107 / 2018 Chhagan Lal, Vijay Laxmi, Manoj Singh Gaur, Mauro Conti, "Enhancing QoE for video streaming in MANETs via multi-constraint routing" , Wireless Networks Volume :24 / 235-256 / 2018 Lokesh Kumar Sharma, Namita Mittal, Anubha Aggarwal, "Feature Extraction for Token Based Word Alignment for Question Answering Systems" , Computacion Y Sistemas Volume :22(4) / 1359-1366 / 2018 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "Image Concealing using Steganography and Secret Sharing Scheme" , IEEE Consumer Electronics Magazine Volume :2018 / 40-45 / 2018 ISBN: 10.1109/MCE.2017. Diwakar Gautam, Mushtaq Ahmed, Yogesh Kumar Meena and Ashetam Ul Haq, "Machine Learning Based Diagnosis of Melanoma Using Macro Images" , Numerical Methods in Biomedical Engineering Volume :34 / 2953 / 2018 Diwakar Gautam, Mushtaq Ahmed, Yogesh Kumar Meena, Ahtesham Ul Haq, "Machine learning–based diagnosis of melanoma using macro images" , International journal for numerical methods in biomedical engineering Volume :34 / 2953 / 2018 Abhishek Kilak, Namita Mittal, "Multiple instances based emotion detection using discriminant feature tracking" , Journal of Statistics and Management Systems Volume :21(4) / 647-659 / 2018 S Ankita Jiyani, Mehul Mahrishi, Yogesh Kumar Meena and Girdhari Singh, "NAM: a nearest acquaintance modeling approach for VM allocation using R-Tree" , International Journal of Computer and Applications Volume :42 / 1-12 / 2018 ISBN: 1925-7074 Tapas Badal, Neeta Nain and Mushtaq Ahmed, "Online Multi-Object Tracking: Multiple Instance Based Target Appearance Model" , Multimedia Tools and Applications Volume :11042 / 1-23 / 2018 ISBN: 10.1007/s11042-01 Chandra Prakash, Rajesh K, Namita Mittal, "Optimized Clustering Techniques for Gait Profiling in Children with Cerebral Palsy for Rehabilitation. Comput. J. 61(11): 1683-1694 (2018)" , The Computer Journal Volume :61 / 1683-1694 / 2018 P. Majumdar, T. De, "P. Majumdar,T. De" , Journal of Optical Switching and Networking Volume :33 / / 2018 Deepa Modi, Neeta Nain, "Part-of-speech Tagging for Hindi Corpus in Poor Resource Scenario" , Journal of Multimedia Information System Volume :5 / 147-154 / 2018 ISBN: 2383-7632 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Pathological brain detection using curvelet features and least squares SVM" , Multimedia Tools and Applications Volume :77 / 3833-3856 / 2018 Kunwar Pal, Mahesh Chandra Govil, Mushtaq Ahmed,

"Priority-based scheduling scheme for live video streaming in peer-to-peer network" , Multimedia Tools and Applications Volume :77 / 24427-2445 / 2018 K Naidu and Ramesh Babu B, "Quicker Solution for Interference Reduction in Wireless Networks (Accepted)" , IET Communications Volume :12.12 / 1-14 / 2018 Chandra Prakash, R Kumar, Namita Mittal, "Recent Developments in Human Gait Research: Parameters, Approaches, Applications, Machine Learning Techniques, Datasets and Challenges" , Artificial Intelligence Review Volume :49 / 1-40 / 2018 Prashant Kumar, Meenakshi Tripathi, Ajay Nehra, Mauro Conti, Chhagan Lal, "SAFETY: Early detection and mitigation of TCP SYN flood utilizing entropy in SDN" , IEEE Transactions on Network and Service Management Volume :15 / 1545-1559 / 2018 Maroti Deshmukh, Neeta Nain and Mushtaq Ahmed, "Secret Sharing Scheme based on Binary Trees and Boolean Operation" , Knowledge and Information Systems Volume :36 / 1-10 / 2018 ISBN: 0219-1377 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "Secret sharing scheme based on binary trees and Booleanoperation" , Knowledge and Information Systems Volume :10 / 1-20 / 2018 ISBN: 10.1007/s10115-01 Mohit Rajput, Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "Securing data through steganography and secret sharing schemes: trapping and misleading potential attackers" , IEEE Consumer Electronics Magazine Volume :7 / 40-45 / 2018 Lavika Goel, Anubhav Garg, "Sentiment Analysis of Social Networking Websites using Gravitational Search Optimization Algorithm" , International Journal of Applied Evolutionary Computation (IJAEC) Volume :9 / 76-85 / 2018 Kunwar Pal, Mahesh Chandra Govil, Mushtaq Ahmed, "Slack time–based scheduling scheme for live video streaming in P2P network" , International Journal of Communication Systems Volume :31 / 3440 / 2018 Ajay Nehra, Meenakshi Tripathi, Manoj Singh Gaur, Ramesh Babu Battula, Chhagan Lal, "SLDP: A Secure and Lightweight Link Discovery Protocol for Software Defined Networking" , Computer Networks, Elsevier Volume :150 / 1-12 / 2018 R. S. Rawat, Emmanuel S. Pilli, R. C. Joshi, "Survey of Peer-to-Peer Botnets and Detection Frameworks" , International Journal of Network Security Volume :20 / 547-557 / 2018 Kalpana Naidu, Ramesh Babu Battula, "Swift Resource Allocation in Wireless Networks" , IEEE Transactions on Vehicular Technology. Volume :21 / 1-15 / 2018 Shweta Bhandari, Rekha Panihar, Smita Naval, Vijay Laxmi, Akka Zemmari, Manoj Singh Gaur, "SWORD: Semantic aWare andrOid malwaRe Detector" , Journal of Information Security and Applications Volume :42 / 46-56 / 2018 Mukesh Kumar Gupta, M.C. Govil, Girdhari Singh, "Text-Mining and Pattern-Matching Based Prediction Models for Detecting Vulnerable Files in Web Applications" , Journal of Web Engineering Volume :17 / 028-044 / 2018 Mithlesh Arya, Namita Mittal , Girdhari Singh , "Texture-based feature extraction of smear images for the detection of cervical cancer" , IEEE/IET Computer Vision Volume :12(8) / 1049-1059 / 2018 Ajay Nehra, M Tripathi, M S Gaur, Ramesh Babu B, Chagan Lal, "TILAK: A Token-based Prevention Approach for Topology Discovery Threats in SDN (Accepted)" , International Journal of Communication Systems, Wiley Volume :32 / 1-14 / 2018 Ajay Nehra, Meenakshi Tripathi, Manoj Singh Gaur, Ramesh Babu Battula, Chhagan Lal, "TILAK: A token■based prevention approach for topology discovery threats in SDN" , International Journal of Communication Systems Volume :31 / 3781 / 2018 2017 Meenakshi Tripathi Manoj Singh Gaur Vijay Laxmi R B Battula, "Balanced energy

routing protocol for clustered wireless sensor network" , Int. J. of Information and Communication Technology, Inderscience Volume :11 / 396 - 411 / 2017 A. Choudhary, M. C. Govil, G. Singh, L. K. Awasthi, E. S Pilli, and D. Kapil, "A Critical Survey of Live Virtual Machine Migration Techniques" , Journal of Cloud Computing Volume :6 / 1-41 / 2017 Maroti Deshmukh Authors, Neeta Nain, Mushtaq Ahmed, "A Novel Approach for Sharing Multiple Color Images by Employing Chinese Remainder Theorem" , Journal of Visual Communication and Image Representation Volume :49 / 291-302 / 2017 Deshmukh, M., Nain, N., Ahmed, M., "A novel approach for sharing multiple color images by employing Chinese Remainder Theorem" , Journal of Visual Communication and Image Representation Volume :49 / 291 - 302 / 2017 Deepa Modi and Neeta Nain, "A Rule-based Chunker for Hindi Language" , ACM Transaction Asian Language Low Resourse Image Processing Volume :16 / 10 / 2017 ISBN: 10.1145/2710018 Neeta Nain and Tapas Badal, "An Adaptive Codebook Model for Background Subtraction in Dynamic Environment" , Sadhna Volume :12046 / 1-10 / 2017 ISBN: 0256-2499 Shweta Bhandari, Wafa Ben Jaballah, Vineeta Jain, Vijay Laxmi, Akka Zemmari, Manoj Singh Gaur, Mohamed Mosbah, Mauro Conti, "Android inter-app communication threats and detection techniques" , Computers & Security Volume :70 / 392-421 / 2017 Manish Jain, Dinesh Gopalani, "Automated Java Testing: JUnit versus AspectJ" , International Journal of Computer, Electrical, Automation, Control and Information Engineering Volume :11 / 1153-1158 / 2017 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, Vijendra Prasad, "Automated pathological brain detection system: A fast discrete curvelet transform and probabilistic neural network based approach" , Expert Systems with Applications Volume :88 / 152-164 / 2017 Meenakshi Tripathi, Manoj Singh Gaur, Vijay Laxmi, Ramesh Babu Battula, "Balanced energy routing protocol for clustered wireless sensor network" , International Journal of Information and Communication Technology Volume :11 / 396-411 / 2017 K. Pal, M. C. Govil , Mushtaq Ahmed, "Comparative Analysis of Utilization Based Hybrid Overlay for Live Video Streaming in P2P Network" , International Journal of Intelligent Engineering and Systems Volume :10 / 263-271 / 2017 Yudong Zhang, Deepak Ranjan Nayak, Ming Yang, Ying Shao, Bin Liu, Shuihua Wang, "Detection of unilateral hearing loss by stationary wavelet entropy" , CNS & Neurological Disorders Drug Targets Volume :16 / 122-128 / 2017 S S Chouhan and Rajdeep Niyogi, "DiMPP: a complete distributed algorithm for multi-agent path planning" , Journal of experimental and Theoretical AI Volume :29 / 1129-1148 / 2017 Jagadeesh Kakarla · Banshidhar Majhi · Ramesh Babu Battula, "IDMMAC: Interference aware Distributed Multi-channel MAC protocol for WSAN" , Journal of Information Processing Systems Volume :13 / 1229-1242 / 2017 ISBN: 10.3745/JIPS.03. Gaurav Singal, Vijay Laxmi, Vijay Rao, Swati Todi, Manoj Singh Gaur, "Improved multicast routing in MANETs using link stability and route stability." , International Journal of Communication Systems Volume :30 / 1 / 2017 P. Mishra, E. S. Pilli, V. Varadharajan, U. Tupakula, "Intrusion Detection Techniques in Cloud Environment: A Survey" , Journal of Networking and Computer Applications Volume :77 / 18-47 / 2017 Mahipal Jadeja and Rahul Muthu, "Labeled Object Treemap: A New Graph-Labeling Based Technique for Visualizing Multiple Hierarchies" , Annals of Pure and Applied Mathematics (APAM) Volume :13 / / 2017 S S Chouhan and

Rajdeep Niyogi, "MAPJA: Multi-agent planning with joint actions" , Applied Intelligence Volume :47 / 1044-158 / 2017 Gaurav Singal, Vijay Laxmi, Manoj Singh Gaur, Vijay Rao, "Moralism: mobility prediction with link stability based multicast routing protocol in MANETs" , Wireless Networks Volume :23 / 663-679 / 2017 Gaurav Singal, Vijay Laxmi, Manoj Singh Gaur, Swati Todi, Vijay Rao, Meenakshi Tripathi, Riti Kushwaha, "Multi-constraints link stable multicast routing protocol in MANETs" , Ad hoc Networks Volume :63 / 115-128 / 2017 Tapas Badal, Neeta Nain, Mushtaq Ahmed, "Multiple Instance Based Target Appearance Model" , Multimedia Tools and Applications Volume :11042 / 1-23 / 2017 ISBN: 10.1007/s11042-01 Tapas Badal, Neeta Nain, Mushtaq Ahmed, "Online Multi-Object Tracking Using Target Specific Decision Making" , EURASIP Journal on Image and Video Processing Volume :17 / 1-15 / 2017 Ramesh babu Battula, Manoj Singh Gaur and Dinesh Gopalani, "Path and Link Aware Channel Assignment Algorithm for Cognitive Radio Wireless Mesh Network" , An International Journal Wireless Personal Communications, Volume :96 / 3979–399 / 2017 ISBN: 10.1007/s11277-01 Ramesh Babu Battula, Dinesh Gopalani, Manoj Singh Gaur, "Path and link aware routing algorithm for cognitive radio wireless mesh network" , Wireless Personal Communications Volume :96 / 3979-3993 / 2017 Lokesh Kumar Sharma, Namita Mittal, "Prominent Feature Extraction for Evidence Gathering in Question Answering" , Journal of Intelligent & Fuzzy Systems Volume :32 (4) / 1-10 / 2017 ISBN: 1064-1246 (P) P. Mishra, E. S. Pilli, V. Varadharajan, U. Tupakula, "PSI-NetVisor: Program Semantic Aware Intrusion Detection at Network and Hypervisor Layer in Cloud" , Journal of Intelligent & Fuzzy Systems Volume :32 / 2909-2921 / 2017 Kalpana Naidu, Ramesh Babu Battula, "Quick resource allocation in heterogeneous networks" , Wireless Networks,Springer Volume :24 / 12-05- 201 / 2017 Mahipal Jadeja, Rahul Muthu and V. Sunitha, "Set Labelling Vertices To Ensure Adjacency Coincides With Disjointness" , Electronic Notes in Discrete Mathematics Volume : 63 / 237–244 / 2017 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Stationary wavelet transform and AdaBoost with SVM based pathological brain detection in MRI scanning" , CNS & Neurological Disorders Drug Targets Volume :16 / 137-149 / 2017 Ankit Vidyarthi, Namita Mittal, "Texture Based Feature Extraction Method for Classification of Brain Tumor MRI" , Journal of Intelligent & Fuzzy Systems Volume :32(4) / 1-12 / 2017 ISBN: 1064-1246 (P) Mahipal Jadeja and Rahul Muthu, "Uniform set labeling vertices to ensure adjacency coincides with disjointness" , Journal of Mathematical and Computational Science Volume :7 / 537-553 / 2017 P. Mishra, E. S. Pilli, V. Varadharajan and U. Tupakula, "VAED: VMI-Assisted Evasion Detection Approach for Infrastructure as a Service Cloud" , Concurrency and Computation: Practice and Experience Volume :29 / 1-21 / 2017 2016 Jagadeesh Kakarla, Banshidhar Majhi and Ramesh Babu Battula, "A Delay and Energy aware Reliable Coordination Mechanism for WSAN" , International Journal of Communication Systems, Wiley. Volume :29 / 2604 / 2016 ISBN: 2621 Shalini Yadav and Neeta Nain, "A Novel Approach for Face Detection using Hybrid Skin Color Model" , Journal of Reliable Intelligent Environments Volume :1 / 1-10 / 2016 ISBN: 10.1007/s40860-01 Ramesh Babu Battula , Manoj Singh Gaur, Dinesh Gopalani , "ATMAC: Adaptive Token based MAC protocol for CRWMN" , International Journal of Communication Systems, Wiley. Volume :29 / 2503 / 2016 ISBN: 2516 Ramesh Babu

Battula, Dinesh Gopalani, Manoj Singh Gaur , "ATMAC: An Adaptive Token Based MAC Protocol for Cognitive Radio Wireless Mesh Networks" , International Journal of Communication Systems Volume :2 / - / 2016 Ankit Vidhyarthi, Namita Mittal, "AVNM: A Voting based Novel Mathematical Rule for Image Classification" , Computer Methods and Programs in Biomedicine Volume :137 / 195-201 / 2016 ISBN: 0169-2607 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Brain MR image classification using two-dimensional discrete wavelet transform and AdaBoost with random forests" , Neurocomputing Volume :177 / 188-197 / 2016 Anil Saini, Manoj Singh Gaur, Vijay Laxmi, Mauro Conti, "Colluding browser extension attack on user privacy and its implication for web browsers" , Computers and Security Volume :63 / 14-28 / 2016 Kunwar Pal, Mahesh Chadra Govil and Mushtaq Ahmed, "Comparative Analysis of Utilization Based Hybrid Overlay for Live Video Streaming in P2P Network" , International Journal of Intelligent Engineering and Systems Volume :10 / 263-271 / 2016 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "Efficient and secure multi secret sharing schemes based on Boolean XOR and arithmetic modulo" , Multimedia Tools and Applications Volume :75 / 1-19 / 2016 ISBN: 1380-7501 Yogesh Kumar Meena and Dinesh Gopalani, "Efficient Voting-Based Extractive Automatic Text Summarization Using Prominent Feature Set" , IETE Journal of Research Volume :62 / 581-90 / 2016 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, Jahangir Mohammed, "Non-linear cellular automata based edge detector for optical character images" , Simulation Volume :92 / 849-859 / 2016 Basant Agarwal,Namita Mittal, "Prominent Feature Extraction for Review Analysis: An Empirical Study" , Journal of Experimental and Theoretical Artificial Intelligence Volume :1 / 1-14 / 2016 ISBN: DOI:10.1080/09528 Rimpy Bishnoi, Vijay Laxmi, Manoj Singh Gaur, Mark Zwolinski, "Resilient routing implementation in 2D mesh NoC. Microelectronics Reliability" , Microelectronics Reliability Volume :56 / 189-201 / 2016 Rajat Goel, MC Govil, Girdhari Singh, "Security in Requirements and Design Phases" , The IIOAB journal Volume :7 / 585-589 / 2016 Dinesh Kumar Tyagi, VK Chaubey, "Survivable Routing with Path Length Constraint in WDM Networks" , International Journal of Applied Engineering Research Volume :11 / 404-410 / 2016 Mohit Kumar Singh and Neeta Nain, "Unobtrusive silhouette extraction using multivariate analysis and shadow removal in RGB color model" , Journal of Reliable Intelligent Environments Volume :1 / 1-12 / 2016 ISBN: 2199-4668 2015 Prakash Choudhary and Neeta Nain, "An Open Linguistic Structure for Multidisciplinary Research on Urdu Handwritten Text Image" , Transaction Asian Language Low Resourse Image Processing Volume :15 / 4 / 2015 Mushtaq Ahmed, Ravindra Kumar Saini, "2D Hexagonal Mesh Vs 3D Mesh Network on Chip: A Performance Evaluation" , International Journal of Computing and Digital Systems Volume :4 / 33-41 / 2015 ISBN: ISSN:2210-142X Rimpy Bishnoi, Vijay Laxmi, Manoj Singh Gaur, José Flich, Francisco Triviño, "A Brief Comment on "A Complete Self-Testing and Self-Configuring NoC Infrastructure for Cost-Effective MPSoCs" , ACM Transactions on Embedded Computing Systems Volume :14 / 1-9 / 2015 Deepti Khanduja and Neeta Nain, "A Hybrid Feature Extraction Algorithm For Devanagari Script, TALIP-14-0017.R1, ACM Transactions on Asian Language Information Processing" , ACM Transactions on Asian Language Information Processing Volume : 15 / 1-10 / 2015 ISBN: 10.1145/2710018 Prakash C, N, Nain,

Mushtaq Ahmed, "A Structure for Annotation and Ground-truthing of Urdu Handwritten Text Image Corpus" , Procedia - Social and Behavioural Sciences- Science Direct Volume :198 / 84-88 / 2015 Prakash Choudhary and Neeta Nain, "Adaptive Semantics Web-based Approach for E-education using the Static Annotated Corpus" , International Journal of Digital Information and Wireless Communications (IJDIWC) Volume :6 / 56-62 / 2015 ISBN: 2225-658X M Sharma, D Gopalani, M Tripathi, "An Approach for Predicting Related Word for the Hindi Language" , International Journal of Computer Applications Volume :123 / 29-34 / 2015 Smita Naval, Vijay Laxmi, M S Gaur, Vinod P. , "An efficient block-discriminant identification of packed malware" , Sadhana Volume :40 / 1435–145 / 2015 Vijay Laxmi, Chhagan Lal, Manoj Singh Gaur, Deepanshu Mehta, "Analysis, detection and countermeasure in TCP-based MANET. Journal of Information Security and Applications" , Journal of Information Security and Applications Volume :22 / 99-112 / 2015 Parvez Faruki, Ammar Bharmal, Vijay Laxmi, Vijay Ganmoor, Manoj Singh Gaur, Mauro Conti, Muttukrishnan Rajarajan, "Android Security: A Survey of Issues, Malware Penetration, and Defenses" , IEEE Communications Surveys and Tutorials Volume :17 / 998-1022 / 2015 Parvez Faruki, Vijay Laxmi, Ammar Bharmal, Manoj Singh Gaur, Vijay Ganmoor, "AndroSimilar: Robust signature for detecting variants of Android malware" , Journal of Information Security and Applications Volume :22 / 66-80 / 2015 Vipin Pal, Girdhari Singh, R.P Yadav, "Balanced cluster size solution to extend lifetime of wireless sensor networks" , Internet of Things, IEEE Volume :2 / 399--401 / 2015 Chhagan Lal, Vijay Laxmi, Manoj Singh Gaur, Seok-Bum Ko, "Bandwidth-aware routing and admission control for efficient video streaming over MANETs. Wireless Networks" , Wireless Networks Volume :21 / 95-114 / 2015 Vipin Pal, Yogita, Girdhari Singh, R.P Yadav, "Cluster Head Selection Optimization Based on Genetic Algorithm to Prolong Lifetime of Wireless Sensor Networks" , Procedia Computer Science Volume :57 / 1417--1423 / 2015 Jagadeesh Kakarla, Banshidhar Majhi and Ramesh Babu Battula, "Comparative Analysis of Routing Protocols in Wireless Sensor–Actor Networks: A Review" , International Journal of Wireless Information Networks, Springer Volume :22 / 220-239 / 2015 Basant Agarwal, Soujanya Poria, Namita Mittal, Alexander F. Gelbukh, Amir Hussain, "Concept-Level Sentiment Analysis with Dependency-Based Semantic Parsing: A Novel Approach." , Cognitive Computing Volume :7 / 487-499 / 2015 ISBN: 1866-9964 Yogesh Kumar Meena, Dinesh Gopalani, "Domain Independent Framework for Automatic Text Summarization" , Elsevier, Procedia Computer Science Volume :48 / 722-727 / 2015 Vipin Pal, Yogita, Girdhari Singh, R.P Yadav, "Effect of Heterogeneous Nodes Location on the Performance of Clustering Algorithms for Wireless Sensor Networks" , Procedia Computer Science Volume :57 / 1042-1048 / 2015 Smita Naval, Vijay Laxmi, Muttukrishnan Rajarajan, Manoj Singh Gaur and Mauro Conti, "Employing Program Semantics for Malware Detection" , IEEE Transactions on Information Forensics and Security Volume :10 / 2591-2604 / 2015 Yogesh Kumar Meena, Dinesh Gopalani, "Evolutionary Algorithms for Extractive Automatic Text Summarization" , Elsevier, Procedia Computer Science Volume :48 / 244-249 / 2015 P. Majumdar, A. Pal, T. De, "Extending light-trail into elastic optical networks for dynamic traffic grooming" , Journal of Optical Switching and Networking Volume :20 / 1-15 / 2015 Yogesh Kumar

Meena, Dinesh Gopalani, "Feature Priority Based Sentence Filtering Method for Extractive Automatic Text Summarization" , Elsevier, Procedia Computer Science Volume :48 / 728-734 / 2015 Jagadeesh Kakarla, Banshidhar Majhi and Ramesh Babu Battula, "IAMMAC: An Interference-Aware Multichannel MAC Protocol for Wireless Sensor–actor Networks" , International Journal of Communication Systems,Wiley Online Library Volume :1 / - / 2015 ISBN: DOI: 10.1002/dac. Jyoti Grover, Manoj Singh Gaur, Vijay Laxmi, "Multivariate verification for sybil attack detection in VANET" , Open Computer Science Volume :5 / 60-78 / 2015 Yogesh Kumar Meena, Dinesh Gopalani, "Optimal Cluster Priority Based Sentence Ranking for Efficient Extractive Text Summaries" , Electrical & Computer Engineering: An International Journal Volume :4 / 36-43 / 2015 S S Chouhan and Rajdeep Niyogi, "Plan restructuring in multi agent planning" , Procedia Computer Science Volume :46 / 396-401 / 2015 Basant Agarwal, Namita Mittal, Pooja Bansal, Sonal Garg, "Sentiment Analysis Using Common-Sense and Context Information." , Computational Intelligence and Neuroscience Volume :2015 / 1-9 / 2015 ISBN: 715730 Lavika Goel, Daya Gupta, VK Panchal, "Two-phase anticipatory system design based on extended species abundance model of biogeography for intelligent battlefield preparation" , Knowledge Based Systems Volume :89 / 420-445 / 2015 2014 Rimpy Bishnoi, Vijay Laxmi, Manoj Singh Gaur, Jose Flich, Francisco Trivino, "“A brief comment on “A Complete Self-Testing and Self-Configuring NoC Infrastructure for Cost-Effective MPSoCs [ACM Transaction on Embedded Computing Systems 12 (2013) Article 106”" , ACM Transaction on Embedded Computing Systems Volume :1 / - / 2014 Subhash Panwar and Neeta Nain, "A Novel Segmentation Methodology for Cursive Handwritten Documents" , IETE Journal of Research Volume :6 / 432-439 / 2014 ISBN: 10.1080/03772063. Parvez Faruki, Ammar Bharmal, Vijay Laxmi, Vijay Ganmoor,Manoj Singh Gaur, Mauro Conti and Rajarajan Muttukrishnan, "Android Security: A Survey of Issues, Malware Penetration and Defenses" , IEEE Communications Survey and Tutorials Volume :1 / - / 2014 P. Faruki, Ammar Bharmal, Vijay Laxmi, MS Gaur, Vijay Ganmoor, "AndroSimilar: Robust Signature for Detecting Variants of Android Malware" , Elsevier Journal of Information Security and Applications Volume :1 / - / 2014 Chhagan Lal, V. Laxmi, M.S.Gaur, Seok-Bum Ko, "Bandwidth-Aware Routing and Admission Control for Reliable Video Streaming over MANETs" , Wireless Networks, Springer, USA Volume :2 / 11276-014 / 2014 ISBN: 1572-8196 Surjeet Das, Dinesh Gopalani, "Big Data Analysis Issues and Evolution of Hadoop" , International Journal of Pure and Applied Research in Engineering and Technology Volume :2 / 152-161 / 2014 Pavan Kumar T, Ramesh Babu Battula, Rajasekhar Rao K, Manoj Singh Gaur, Dinesh Goplani , "Cognitive Radio Wireless Mesh Networks: Routing and Its Challenges" , International Journal of Applied Engineering Research Volume :9 / 1333-1345 / 2014 Pavan Kumar T, Ramesh Babu Battula, Rajasekhar Rao K, Manoj Singh Gaur, Dinesh Goplani , "Cognitive Radio Wireless Mesh Networks: Routing and its Issues" , International Journal of Applied Engineering Research. Volume :10 / 1333-1345 / 2014 M. C. Govil, M. M. Sharma, J. K. Deegwal, A. Kumar, "Compact planar monopole UWB antenna with quadruple band-notched characteristics" , Progress In Electromagnetics Research C Volume :47 / 29-36 / 2014 Vinod P., V. Laxmi, Manoj Singh Gaur, Grijesh Chauhan, "Detecting

Malicious Files using NonSignature based Methods" , International Journal of Information and Computer Security, Inderscience. Volume :0 / - / 2014 Basant Agarwal, Namita Mittal, "Enhancing Performance of Sentiment Analysis by Semantic Clustering of Features" , IETE Journal of Research Volume : 60 / 414-422 / 2014 ISBN: DOI:10.1080/03772 Rajbir Kaur, V. Laxmi, MS Gaur, "Exploiting convergence characteristics to tackle collusion attacks in OLSR" , Security and Communication Networks Volume :6 / 108-122 / 2014 Vijay Laxmi, Chhagan Lal, M. S. Gaur, Deepanshu Mehta, "JellyFish Attack: Analysis, Detection and Countermeasure in TCP-based MANET" , Elsevier Journal of Information Security and Applications Volume :0 / - / 2014 ISBN: - Arka Prokash Mazumdar, Anandghan Waghmare, and Ashok Singh Sairam, "Modelling Energy Efficiency of OR Protocols in Wireless Networks" , International Journal of Ad Hoc and Ubiquitous Computing Volume :16 / 42-57 / 2014 ISBN: 1743-8233 Chhagan Lal, V.Laxmi, M.S.Gaur , "Multi-Constraint QoS-aware Routing for Real-life Video Streaming in MANETs" , Journal of Communication Systems, Wiley Volume :1 / - / 2014 Preety Singh, V. Laxmi, MS Gaur, "Near Optimal Geometric Feature Selection for Visual Speech Recognition" , International Journal of Pattern Recognition and Artificial Intelligence Volume :27 / - / 2014 Meenakshi Tripathi,M.S. Gaur, V. Laxmi, "Node misbehaviour detection and removal in clustered based Wireless Sensor Network" , Hindwai ISRN Sensor Networks Journal Volume :2013 / - / 2014 Namita Mittal, Basant Agarwal, Ritul Aditya, "Ontology Driven Semantic Query Optimization" , Journal of Computer Systems, Online Volume :01 / 85-90 / 2014 ISBN: 2394-1065 Basant Agarwal, Namita Mittal, "Semantic feature clustering for sentiment analysis of English reviews" , IETE Journal of Research Volume :60(6) / 414-422 / 2014 Jyoti Grover, MS Gaur, V. Laxmi, "Sybil Attack Detection in VANET using neighboring Vehicles" , International Journal of Security and Networks (IJSN), Inderscience Volume :1 / - / 2014 Jyoti Grover, Vijay Laxmi, Manoj Singh Gaur, "Sybil attack detection in VANET using neighbouring vehicles" , International Journal of Security and Networks Volume :9 / 222-233 / 2014 2013 Jyoti Grover, MS Gaur, V. Laxmi, "Attack models and infrastructure supported detection mechanisms for position forging attacks in vehicular ad hoc networks" , CSI Transactions on ICT Volume :1 / 261-279 / 2013 Lavika Goel, Daya Gupta, VK Panchal, "Biogeography and geo-sciences based land cover feature extraction" , Applied Soft Computing Volume :13 / 4194-4208 / 2013 Pavan Kumar T, Ramesh Babu B, Rajasekhar Rao K and Dinesh Gopalni, "Cluster based Routing Protocol for Cognitive Radio Wireless Mesh Networks" , International Journal of Computer Applications Volume :80 / 27-31 / 2013 ISBN: 0975 – 8887 Meenakshi Tripathi, Manoj Singh Gaur, Vijay Laxmi, "Comparing the impact of black hole and gray hole attack on LEACH in WSN" , Procedia Computer Science Volume :19 / 1101-1107 / 2013 Neeta Nain and Subhash Panwar, "Cursive Handwritten Text Document Preprocessing Methodologies" , Lecture Notes in Electrical Engineering, Springer Volume :247 / 267-281 / 2013 ISBN: 978-94-007-6818-5 Meenakshi Tripathi, MS Gaur, V Laxmi, P Sharma, "Detection and countermeasure of node misbehaviour in clustered wireless sensor network" , Hindwai ISRN Sensor Network Volume :2013 / 1-9 / 2013 Meenakshi Tripathi,M.S. Gaur, V. Laxmi , P. Sharma, "Detection and Removal of Misbehaviour Nodes from Clustered Wireless Sensor Network" , Hindwai ISRN

Sensor Network Volume :2013 / 9 / 2013 Lavika Goel, Daya Gupta, V. K. Panchal, "Land Cover Feature Extraction of Multi-spectral Satellite Images Based on Extended Species Abundance Model of Biogeography" , LNCS Transactions on Computational Science XXI Volume :8160 / 90-118 / 2013 Subhash Panwar, Neeta Nain, Subhra Saxena, P. C. Gupta , "Language Adaptive Methodology for Handwritten Text Line Segmentation" , Lecture Notes in Computer Science, Springer Volume :8047 / 344-351 / 2013 ISBN: 978-3-642-40261-6 Arka Prokash Mazumdar, and Ashok Singh Sairam, "On Performance Modelling of Ad hoc Opportunistic Routing Protocols (Contributed Book Chapter)" , Routing in Opportunistic Networks (Ed.: I Woungang, SK Dhurandher, A Anpalagan, AV Vasilakos) Volume :0 / 223-250 / 2013 ISBN: 978-1-4614-3513-6 Lavika Goel, Daya Gupta, VK Panchal, "Performance Analysis of Biogeography Based Land Cover Feature Extractor for Building Hybrid Intelligent Models" , International Journal of Applied Evolutionary Computation (IJAEC) Volume :4 / 1-26 / 2013 Arka Prokash Mazumdar and Ashok Singh Sairam, "TOAR: transmission-aware opportunistic ad hoc routing protocol" , Journal on Wireless Communications and Networking Volume :2013 / 1-19 / 2013 ISBN: 1687-1499 2012 B. Ramesh Babu, SK. Mansoor Rahaman,T. Pavan Kumar, Venkaiahnaidu.A, "An Algorithmic Approach to Avoid Starvation in Wireless Mesh Networks" , International Journal of Computer Applications Volume :40 / 26-30 / 2012 K R Yadav, Vipin Pal, Girdhari Singh, R P Yadav , "AN EFFICIENT LOAD BALANCING CLUSTERING SCHEME FOR DATA CENTRIC WIRELESS SENSOR NETWORKS" , International Journal of Communication Network and Security (IJCNS) Volume :1 / 1-5 / 2012 Meenakshi Tripathi,M.S. Gaur, V. Laxmi , "Analysis of effects of Mobility and Active Route Timeout between Sensor Nodes in Wireless Sensor Networks" , Special Issue of International Journal of Computer Applications on Wireless Communication and Mobile Networks Volume :5 / 22-25 / 2012 M. M. Agarwal, M. C. Govil and A. K. Jhankal, "Analysis of energy consumption in mobile ad-hoc routing protocols through route recovery and maintenance mechanisms" , International Transactions in Mathematical Sciences and Computers, Volume :5 / 121-130 / 2012 Neeta Nain, "Creating Three Dimensional Surfaces from Two Dimensional Slices for Medical Imaging" , Journal of Computer and Information Technology volume 2 issue 2, Academy Publish Volume :2 / 36-40 / 2012 ISBN: 2161-7112 P. Dadhich and M. C. Govil, "Decentralized reputation system for mobile agent security" , Journal of Rajasthan Academy of Physical Sciences Volume :11 / 19-27 / 2012 Virendra S Shekhawat, D K Tyagi, V K Chaubey, "Design and Characterization of a Modified WDM Ring Network - An Analytical Approach" , optik Volume :123 / 1103-1107 / 2012 ISBN: 0030-4026 Vipin Pal, Girdhari Singh, R P Yadav, Pavitar Pal, "Energy Efficient Clustering Scheme for Wireless Sensor Networks: A Survey" , Journal of Wireless Networking and Communications Volume :2 / 168-174 / 2012 ISBN: 2167-7328 Riti Kushwaha, Neeta Nain and Promila Jangra, "Extraction of Lip Contour from Face" , International Journal of Current Engineering and Technology Volume :2 / 265-269 / 2012 ISBN: 2277-4106 Jay Dhariwal, Rikita Dhaiwala, Neeta Nain, "Eye Gazing with Low Resolution Web-Cam Images using Artificial Neural Network" , International Journal of Computer Science and its Applications Volume :2 / 130-134 / 2012 ISBN: 2250 – 3765 Riti Kushwaha and Neeta Nain, "Facial Expression Recognition" ,

International Journal of Current Engineering and Technology Volume :2 / 270-278 / 2012 ISBN: 2277 – 4106 Neeta Nain, Subhash Pawar , "Handwritten Text Recognition Based on Neural Networks" , Journal of Computer and Information Technology volume 2 issue 2, Academy Publish Volume :2 / 95-103 / 2012 ISBN: 2161-7112 Lavika Goel, Daya Gupta, VK Panchal, "Hybrid bio-inspired techniques for land cover feature extraction: A remote sensing perspective" , Applied Soft Computing Volume :12 / 832-849 / 2012 Arka Prokash Mazumdar, and Ashok Singh Sairam, "Opportunistic Routing: Opportunities and Challenges" , International Journal of Information and Electronics Engineering Volume :2 / 247-252 / 2012 ISBN: 2010-3719 Vipin Pal, Girdhari Singh, Rajender Prasad Yadav, "SCHS: Smart Cluster Head Selection Scheme for Clustering Algorithms in Wireless Sensor Networks" , Wireless Sensor Network Volume :4 / 273-280 / 2012 Ramesh Babu Battula,Lakshmi Movva,Chaithanya Kurra,Koteswara Rao G,Miriyala Sridhar,Paruchuri Harish, "Underwater Acoustic Sensor Networks: A Survey on MAC and Routing Protocols" , IJCTA Volume :3 / 895-902 / 2012 Vinod Kumar Jatav, Meenakshi Tripathi, MS Gaur, Vijay Laxmi, "Wireless sensor networks: Attack models and detection" , Proceedings of IACSIT Hong Kong Conferences Volume :30 / 144-150 / 2012 2011 Pavan Kumar Tummala, Ramesh Babu Battula, Srikanth Vemuru, Rajasekhara Rao Kurra, "A Fast MAC Mechanism for Handoff Process in Heterogeneous Wireless Networks" , IJCSET Volume :1 / 684-689 / 2011 Jagadeesh Kakarla, S Siva Sathya, B Govinda Laxmi, Ramesh Babu B, "A Survey on Routing Protocols and its Issues in VANET" , International Journal of Computer Applications Volume :28 / 38-44 / 2011 ISBN: 0975 – 8887) Naveen Choudhary, M.S.Gaur, V. Laxmi, "Communication Bandwidth Adaptable Network Design of Complex Application Specific SoC" , International Journal of Computer Applications Volume 30– No.3, September 2011, (IJCA), September 2011, pp. 15-22, Volume :30 / 15-22 / 2011 ISBN: ISBN: 978-93-8086 Neeta Nain, Shweta Singhal, Kranti Arora, Harish Dalmia, Paras Sharma, Nemi Chand Singh, "Defect Analysis using Texture" , International Journal of IT & Knowledge Management Volume :4 / 669-672 / 2011 ISBN: 0973-4414 Nishtha Kesswani, Dinesh Gopalani, "Design and Implementation of Multi-parameter Dijkstra (mpd) Algorithm: A Shortest Path Algorithm for Real-road Networks" , International Journal of Advances in Engineering Research Volume :2 / 01-12 / 2011 R. Rastogi, D. S. Chauhan, and M. C. Govil, "Disjoint paths multi-stage interconnection networks stability problem" , International Journal of Computer Science Issues (IJCSI) Volume :8 / 260-271 / 2011 Vipin Pal, K R Yadav, Girdhari Singh, R P Yadav, "Effect of Frame Length on the Performance of Clustering in Wireless Sensor Networks" , International Journal of Computer Science & Management Systems Volume :3 / 41-46 / 2011 ISBN: 0975-5349 Naveen Choudhary, M.S.Gaur, V. Laxmi, "Energy Efficient Network Generation for Application Specific NoC" , Global Journal of Computer Science and Technology (GJCST) Volume :11 / 47-56 / 2011 ISBN: ISSN: 0975-4172 Naveen Choudhary, M.S.Gaur, V. Laxmi, "Escape Path based Irregular Network-on-chip Simulation Framework" , International Journal of Computer Applications (IJCA), Special Issue: Evolution in Networks and Computer Communications Volume :1 / 7-12 / 2011 ISBN: ISBN: 978-93-8086 Neeta Nain, Akshay Kumar, Amlesh K. Mohapatra, Ratan Das, Ashok Kumar, NemiChand Singh, "Face Recognition using LDA with

Wavelet Transform Approach" , International Journal of IT & Knowledge Management Volume :4 / 603-607 / 2011 ISBN: 0973-4414 Lavika Goel, Daya Gupta, V.K. Panchal, "Information Sharing In Swarm Intelligence Techniques: A Perspective Application for Natural Terrain Feature Elicitation in Remote Sensing Images" , INTERNATIONAL JOURNAL OF COMPUTER APPLICATIONS Volume :32 / 34-40 / 2011 Naveen Choudhary, M.S.Gaur, V. Laxmi, "Network-on-Chip Design for High Performance Demanding Multimedia Application" , International Journal of Computer Applications (IJCA), Special Issue: IP Multimedia Communications Volume :1 / 155-160 / 2011 ISBN: ISBN: 978-93-8086 R. Rastogi, D. S. Chauhan and M. C. Govil, "On stability problems of Omega and 3-disjoint paths Omega multi-stage interconnection networks" , International Journal of Computer Science Issues (IJCSI) Volume :8 / 66-76 / 2011 Mushtaq Ahmed, V. Laxmi, M. S. Gaur, "Performance Analysis of Minimal Path Fault Tolerant Routing in NoC" , Journal of Electronics (China) Volume :28 / 587-595 / 2011 ISBN: 0217-9822 Namita Mittal, Richi Nayak, Mahesh Chandra Govil, Kamal Chand Jain, "Personalised search - a hybrid approach for web information retrieval and its evaluation" , International Journal of Knowledge and Web Intelligence Volume :2 / 119-137 / 2011 N. Mittal, R. Nayak, M. C. Govil and K. C. Jain, "Personalised search- a hybrid approach for web information retrieval and its evaluation" , International Journal of Knowledge and Web Intelligence Volume :2 / 119-137 / 2011 Naveen Choudhary, M.S.Gaur, V. Laxmi, "Power proficient Application Specific Communication Infrastructure for Advance SoC" , International Journal of Soft Computing and Engineering (IJSCE) Volume :1 / 227-232 / 2011 ISBN: ISSN: 2231-2307. Naveen Choudhary, M.S.Gaur, V. Laxmi, "Routing Centric NoC Design for High Performance Multimedia Application" , International Journal of Soft Computing and Engineering (IJSCE) Volume :1 / 254-258 / 2011 P. Dadhich, K. Dutta and M. Govil, "Trust enhanced authorization for distributed systems" , International Journal of Scientific and Engineering Research Volume :2 / 40 / 2011 2010 Virendra Singh Shekhawat, Mahesh Lagadapati, Dinesh Tyagi, and V K Chaubey, "A Novel Aggressive Intermediate-Node Initiated Reservation (AIIR) Protocol for Wavelength Routed Optical WDM Networks" , International J. of Recent Trends in Engineering and Technology Volume :3 / 126-128 / 2010 Lavika Goel, Daya Gupta and V.K. Panchal, "Embedding Expert Knowledge to Hybrid Bio-Inspired Techniques: An Adaptive Strategy towards Focused Land Cover Feature Extraction" , International Journal of Computer Science & Information Security (IJCSIS) Volume :1 / 244-253 / 2010 Dinesh Gopalani, M.C. Govil, "Interpreter for Untyped Imperative Object Calculus" , International Journal of Intelligent Information Processing Volume :4 / 79-82 / 2010 ISBN: 0973-3892 Lavika Goel, "Land cover Feature Extraction using Hybrid Swarm Intelligence Techniques-A Remote sensing perspective" , ACEE INTERNATIONAL JOURNAL ON SIGNAL & IMAGE PROCESSING Volume :1 / 1 / 2010 P. Gupta and M. Govil, "MVC design pattern for the multi framework distributed applications using XML, spring and struts framework" , International Journal of Computer Science & Engineering Volume :2 / 1047-1051 / 2010 E. S. Pilli, R. C. Joshi and R. Niyogi, "Network Forensic Frameworks: Survey and Research Challenges" , Digital Investigation Volume :7 / 14-27 / 2010 P. Dadhich, K. Dutta and M. Govil, "Security issues in mobile agents" , International Journal of Computer Applications Volume :11 /

1-7 / 2010 P. Gupta, P. Bari and M. Govil, "Spring Web MVC Framework for rapid open source J2EE application development: a case study" , International Journal of Engineering Science and Technology (IJEST) Volume :2 / 1684-1689 / 2010 Souvik Bhattacharyya, Arka Prokash Mazumdar, Indradip Banerjee, and Gautam Sanyal, "Text Steganography using Formatting Character Spacing" , International Journal of Information and Computing Science Volume :13 / - / 2010 ISBN: 0972-1347 2009 Neeta Nain, Rajesh Kumar, and Bhavitavya Bhadviya, "A Gray Level Feature Detector and its Harware Architecture" , Advances in Electrical Engineering and Computational Science, Springer Volume :12 / 135-145 / 2009 ISBN: 978-90-481-2310-0 Virendra Singh Shekhawat, Dinesh Kumar Tyagi, V K Chaubey, "A Novel Packet Switch Node Architecture for Contention Resolution in Synchronous Optical Packet Switched Networks" , Scientific Research Volume :2 / 562-568 / 2009 ISBN: 1913-3715 K.K.Palliwal, MS Gaur, V.Laxmi, "Impact of Faulty Links on Quality-of-Service in Network-on-Chip under Different Traffic Patterns" , IJCSNS International Journal of Computer Science and Network Security, Volume :9 / 108-117 / 2009 M S Gaur, Raghavendra N V, V Laxmi, and Ujjwal Kumar, "Structural Fault Modelling in Nano Devices" , Nano-Net, Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering Springer Berlin Heidelberg Volume :0 / - / 2009 2008 MS Gaur, V Laxmi, "Development of a low-cost smart card based secure information exchange system with tamper-proofing features" , International Journal of Product Development, Inderscience Volume :5 / 176-187 / 2008 Neeta Nain, Gaurav Jindal, Ashish Garg, Anshul Jain, "Dynamic Thresholding Based Edge Detection" , Lecture Notes in Engineering and Computer Science Volume :2170 / 694-699 / 2008 ISBN: 20780958 Neeta Nain, Prashant Gour, Nitish Agarwal, Rakesh P Talawar, Subhash Chandra, "Face Recognition using PCA and LDA with Singular Value Decomposition(SVD) using 2DLDA" , Lecture Notes in Engineering and Computer Science Volume :2170 / 649-652 / 2008 ISBN: 20780958 Neeta Nain, Vijay Laxmi, Bhavitavya Bhadviya, "Feature Point Detection for Real Time Applications" , Lecture Notes in Engineering and Computer Science, Springer Volume :2170 / 643-648 / 2008 ISBN: 20780958 Neeta Nain, Deepak B M, Dinesh Kumar, Manisha Baswal, Biju Gautham, "Optimized Minutiae-Based Fingerprint Matching" , Lecture Notes in Engineering and Computer Science Volume :2170 / 682-687 / 2008 ISBN: 20780958 G. Singh, M. C. Govil, and M. Kejriwal, "Real time communicative acts: Introduction and implementation" , PCTE Journal of Computer Sciences Volume :2 / 60-66 / 2008 2006 M. C. Govil, U. Pandel, A. Bose and V. Shashank, "Design of route planner for i-Garbage system" , International Journal of Information and Computing Science Volume :1 / - / 2006 V. Laxmi, JN Carter and RI Damper, "Human vis-à-vis Machine Perception of Biological Motion" , Cognitive Systems Research 7(4): 339-356 (2006) Volume :7 / 339-356 / 2006 2005 K. Sundrani, L. K. Awasthi and M. C. Govil, "A novel scheme for location management in ad-hoc networks" , ACCST Research Journal Volume :3 / 199-204 / 2005 M. Govil, U. Pandel, A. Bose and V. Shashank, "Design of ecofriendly waste management system" , Nature, Environment and Pollution Technology Volume :4 / 551-554 / 2005 M. C. Govil, L. Kumar, A. Bose and V. Shashank, "Design of online garbage management system" ACCST Research Journal" , ACCST Research Journal Volume :3 / 56-60 / 2005 P. Sharma, L. K.

Awasthi, R. K. Sharma and M. C. Govil, "Region growing approach for image segmentation" , International Journal of Information and Computing Science Volume :8 / 1-7 / 2005 2004 M. C. Govil, "A new schedulability test algorithm for real-time systems" , ACCST Research Journal Volume :2 / 216-220 / 2004 Conference Publications (715) 2025 Anand Kumar Jain and Neeta Nain, "Detection and Classification of Cassava Diseases Using Concatenate Model" , 13th International Conference on Soft Computing for Problem Solving - SocProS 2025 by :Springer at IIT Roorkee / 1-6 / 2025 Anand Kumar Jain and Neeta Nain, "Cashew Diseases Classification Using Concatenate of Models" , European Conference on Computer Vision by :Institute for Scientific and Engineering Research at Paris, France / 1-6 / 2025 Madhav Khatri, Mushtaq Ahmed , "A-FLB: Dynamic Adaptive Fuzzy-Based Load Balancing With Genetic Optimization for Enhanced Cloud Performance" , 17th International Conference on COMmunication Systems & NETworkS ComsNet25 by :IEEE at Chancery Pavilion Hotel, Residency Road, Bengaluru / 6 / 2025 Pravesh Bansal, Mushtaq Ahmed, "Optimized Perception-Based Student Behavior Analysis Using Machine Learning" , International Conference on Emerging Applications of Intelligence and Computing EAIC 2025 Accepted by :IEEE at NIT Jalandhar / / 2025 K. P. Singh, E. S. Pilli and V. Laxmi, "Honeypot-Based Data Collection for Dark Web Investigation Using Tor Network" , Twentieth IFIP WG 11.9 International Conference on Digital Forensics ICDF 2024 by :Springer at New Delhi / 271-290 / 2025 ISBN: 978-3-031-71024-7 K. P. Singh, E. S. Pilli and V. Laxmi, "Plugin-Based Tor Traffic Analysis: A Deep Learning Approach for Identification of Obfuscated Tor Traffic" , 9th International Conference on Smart Trends in Computing and Communications - SmartCom 2025 by :Springer at Pune, India / / 2025 T. Dutta, S. Majhi, D. R. Nayak, D. Jha, "SAM-Mamba: Mamba Guided SAM Architecture for Generalized Zero-Shot Polyp Segmentation" , Winter Conference on Applications of Computer Vision WACV 2025 by :IEEE at Arizona, USA / / 2025 2024 Ravindra Kumar Soni and Neeta Nain, "Enhancing Low-Resolution Face Recognition With Self Attention Network and Resolution Augmentation Approach" , IEEE International Conference on Computational Intelligence and Network Systems by :IEEE at Dubai / 1-5 / 2024 Anand Kumar Jain, Shivam Sharma and Neeta Nain, "Multi-Disease Detection and Classification of Sugarcane Leaves Using Transfer Learning" , 2024 11th International Conference on Soft Computing & Machine Intelligence by :IEEE at MELBOURNE, AUSTRALIA / 308-312 / 2024 Ravindra Kumar Soni and Neeta Nain, "Unconstrained Low-Resolution Face Recognition Using Attention Network and Resolution Aware Images" , 9th International Conference on Computer Vision and Image Processing by :Springer at IIITDM Kancheepuram, Chennai / 1-8 / 2024 Anand Kumar Jain and Neeta Nain, "Disease Detection and Classification of Rice Leaves Using Transfer Learning With Concatenate" , International Conference on Machine Learning, Image Processing, Network Security, and Data Sciences, MIND 2024 by :Springer at NIT Goa / 1-5 / 2024 Pravesh Bansal, Mushtaq Ahmed, "Fuzzy Logic-Based Analysis of Student Behavior Patterns in Educational Environments" , 4th International Conference on Innovation in IoT Robotics and Automation Presented by :AIP at MIT Moradabad India / 1-9 / 2024 Idris Afzal Shah, Mushtaq Ahmed, "A Novel Delay Tolerant Routing Protocol for Opportunistic Networks" , 9th International Conference for Convergence in Technology I2CT 2024 by :IEEE at Lonavala Pune / / 2024 Alina Khan, Diwakar Gautam, Deepak Jhanwar, Farruckh Anwar, Mushtaq Ahmed, "Color Preservation of Lymphoblastic Cells Using Statistical Region Merging" , 1ST INTERNATIONAL CONFERENCE on PIONEERING DEVELOPMENTS in COMPUTER SCIENCE & DIGITAL TECHNOLOGIES by :IEEE at NIT DELHI / / 2024 Akash Yadav, Mushtaq Ahmed, "Predictive Modeling for Thread Optimization in OpenMP-Based Parallelization Using Machine Learning" , 17th IEEE MCSoC Multicore and Many-Core Systems-on-Chip Symposium by :IEEE at Kuala Lumpur, Malaysia / 6 / 2024 Vijay Budania, Sanjay Tehariya, Suhana Sharma, Atinder Pal Singh, Aman Mina, Mushtaq Ahmed, "Coalition-Based Web Server Load Balancing in Software Defined Network" , The 6th International Conference on Computational Intelligence & Networks CINE-2024 by :IEEE at KIIT DU Bhubaneswar, India / 6 / 2024 Mayank Kumar Jain, Sonali Karneedi, Venkata Vyjayanthi Pedapati, Dinesh Gopalani, Yogesh Kumar Meena, "Validata: Enhancing Fake News Detection Using Recursive Feature Selection and Machine Learning in Web-Based Applications" , 2024 IEEE Region 10 Symposium TENSYMP by :IEEE at New Delhi, India / / 2024 Tarun Jain, Dinesh Gopalani, Yogesh Kumar Meena, "Image Tweet Classification for Crisis Informative Task" , 2024 International Conference on Integrated Circuits, Communication, and Computing Systems by :IEEE at Una, India / / 2024 Tarun Jain, Dinesh Gopalani, Yogesh Kumar Meena, "Classification of Humanitarian Crisis Response Through Unimodal Multi-Class Textual Classification" , 2024 International Conference on Emerging Systems and Intelligent Computing by :IEEE at Bhubaneswar, India / / 2024 Lav Upadhyay, Meenakshi Tripathi, Jyoti Grover, "Performance Analysis of Ensemble Feature Selection Based Network Intrusion Detection System Using Ensemble Machine Learning" , 2024 International Conference on Emerging Trends in Networks and Computer Communications, ETNCC by :IEEE at Windhoek, Namibia / 1-6 / 2024 Riya Chawla, Meenakshi Tripathi, "An Analysis of ICT Based Teaching-Learning Tools for Children With Autism Spectrum Disorder" , 2024 IEEE Region 10 Symposium TENSYMP by :IEEE at New Delhi, India / / 2024 Shubham Tomar, Meenakshi Tripathi, "Paving the Way Advancing V2X Safety Through Innovative Attack Generation and Analysis Framework V2XSAF" , International Conference on Information Systems Security by :IEEE at Jaipur / / 2024 Richa Kumari, Dinesh Kumar Tyagi, Ramesh Babu Battula, "PvFL-RA: Private Federated Learning for D2D Resource Allocation in 6G Communication" , 38th International Conference on Advanced Information Networking and Applications- AINA 2024 by :Springer at Kitakyushu, Japan / 261-273 / 2024 ISBN: ISBN 978-3-031-57 Avinash Reddy Avuthu, Venkat Sai Akshay Gandlapalli, Vital Sai Katam and Ramesh Babu Battu, "Secure Spectrum Sensing in CRNs: A Study on SSDF Attacks and Countermeasure Using USRP" , 15th International IEEE Conference on Computing, Communication and Networking Technologies -ICCCNT by :IEEE at IIT Mandi, India / / 2024 Avuthu Avinash Reddy, Katam Vital Sai, Gandlapalli V S Akshay and Ramesh Babu Battula , "Performance Analysis of ML and DL Models on 5G Bands: An Experimental Study" , 6th IEEE International Conference on Electrical, Computer and Communication Technologies - ICECCT 2024 by :IEEE at Chhattisgarh, India / / 2024 Anil Kumar Prajapati, Emmanuel Shubhakar Pilli, Ramesh Babu Battula and Krishan Pal Singh, "Securing RPL-Based IoT Networks: A Hyperparameter Based Deep Learning Approach for Intrusion Detection" , The 11th International Symposium on Networks Computers and Communications - ISNCC-2024 by :IEEE at Washington DC- USA / / 2024 ISBN: Accepted Sachin Dube, Dinesh Kumar Tyagi, Ramesh Babu Battula, "RW-SVD: A Surround View Rough Weather Video Anomaly Dataset and a Brief Overview of Existing Datasets" , 17th Asian Conference on Computer Vision by :Springer at Hanoi, Vietnam / 143-159 / 2024 ISBN: 978-981-96-0901-x Kuldeep Biradar, Dinesh Kumar Tyagi, Ramesh Babu Battula, P Subbarao, "Robust Anomaly Detection Through Transformer-Encoded Feature Diversity Learning" , 17th Asian Conference on Computer Vision by :Springer Nature Singapore at Hanoi, Vietnam / / 2024 Prem Shanker Yadav, Kushall Singh, Dr.Dinesh Kumar Tyagi, Dr.Ramesh Babu Battula, "Adversarial Weather-Resilient Image Retrieval: Enhancing Restoration Using Captioning for Robust Visual Search" , 17th Asian Conference on Computer Vision by :Springer Nature Singapore at Hanoi, Vietnam / / 2024 A. K. Prajapati, E. S. Pilli, R. B. Battula and K. P. Singh, "Securing RPL-Based IoT Networks: A Hyperparameter Based Deep Learning Approach for Intrusion Detection" , 11th International Symposium on Networks, Computers and Communications - ISNCC24 by :IEEE at Washington DC, USA / / 2024 K. P. Singh, E. S. Pilli and V. Laxmi, "Dark Web Surveillance and User Profiling Framework for Evidence Extraction Using OSINT" , Third International Conference on Information Security, Privacy and Digital Forensics - ICISPD 2024 by :Springer at Surat, India / / 2024 A. Seetha , J. Parmar, S. S. Chouhan, E. S. Pilli, and A. Jain , "DisEvD: A Benchmark Dataset for Disruptive Event Identification From Online Social Network" , 12th International Conference on Big Data and Artificial Intelligence BDA 2024 by :Springer at Hyderabad, India / / 2024 A. Jain and E. S. Pilli , "LibMultiSig - a Multisignature Transaction Library for Bitcoin" , International Conference on Intelligent Systems and Security - ICISS 2024 by :Springer at Shibpur, India / / 2024 Prafulla Saxena , Susim Mukul Roy , Dinesh Kumar Tyagi , Santosh Kumar Vipparthi , Subrahmanyam Murala, R. Balasubramanian, "RefMOS: A Robust Referred Moving Object Segmentation Framework Based on Text Query" , 20th IEEE International Conference on Advanced Video and Signal Based Surveillance -AVSS by :IEEE at Niagara Falls, Canada, / 1-7 / 2024 ISBN: 979-8-3503-7429-2 Prem Shanker Yadav, Dinesh Kumar Tyagi ,Santosh Kumar Vipparathi, "Fusing Image and Text Features for Scene Sentiment Analysis Using Whale-Honey Badger Optimization Algorithm WHBOA" , Pattern Recognition, 27th International Conference ,ICPR 2024 by :Springer at Kolkata,India / 446-462 / 2024 ISBN: 978-3-031-78165-0 Kuldeep Biradar, Dinesh Kumar Tyagi, Ramesh Babu Battula, P Subbarao, "Robust Anomaly Detection Through Transformer-Encoded Feature Diversity Learning" , 17th Asian Conference on Computer Vision by :Springer at Hanoi, Vietnam / 115-128 / 2024 ISBN: 978-981-96-0885-x Prafulla saxena, Dinesh Kumar Tyagi, Santosh Kumar Vipparthi, Subrahmanyam Murala, "WARMOS: Enhancing Weather-Affected Referred Moving Object Segmentation" , 17th Asian Conference on Computer Vision by :Springer at Hanoi, Vietnam / 102-114 / 2024 ISBN: 978-981-96-0885-x Prem Shanker Yadav, Kushall Singh, Dr.Dinesh Kumar Tyagi, Dr.Ramesh Babu Battula, "Adversarial Weather-Resilient Image Retrieval: Enhancing Restoration Using

Captioning for Robust Visual Search" , 17th Asian Conference on Computer Vision by :Springer at Hanoi, Vietnam / 129-142 / 2024 ISBN: 978-981-96-0901-x Sachin Dube,Kuldeep Biradar,Dinesh Kumar Tyagi, and Santosh Kumar Vipparthi, "WAVE-NET: Weakly-Supervised Video Anomaly Detection Through Feature Enhancement and Triplet Loss" , 9th International Conference on Computer Vision & Image Processing CVIP2024 by :Springer at IIITDM Kancheepuram, Chennai / / 2024 ISBN: (Accepted) Richa Kumari, Kushall Pal Singh, Sandeep Jangir, Dinesh Kumar Tyagi and Ramesh Babu Battula, "Lightweight Distributed Ledger Technology and Consensus Algorithms for D2D Communication" , 4th International Conference on Advanced Network Technologies and Intelligent Computing ANTIC 2024 by :Springer at BHU, VARANASI / 308-324 / 2024 ISBN: 978-3-031-83782 Praveen Singh Thakur, Mahipal Jadeja, Satyendra Singh Chouhan, Santosh Singh Rathore, "Evaluating Deep Learning Embedding Techniques for Code Smell Detection" , 12th International Conference on Big Data and Artificial Intelligence BDA 2024 by :Springer at Hyderabad / / 2024 Ritu Rai, Jyoti Grover, "Comparative Analysis of Cosine and Jaccard Similarity-Based Classification for Detecting CAN Bus Attacks" , 2024 IEEE Region 10 Symposium TENSYMP by :IEEE at New Delhi / 1-6 / 2024 Lav Upadhyay, Meenakshi Tripathi, Jyoti Grover, "Performance Analysis of Ensemble Feature Selection Based Network Intrusion Detection System Using Ensemble Machine Learning" , International Conference on Emerging Trends in Networks and Computer Communications ETNCC by :IEEE at Namibia / 1-6 / 2024 Shyamili Toluchuri, Aishwarya Upadhyay, Smita Naval, Vijay Laxmi, Manoj Singh Gaur, "GAN-Based Seed Generation for Efficient Fuzzing" , 21st International Conference on Security and Cryptography - SECRYPT 2024 by :SCITEPRESS at Dijon, France / 686-691 / 2024 ISBN: 978-989-758-709-2 Karishma Yadav, Smita Naval, "Enhancing Smart Contract Security Through Obfuscation: Verification via Control Flow Graph Analysis" , 6th International Conference on Communication and Intelligent Systems - ICCIS 2024 by :SCRS, Microsoft Corporation at MANIT, Bhopal, India / / 2024 Jyoti Nagpal, Lavika Goel, "DAMPSO: Dynamic Accelerated Memory-Based PSO for Hyperparameter Tuning of Plant Disease Classifiers" , 5th Doctorial Symposium on Computational Intelligence DOSCI 2024 Springer LNNS Publications by :Springer at Delhi / 1-6 / 2024 Jyoti Nagpal, Lavika Goel, "Deep Learning-Based Classification of Plant Leaf Diseases Using Advanced Particle Swarm Optimization" , 3rd International Conference on Emerging Trends in Expert Applications and Security ICE-TEAS 2024 by :Springer at JECRC Jaipur / 1-8 / 2024 Aishwarya Mishra, Lavika Goel , "Computational Intelligence in Smart Farming: Vision and Trials" , World Congress on Smart Computing WCSC 2024, Springer Publications, Algorithms for Intelligent Systems by :Springer at Babu Banarasi Das University, Lucknow / 1-8 / 2024 Siddhi Kumari Sharma, Lavika Goel , Namita Mittal, "A New Nature-Inspired Technique Based on Earthquake Dynamics" , 5th International Conference on Data Science and Applications ICDSA 2024, Lecture Notes in Networks and Systems, Springer by :Springer at Malaviya National Institute of Technology Jaipur, / 1-8 / 2024 Lavika Goel, "2-D Global Routing Using Hybrid Biogeography-Based Optimization and Maze Routing Algorithm" , International Conference on Business Intelligence and Information Technology, BIIT 2024, Springer Publications by :Springer at Harbin, China / 1-10 / 2024 Vijay Kumari, Miloni Mittal, Yashvardhan Sharma, Lavika Goel, "FAQ-Based Question Answering Systems With Query-Question and Query-Answer Similarity" , 16th International Conference on Agents and Artificial Intelligence ICAART 2024 by :SCITEPRESS at Rome, Italy / 1189-1196 / 2024 Siddhi Kumari Sharma, Lavika Goel , Namita Mittal, "Hybridizing Earthquake Dynamics-Based Optimization With Multiple Adaptative Differential Evolution: Towards a Faster Convergence Metaheuristic" , Ninth International Conference on Data Mining and Big Data DMBD 2024 by :Springer at Ho Chi Minh City, Vietnam / 1-12 / 2024 Niladri Chakraborti, Deepak Ranjan Nayak, "MCT-Net: MCT-NET: A Lightweight Multiscale Convolutional Transformer Network for Polyp Segmentation" , 31st IEEE International Conference on Image Processing ICIP 2024 by :IEEE at Abu Dhabi / / 2024 Babita, Kadali S. Akash, Deepak Ranjan Nayak, M. Tanveer, "CaDT-Net: A Cascaded Deformable Transformer Network for Multiclass Breast Cancer Histopathological Image Classification" , 31st International Conference on Neural Information Processing ICONIP2024 by :Springer at Auckland / / 2024 Babita, Deepak Ranjan Nayak, "LiCT-Net: Lightweight Convolutional Transformer Network for Multiclass Breast Cancer Classification" , IEEE TENCON 2024 - Artificial Intelligence and Deep Learning Technologies for a Sustainable Future by :IEEE at Singapore / / 2024 2023 Parvati Bhurani, Satyendra Singh Chouhan, Namita Mittal, "Study of Class Incremental Learning Strategies for Intrusion Detection System" , 10th International Conference on Frontiers in Intelligent Computing: Theory and Applications by :Springer at India / / 2023 Pawan Lahoti, Namita Mittal, Girdhari Singh, "An Ensemble BERT Model for English-Hindi-Marathi Multilingual Question Answering" , 3rd International Conference on Emerging Trends and Technologies on Intelligent Systems ETTIS-2023 by :Springer at Noida / 1-15 / 2023 ISBN: 978-981-99-3963-3 Virendra Kumar Meghwal, Namita Mittal, Girdhari Singh, "A Multiheaded Attention Based Model for Generating Hindi Captions" , 3rd International Conference on Emerging Trends and Technologies on Intelligent Systems ETTIS-2023 by :Springer at Noida / / 2023 ISBN: 978-981-99-3963-3 Lavika Goel, Siddhi Kumari Sharma, Namita Mittal, Atulya Raj, Sachi Pandey , "Integrating Hybrid Feature Extraction Techniques With Support Vector Machine for Efficient Facial Emotion Recognition" , 7th International Conference on Smart Trends in Computing and Communications by :Springer at Jaipur / 111-129 / 2023 ISBN: 978-981-99-0838-7 Pawan Lahoti, Namita Mittal, Girdhari Singh, "OptBertDCNN: A Framework Based on BERT and Optimized Deep Convolutional Neural Network for MQA" , 2023 Fifteenth International Conference on Contemporary Computing IC3 2023 by :ACM at Noida / 1-8 / 2023 Riti Kushwaha, Gaurav Singal, Neeta Nain, "A Transfer Learning Based Approach for Human Foot Image Classification" , Fourth International Conference on Computing and Communication Systems by :IEEE at Nehu, Shillong / 1-6 / 2023 Praveen Kumar Chandaliya, Kiran Raja, Snehal Gharat, Neeta Nain, Raghavendra Ramachandra, Christoph Busch, "MuSTAT: Face Ageing Using Multi-Scale Target Age Style Transfer" , The Eighth International Conference on Computer Vision and Image Processing by :Springer Nature Switzerland at IIT Jammu / 186-199 / 2023 Ravindra Kumar Soni and Neeta Nain, "Lightweight Low-Resolution Open-Set Face Recognition in Surveillance Applications" , The 17th International Conference on

Signal Image Technology & Internet Based Systems by :IEEE at Bangkok, Thailand / 1-8 / 2023 Pravesh Bansal, Musthaq Ahmed, "An Expert System for Analyzing the Behavior of Students in the Higher Education - Awarded Best Paper" , International Conference on Emerging Computation Intelligence -ICECI 2023 by :ICECI 2023 at Aligarh Muslim University, Aligarh, India / 6 / 2023 Vijay Budania, Mushtaq Ahmed, "Deep Learning With Encoders for Intrusion Detection Systems - Awarded Best Paper" , International Conference on Emerging Computation Intelligence -ICECI 2023 by :ICECI 2023 at AMU Aligarh, UP India / 6 / 2023 Sanjay Teheriya, Mushtaq Ahmed, "New Fuzzy Logic Based Hybrid Overlay NFLHyO in P2P Live Streaming" , 5th International Conference on Communication and Computational Technologies -ICCCT 2023 by :Web of Science at Rajasthan Institute of Engg and Tech Jaipur India / 6 / 2023 Akash Yadav, Mushtaq Ahmed, Alina Khan, "An Efficient Hybrid MPI-OpenMP Based Parallel Approach for Longest Common Subsequence" , 27th Annual International Conference on Advanced Computing and Communications ADCOM 2022 by :IET at IIITB, Bangalore India / 6 / 2023 Mushtaq Ahmed, Madhav Khatri, Faisal Ahmed, Jitendra Goyal, "An Optimized Fuzzy-Based Load Balancing in Cloud Computing" , International Conference on Recent Advances in Electrical Electronics and Digital Healthcare Technologies 2023 REEDCON2023 by :IEEE at Jamia Milia Islamia JMI, New Delhi India / 323-328 / 2023 ISBN: 978-1-6654-9382-6 Jitendra Goyal, Mushtaq Ahmed, Dinesh Gopalani, Daksh, Zeenat Bano, Aman Choudhary, "Cemetery Allocation Management System Using Ethereum Blockchain Accepted" , 4th International Conference on Data Science and Applications ICDSA 2023 by :Springer at MNIT Jaipur India / / 2023 Mushtaq Ahmed, "an Improved Delay Tolerant Routing Protocol for Opportunistic Network" , IEEE 2024 9th International Conference for Convergence in Technology-I2CT by :IEEE at Pune, Maharashtra / / 2023 Tarun Jain, Dinesh Gopalani, Yogesh Kumar Meena, "Classification of Events Tweets Using Machine Learning" , 2023 OITS International Conference on Information Technology by :IEEE at Raipur, Chatisgarh, INDI A / / 2023 Jitendra Goyal, Mushtaq Ahmed, Dinesh Gopalani, Daksh Zeenat Bano, Aman Choudhary, "Cemetery Allocation Management System Using Ethereum Blockchain" , International Conference on Data Science and Applications by :Springer at Jaipur, India / / 2023 Ankit Bajaj, Dinesh Gopalani, Rachit Mathur, Hemanjaneya Reddy, Swapna Satyanarayan, Ansuman Chand, "Unveiling the Root Cause of EV Charging Irregularities: A Statistical Approach" , International Conference on Green Energy, Computing and Intelligent Technology by :Springer Nature Singapore at Malaysia / / 2023 Akhil Pariyarath, Shubham Tomar, Meenakshi Tripathi, "Efficient Privacy-Preserving Authentication Using Blockchain for VANET" , 15th International Conference on COMmunication Systems & NETworkS-COMSNETS 2023 by :IEEE at Banglore / / 2023 Shashvat Sharma, Meenakshi Tripathi, Harish Kumar Sahu, Ashish Karan, "A Post-Quantum End-to-End Encryption Protocol" , 2023 IEEE International Conference on Advanced Networks and Telecommunications Systems IEEE-ANTS-2023 by :IEEE at Jaipur, India / / 2023 Lav Upadhyay, Meenakshi Tripathi, Jyoti Grover , "Feature Selection-Based Evaluation for Network Intrusion Detection System With Machine Learning Methods on CICIDS2017" , International Conference on Communication and Intelligent Systems by :Springer Nature

Singapore at Jaipur,India / / 2023 Rishank Goyal, Meenakshi Tripathi, Shubham Tomar, "GasOptiScan: Unveiling Gas-Inefficient Smart Contracts via Loop Fusible Pattern Detection for Enhanced Cost Efficiency" , International Conference on Emerging Trends in Networks and Computer Communications by :IEEE at Windhoek, Namibia / / 2023 Rajat Shri Shrimal, Jyoti Gajrani, Vinesh Kumar Jain, Meenakshi Tripathi, Dharm Singh Jat, "Detection of Ransomware Attacks Using Weight of Evidence Technique" , Nternational Conference on Emerging Trends in Networks and Computer Communications by :IEEE at Windhoek, Namibia / / 2023 Vikas Kumar Jain, Meenakshi Tripathi, "Multi-Objective Approach for Detecting Vulnerabilities in Ethereum Smart Contracts" , International Conference on Emerging Trends in Networks and Computer Communications by :IEEE at Windhoek, Namibia / / 2023 Meenakshi Tripathi, Shadab Khan, Sangharatna Godboley , "Comparison Between Performance of Constraint Solver for Prediction Model in Symbolic Execution" , International Conference on Artificial Intelligence of Things by :Springer Nature Switzerland at Chandigarh, India / / 2023 Akhil Pariyarath, Shubham Tomar, Meenakshi Tripathi, "Efficient Privacy-Preserving Authentication Using Blockchain for VANET" , 2023 15th International Conference on COMmunication Systems & NETworkS by :IEEE at Bangalore, India / / 2023 Kartik Singh, Meenakshi Tripathi, Basant Agarwal, Abhay Kumar Sain, "Ensemble of Transformer Based Approach for Hate Speech Detection on Twitter Data" , 10th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering by :IEEE at Gautam Buddha Nagar, India / / 2023 Deepti Sharma, Adarsh Kumar, Ramesh Babu Battula, "FedBeam: Federated Learning Based Privacy Preserved Localization for Mass-Beamforming in 5GB" , 37th International Conference on Information Networking, by :IEEE at Bankok, Thailand, Bangkok, Thailand / / 2023 Khyati Shrivastav, Ramesh Babu Battula, "WSN-IoT Integration With Artificial Intelligence: Research Opportunities and Challenges" , International Conference on Paradigms of Computing, Communication and Data Sciences by :Springer at Jaipur / / 2023 Anil Kumar Prajapati, Emmanuel Shubhakar Pilli, Ramesh Babu Battula, Abhishek Verma, "A Defense Solution to Secure Low-Power and Lossy Networks Against DAO Insider Attacks" , IEEE Region 10 Conference TENCON 2023 by :IEEE at Chiang Mai, Thailan / / 2023 A. K. Prajapati, E. S. Pilli, R. B. Battula, and A. Verma, "Defense Solution to Secure Low-Power and Lossy Networks Against DAO Insider Attacks" , 2023 IEEE Region 10 Conference - TENCON by :IEEE at Chiang Mai, Thailand / / 2023 M. Choudhary, S. S. Chouhan, E. S. Pilli, and N. Singh, "MSPIS: Multimodal Suspicious Profile Identification System in Online Social Network" , 10th International Conference on Pattern Recognition and Machine Intelligence - PReMI 2023 by :Springer at Kolkata, India / / 2023 A. Jain and E. S. Pilli, "SoK: Digital Signatures and Taproot Transactions in Bitcoin" , 19th International Conference on Information Systems Security - ICISS 2023 by :Springer at NIT Raipur / / 2023 A. Narwaria, A. P. Mazumdar, S. Sharma, "Energy Efficient Multi-Objective Task Allocation in Software-Defined Wireless Sensor Network" , IEEE International Conference for Convergence in Technology I2CT by :IEEE at Lonavla, India / / 2023 A. Narwaria, A. P. Mazumdar, "Overlapping FSS-Based Energy-Efficient Routing in Wireless Sensor Networks" , IEEE International Conference on Energy, Power and

Environment: Towards Flexible Green Energy Technologies ICEPE by :IEEE at Shillong, India / / 2023 Rohit Kumar Gupta, Arka Prokash Mazumdar, "Cost-Aware and Time-Varying Request Rate-Based Dynamic Cache Provisioning Over CCDN" , 2023 IEEE International Conference on Advanced Networks and Telecommunications Systems ANTS by :IEEE at Jaipur, India / 610-615 / 2023 Jitendra Parmar, Satyendra Singh Chouhan, "Open-World Machine Learning for Unknown Class Identification in Human-Machine Interaction Systems" , 10th International Conference on Frontiers in Intelligent Computing: Theory and Applications by :Springer at India / / 2023 Ritu Rai, Jyoti Grover, Soumya Pandey, "Unveiling Threats: A Comprehensive Taxonomy of Attacks in in-Vehicle Networks" , International Conference on Security of Information and Networks by :IEEE at Jaipur / 1-7 / 2023 Girish Sharma, Jyoti Grover, Abhishek Verma, "A Lightweight Security Solution for Mitigation of Hatchetman Attack in RPL-Based 6LoWPAN" , 2023 IEEE International Conference on Advanced Networks and Telecommunications Systems IEEE-ANTS-2023 by :IEEE at Jaipur / 750-755 / 2023 L Upadhyay, M Tripathi, J Grover, "Feature Selection-Based Evaluation for Network Intrusion Detection System With Machine Learning Methods on CICIDS2017" , International Conference on Communication and Intelligent Systems by :Springer at Jaipur / / 2023 Rahul Saxena and Mahipal Jadeja, "Analysing Shifts in Perceptions of Indians During COVID-19 Pandemic by Mining Tweets" , 3rd International Conference on Intelligent Communication and Computational Techniques by :IEEE at Jaipur, India / / 2023 ISBN: 978-1-6654-5357-8 Rahul Saxena, Mahipal Jadeja and Pranshu Vyas, "An Efficient Influence Maximization Technique Based on Betweenness Centrality Measure and Clustering Coefficient" , 15th International Conference on Computer and Automation Engineering by :IEEE at Sydney, Australia / / 2023 Atul Kumar Verma and Mahipal Jadeja, "An Efficient Centrality-Based GNN for Community Detection in Dynamic Networks" , 4th International Conference on SMART SYSTEMS: INNOVATIONS in COMPUTING by :Springer at Manipal University, Jaipur / / 2023 Karishma Yadav, Smita Naval, "CFG Analysis for Detecting Vulnerabilities in Smart Contracts" , International Conference on Smart Trends for Information Technology and Computer Communications by :Springer Nature Singapore at Jaipur, India / 753-763 / 2023 ISBN: 978-981-99-0838-7 Lavika Goel, Siddhi Kumari Sharma, Namita Mittal , Atulya Raj, and Sachi Pandey, "Integrating Hybrid Feature Extraction Techniques With Support Vector Machine for Efficient Facial Emotion Recognition" , 7th International Conference on Smart Trends in Computing and Communications SmartCom 2023, Lecture Notes in Networks and Systems, Springer by :Springer at Jaipur / 111-129 / 2023 Vijay Kumari, Abhishek Ashwanikumar Sharma, Yashvardhan Sharma, Lavika Goel, "Scalability and Sustainability in Chatbot and Mobile Application Development" , 2023 13th International Conference on Cloud Computing, Data Science & Engineering Confluence by :IEEE at Delhi / 397 - 403 / 2023 Vijay Kumari, Abhimanyu Sethi, Yashvardhan Sharma, Lavika Goel , "Visual Question Answering Analysis Datasets,Methods and Image Featurization Techniques" , 12th International Conference on Pattern Recognition Applications and Methods ICPRAM 2023, Science and Technology Publications by :Springer at Lisbon, Portugal / 281-288 / 2023 Aishwarya Mishra, Lavika Goel, "A Natural Way to Stability: A New Evolutionary

Algorithm Based on Ocean Water Currents" , 3rd International Conference on Intelligent Vision and Computing ICIVC 2023, Springer Publications by :Springer at NIT Agartala / 1-6 / 2023 Vivek Sharma, Ashish Kumar Tripathi, Himanshu Mittal, "CLDA-Net: A Novel Citrus Leaf Disease Attention Network for Early Identification of Leaf Diseases" , 15th International Conference on Computer and Automation Engineering by :IEEE at Sydney, Australia / 178-182 / 2023 Dipankar Das, Deepak Ranjan Nayak, "GS-Net: Global Self-Attention Guided CNN for Multi-Stage Glaucoma Classification" , 30th IEEE International Conference on Image Processing ICIP 2023 by :IEEE at Kuala Lumpur, Malaysia / / 2023 2022 Megha Sharma, Namita Mittal, Anukram Mishra, Arun Gupta, "Analytical Machine Learning for Medium-Term Load Forecasting Towards Agricultural Sector" , Second Doctoral Symposium on Computational Intelligence by :Springer at Institute of Engineering and Technology Lucknow / 581-592 / 2022 Virendra Kumar Meghwal, Namita Mittal, Girdhari Singh , "Attending Local and Global Features for Image Caption Generation" , International Conference on Computer Vision and Image Processing(CVIP) by :Springer at VNIT Nagpur / / 2022 ISBN: 978-3-031-31407-0 Parvati Bhurani, Satyendra Singh Chouhan, Namita Mittal , "Study of Class Incremental Learning Strategies for Intrusion Detection System" , 10th International Conference on Frontiers in Intelligent Computing: Theory and Applications by :Springer at Mizoram / 281-291 / 2022 ISBN: 978-981-19-7524-0 Megha Sharma, Namita Mittal, Anukram Mishra, Arun Gupta, "Sector-Wise Expert Input Selection for Electricity Load Forecasting" , 2022 IEEE 7th International Conference on Recent Advances and Innovations in Engineering by :IEEE at Surathkal / 87-92 / 2022 ISBN: 978-1-6654-8910-2 Ravindra Kumar Soni and Neeta Nain, "Improving Identification Accuracy on Unconstrained Low-Resolution Tiny Faces via Absolute Cosine Similarity" , 26th IAPR International Conference on Pattern Recognition 2022 by :IEEE at Montr■al Qu■bec / 1 - 4 / 2022 Ravindra Kumar Soni and Neeta Nain, "Synthetic Data Approach for Unconstrained Low-Resolution Face Recognition in Surveillance Applications" , ICVGIP 22: Thirteenth Indian Conference on Computer Vision, Graphics and Image Processing by :ACM at IIT Gandhi Nagar / 1-6 / 2022 Praveen Kumar Chandaliya and Neeta Nain, "Longitudinal Analysis of Mask and No-Mask on Child Face Recognition Authors" , ICVGIP 22: Thirteenth Indian Conference on Computer Vision, Graphics and Image Processing by :ACM at IIT Gandhinagar / 1-7 / 2022 Jitendra Goyal, Deeksha Ratnawat, Mushtaq Ahmed, Dinesh Gopalani , "Simulation and Synthesis of SHA-256 Using Verilog HDL for Blockchain Applications" , Advances in Data-Driven Computing and Intelligent Systems ADCIS 2022 by :Springer Nature Singapore at Goa, India / 463--477 / 2022 ISBN: 978-981-99-0980-3 Mayank Kumar Jain, Ritika Garg, Dinesh Gopalani, Yogesh Kumar Meena, "Review on Analysis of Classifiers for Fake News Detection" , International Conference on Emerging Technologies in Computer Engineering by :Springer at Jaipur, India / 395■407 / 2022 ISBN: 978-3-031-07012-9 Sainyali Trivedi, Mayank Kumar Jain, Dinesh Gopalani, Yogesh Kumar Meena, Yogendra Gupta, "Fake News Detection: A Study" , Proceedings of the International Conference on Intelligent Computing, Communication and Information Security by :Springer at Jaipur / 395-408 / 2022 Rukhsar Sultana, Jyoti Grover and Meenakshi Tripathi, "A Data-Centric and Dynamic-Range Based Misbehavior Detection Approach for

VANET" , TENCON 2022 by :IEEE at Hong Kong / 1-6 / 2022 KawalDeep Kaur, Shubham Tomar, Meenakshi Tripathi, "Gas Fee Reduction by Detecting Loop Fusible Patterns in Ethereum Smart Contract" , IEEE International Conference on Advanced Networks and Telecommunications Systems -ANTS by :IEEE at IIT Gandhinagar / / 2022 Sunil Kumar, Jyoti Gajrani, Meenakshi Tripathi, "Fuzzing REST APIs for Bugs: An Empirical Analysis" , International Conference on Frontiers of Intelligent Computing: Theory and Applications FICTA 2022 by :Springer at NIT Mizoram / / 2022 Geetu Dhawan, Arka Prokash Mazumdar, Yogesh Kumar Meena, "EAC: Energy-Aware Caching Scheme for Internet of Things Using ICN" , 2022 IEEE International Conference on Connected Systems & Intelligence (CSI) by :IEEE at Trivandrum, India / 1-7 / 2022 ISBN: 978-1-6654-5816-0 Saurabh Ranjan Srivastava, Yogesh Kumar Meena, Girdhari Singh, "Association Rule Chains ARC a Novel Data Mining Technique for Profiling and Analysis of Terrorist Attacks" , International Conference on Emerging Technologies in Computer Engineering by :Springer at Jaipur, India / 466-478 / 2022 ISBN: 978-3-031-07012-9 Manisha Samanta, Yogesh Kumar Meena, Arka Prokash Mazumdar, "Efficacy of Online Event Detection With Contextual and Structural Biases" , International Conference on Emerging Technologies in Computer Engineering by :Springer at Jaipur, India / 419-430 / 2022 ISBN: 978-3-031-07012-9 Deepti Sharma, Kuldeep M Biradar, Santosh K Vipparthi, Ramesh B Battula, "HYPE: CNN Based HYbrid PrEcoding Framework for 5G and Beyond" , International Conference on Advanced Information Networking and Applications (AINA 2022) by :IEEE at University of Technology Sydney (UTS), Sydney, AUS / / 2022 Arunima Sharma, Dhwani Agrawal, Nandini Roy, Sunita Bhichar Ramesh Babu Battula , "POTENT - Decentralized Platoon Management With Heapify for Future Vehicular Networks" , 36th International Conference on Advanced Information Networking and Applications (AINA-2022) by :IEEE at University of Technology Sydney (UTS), Sydney, AUS / / 2022 V. Agarwal, P. Mishra, S. Kumar, E. S. Pilli, "A Review on Attack and Security Tools at Network Layer of IoT" , Optical and Wireless Technologies by :Springer at Jaipur, India / 497-506 / 2022 L. Sadineni, E. S. Pilli and R. B. Battula , "ProvNet-IoT: Provenance Based Network Layer Forensics in Internet of Things" , Digital Forensic Research Workshop Asia Pacific (DFRWS APAC) by :Elsevier at Adelaide, Australia / 1-8 / 2022 S. C. Kumain, M. Singh, M. C. Govil, and E. S. Pilli, "An Efficient Salt and Pepper Noise Reduction Approach for Video(s) Using Optimized Filter Approach" , 2022 Second International Conference on Emerging Frontiers in Electrical and Electronic Technologies (ICEFEET) by :IEEE at Patna, India / / 2022 Gauransh Kalla,Arka Prokash Mazumdar,Dinesh Kumar Tyagi,Abhishek Narwaria, "Distance-Aware Hierarchical Data-Collecting Path Selection for Mobile Sink in Sparse WSNs" , IEEE World Forum on Internet of Things(WF-IOT) by :IEEE at Yokohama, Japan / / 2022 A. Satrawala, A. P. Mazumdar, S. K. Vipparthi, "Distributed Adaptive Recommendation & Time Stamp Based Estimation of Driver-Behaviour" , 2022 IEEE Region 10 Symposium (TENSYMP) by :IEEE at Mumbai, India / 1-6 / 2022 G. Dhawan, A. P. Mazumdar, Y. K. Meena, "CNCP: A Candidate Node Selection for Cache Placement in ICN-IoT" , 6th IEEE Conference on Information and Communication Technology, CICT by :IEEE at Gwalior, India / / 2022 Sachin Dube, Kuldeep Biradar, Santosh Kumar Vipparthi, Dinesh Kumar Tyagi, "MAG-Net: A Memory Augmented Generative Framework for Video Anomaly Detection Using Extrapolation" , International Conference on Computer Vision and Image Processing(CVIP) by :Springer at IIT Ropar, Punjab, INDIA / 426-437 / 2022 ISBN: 978-3-031-11349- Prafulla Saxena, Kuldeep Biradar, Dinesh Kumar Tyagi, Santosh Kumar Vipparthi, "RIChEx: A ROBUST INTER-FRAME CHANGE EXPOSURE for SEGMENTING MOVING OBJECTS" , 29th IEEE International Conference on Image Processing (ICIP 2022) by :IEEE at Bordeaux, France / / 2022 Richa Kumari,Dinesh Kumar Tyagi, "Self-Organised Mobility Aware Device Discovery for Ultra-Dense D2D Communication Network" , EEE International Conference on Advanced Networks and Telecommunications Systems ANTS- 2022 by :IEEE at Gandhinagar, Gujarat, India / / 2022 Aditi Seetha, Satyendra Singh Chouhan, Sanskar Soni, Dev Milan Mehta, Vinush Vishwanath, "Disruptive Event Identification in Online Social Network" , 26th International Symposium on Methodologies for Intelligent Systems (ISMIS 2022) by :Springer at Italy / 24-34 / 2022 Anita Shrotriya, Akhilesh Kumar Sharma, Jyoti Grover, "Performance Evaluation of Image-Based Diseased Leaf Identification Model Using CNN and GA" , International Conference on Artificial Intelligence and Sustainable Engineering by :Springer at NIT Goa / 167--177 / 2022 ISBN: 978-981-16-8542-2 Girish Sharma, Jyoti Grover, Abhishek Verma, Rajat Kumar, Rahul Lahre, "Analysis of Hatchetman Attack in RPL Based IoT Networks" , International Conference on Emerging Technologies in Computer Engineering by :Springer at Jaipur / 666-678 / 2022 ISBN: 978-3-031-07012-9 Rajat Kumar, Jyoti Grover, Girish Sharma and Abhishek Verma , "Addressing DIO Suppression Attack in RPL Based IoT Networks" , International Conference on Information Security, Privacy and Digital Forensics by :Springer at National Forensic Sciences University Goa / 91-105 / 2022 Praveen Singh Thakur, Mahipal Jadeja, Satyendra Singh Chouhan, "Text Augmentation Based Imbalance Learning for Unstructured Text Data" , 4th International Conference on Cybernetics, Cognition and Machine Learning Applications-ICCCMLA by :IEEE at Goa / 73-77 / 2022 ISBN: 978-1-6654-6246-4 Vijay Kumari, Srishti Keshari, Yashvardhan Sharma, Lavika Goel , "Context-Based Question Answering System With Suggested Questions" , 2022 12th International Conference on Cloud Computing, Data Science & Engineering (Confluence), IEEE Publications. by :IEEE at New Delhi, India / 368-37 / 2022 L. Goel and A. Mishra, "A Survey of Recent Deep Learning Algorithms Used in Smart Farming, Doi: 10.1109/TENSYMP54529.2022.9864477, 2022." , 2022 IEEE Region 10 Symposium (TENSYMP) by :IEEE at IIT Bombay / 1-6 / 2022 Lavika Goel, Jyoti Nagpal, "A Hybrid Convolutional Neural Network - Random Forest Model for Plant Disease Diagnosis" , World Conference on Information Systems for Business Management , 2022 by :Springer at Bangkok, Thailand / / 2022 ISBN: 2190-3018 Aishwarya Mishra, Lavika Goel, "Geo Science-Based Optimization Algorithms: A New Paradigm" , 4th International Conference on Communication and Intelligent Systems 2022 by :Springer at NIT Delhi, 19-20th December, 2022. / 1-6 / 2022 Vijay Kumari, Yashvardhan Sharma, Lavika Goel, "A Comparative Analysis of Transformer-Based Models for Document Visual Question Answering" , International Conference on Computational Intelligence and Data Engineering. ICCIDE 2022 by :Springer at VIT-AP University / 1-8 / 2022 Vivek Sharma, Ashish Kumar Tripathi, Himanshu Mittal, "Technological Advancements in Automated Crop Pest and Disease Detection: A Review & Ongoing Research" , International Conference on Computing, Communication, Security and Intelligent Systems (IC3SIS) by :IEEE at Ernakulam, India / / 2022 Sachine Gupta, Ashish Kumar Tripathi, Sachin Agrawal, "FruVeg-Net: A Novel Method for Early Disease Diagnosis in Multi-Fruits and Vegetables" , International Conference on Computing, Communication, Security and Intelligent Systems by :Springer at Ernakulam, India / / 2022 Himanshu K. Gajera, Deepak Ranjan Nayak, Mukesh A. Zaveri, "Fusion of Local and Global Feature Representation With Sparse Autoencoder for Improved Melanoma Classification" , 44th International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) by :IEEE at Glasgow, Scotland, UK / 00-00 / 2022 Amogh M Joshi, Deepak Ranjan Nayak, "GDenseMNet: Global Dense Multiscale Feature Learning Network for Efficient COVID-19 Detection in CT Images" , 2022 International Joint Conference on Neural Networks (IJCNN) by :IEEE at Padua, Italy / / 2022 Tapas K. Dutta, Deepak Ranjan Nayak, "CDANet: Channel Split Dual Attention Based CNN for Brain Tumor Classification in MR Images" , 29th IEEE International Conference on Image Processing (ICIP 2022) by :IEEE at Bordeaux, France / / 2022 S. Majhi, D. R. Nayak, R, Dash, P. K. Sa, "Multi-Level 3DCNN With Min-Max Ranking Loss for Weakly-Supervised Video Anomaly Detection" , 29th International Conference on Neural Information Processing (ICONIP 2022) by :Springer at Delhi, India / / 2022 Himanshu K. Gajera, Mukesh A. Zaveri, Deepak Ranjan Nayak, "Towards Exploring Deep Features for Efficient Melanoma Diagnosis in Dermoscopic Images" , 20th OITS International Conference on Information Technology 2022 (OCIT 2022) by :IEEE at Bhubaneswar / / 2022 Kundan Kumar Jha, Prabhkirat Singh, Navin Bharti, Ditipriya Sinha, Vikash Kumar, "GAN-Based Data Generation Technique and Its Evaluation for Intrusion Detection Systems" , Machine Vision and Augmented Intelligence by :Springer Singapore at NIT Jamshedpur / / 2022 2021 Shikha Mundra, Namita Mittal, "Evaluation of Text Representation Method to Detect Cyber Aggression in Hindi English Code Mixed Social Media Text" , Thirteenth International Conference on Contemporary Computing IC3-2021 by :ACM at Noida / 402-409 / 2021 ISBN: 978-1-4503-8920-4 Sakshi Parashar, Namita Mittal, "Legal Case Retrieval Using SVM Classifier" , 9th International Conference on Pattern Recognition and Machine Intelligence December 15 - 18, 2021, Kolkata, India by :Springer at ISI Kolkata / 1-12 / 2021 Shikha Mundra, Nikhil Singh, Namita Mittal, "Fine-Tune BERT to Classify Hate Speech in Hindi English CodeMixed Text" , FIRE 21: Proceedings of the 13th Annual Meeting of the Forum for Information Retrieval Evaluation by :ACM at Virtual Conference / / 2021 Praveen Kumar Chandalia, Neeta Nain, "Child Face Age Progression and Regression Using Self-Attention Multi-Scale Patch GAN" , IEEE IJCB/CVF 2021 by :IEEE at Shenzhen, China / 1-8 / 2021 Gopal Behra, Neeta Nain, "Trade-Off Between Memory Based and Model Based Collaborative Filtering Recommender System" , International Conference on Paradigms of Communication, Computing and Data Sciences (PCCDS 2021) by :IEEE at Kurukshetra / / 2021 Gopal Behera and Neeta, "Collaborative Recommender System (CRS) Using Optimized SGD - ALS" , 5 Th International Conference on Advances in Computing and Data Sciences (ICACDS)-2021 by :Springer at Baburao Ganpatrao Thakare College of

Engineering, / / 2021 Saurabh Sagar, Mushtaq Ahmed, Mohammed Yaseen Husain, "Fuzzy Randomized Load Balancing for Cloud Computing" , International Conference on P2P, Parallel, Grid, Cloud and Internet Computing by :Springer at Fukuoka Institute of Technology, Fukuoka, Japan / 6 / 2021 Jitendra Goyal, Mushtaq Ahmed, Dinesh Gopalani, "Empirical Study of Standard Elliptic Curve Domain Parameters for IoT Devices" , 2021 International Conference on Electrical, Communication, and Computer Engineering (ICECCE) by :IEEE at India / 1-6 / 2021 ISBN: 978-1-6654-3897-1 Vimal Kumar Soni, Dinesh Gopalani, M.C. Govil, "A Dataset to Evaluate Hindi Word Embeddings" , 4th International Conference on Emerging Technologies in Computer Engineering: Data Science & Blockchain Technology (ICETCE 2021) by :IOP Publishing at Jaipur / / 2021 Avuthu Avinash Reddy, Ramesh Babu Battula, Dinesh Gopalani, Arunima Sharma, "Location Based Detection Mechanism for PUEA on CR Enabled 5G-IoT Network" , IEEE International Conference on Advanced Networks and Telecommunications Systems by :IEEE at Hyderabad / 331-336 / 2021 Shweta Patidar, Meenakshi Tripathi, Subham Kumar, "Leveraging LSTM-RNN Combined With SVM for Network Intrusion Detection" , International Conference on Data Science, Machine Learning and Artificial Intelligence by :ACM at Namibia / / 2021 Shalin Kumar Deval, Meenakshi Tripathi, Bruhadeshwar Bezawada, Indrakshi Ray, "X-Phish: Days of Future Past"‡: Adaptive & Privacy Preserving Phishing Detection" , Conference on Communications and Network Security by :IEEE at Online / / 2021 Subham Kumar Gupta, Meenakshi Tripathi, Jyoti Grover, "Towards an Effective Intrusion Detection System Using Machine Learning Techniques: Comprehensive Analysis and Review" , 9th International Conference on Reliability, Infocom Technologies and Optimization Trends and Future Directions- ICRITO by :IEEE at Amity University, Noida / / 2021 Rashika Joshi, Meenakshi Tripathi, Amit Kumar, Manoj Singh Gaur, "Comparative Study of Object Recognition Algorithms for Effective Electronic Travel Aids" , International Conference on Deep Learning, Artificial Intelligence and Robotics by :Springer at MNIT Jaipur / / 2021 Yogesh Meena, Mahipal Singh Sankhla, Swaroop S Sonone, Aastha Parashar, Kapil Parihar, Kavita Saini, "Cyber Exploitation Through Cybercrimes & Challenges" , 3rd International Conference on Advances in Computing, Communication Control and Networking ICAC3N by :IEEE at Reater Noida, India / 1467-1472 / 2021 ISBN: 978-1-6654-3812-4 Avinash Reddy Avuthu, Arunima Sharma, Dinesh Gopalani, Ramesh Babu Battula, "Location Based Detection Mechanism for PUEA on CR Enabled 5G-IoT Network" , Location Based Detection Mechanism for PUEA on CR Enabled 5G-IoT Network by :IEEE at Hyderabad / / 2021 Lakshminarayana Sadineni, Emmanuel S. Pilli, Ramesh Babu Battula, "Ready-IoT: A Novel Forensic Readiness Model for Internet of Things" , IEEE 7th World Forum on Internet of Things (WF-IoT) by :IEEE at New Orleans, LA, USA / / 2021 P. Mishra, S. Kumar, U. Garg, E. S. Pilli, and R. C. Joshi, "Security Perspectives of Various IoT Cloud Platforms: A Review & Case Study" , 2021 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS) by :IEEE at Greater Noida, India / 727-731 / 2021 ISBN: 978-1-7281-8529-3 L. Sadineni, E. S. Pilli and R. B. Battula, "Ready-IoT: A Novel Forensic Readiness Model for Internet of Things" , IEEE 7th World Forum on Internet of Things (WF-IoT) by :IEEE at New Orleans, Louisiana, USA / 89-94 / 2021 M. Choudhary, S. S. Chouhan, andE. S. Pilli, "CbPIS: Cyberbullying Profile Identification System With Users in Loop" , Thirteenth International Conference on Contemporary Computing (IC3-2021) by :ACM at Noida, India / 203-208 / 2021 ISBN: 978-1-4503-8920-4 G. Sharma, A. M. Joshi, E. S. Pilli, "An Automated MDD Detection System Based on Machine Learning Methods in Smart Connected Healthcare" , 2021 IEEE International Symposium on Smart Electronic Systems (iSES)(Formerly iNiS) by :IEEE at Jaipur, India / 27-32 / 2021 Vinesh Kumar Jain, Arka Prokash Mazumdar and Mahesh Chandra Govil, "CoAP Congestion Control: A Dynamic Send Rate Based Approach" , IEEE 4th International Conference on Computing, Power and Communication Technologies (GUCON), 2021 by :IEEE at Malaysia / 1-6 / 2021 Abhishek Narwaria, Arka Prokash Mazumdar and Gauransh Kalla, "C3HAC: A Controller Placement Approach for SDWSN" , IEEE Region 10 Conference (TENCON), 2021 by :IEEE at New Zealand / 935-940 / 2021 Monika Choudhary, Satyendra Singh Chouhan, Emmanuel S Pilli, "CbPIS: Cyberbullying Profile Identification System With Users in Loop" , Thirteenth International Conference on Contemporary Computing (IC3-2021) by :IEEE at India / 203-208 / 2021 Satyendra Singh Chouhan, Santosh Singh Rathore, Ritesh Choudhary, "A Study of Aging-Related Bugs Prediction in Software System" , International Conference on Paradigms of Computing, Communication and Data Sciences (PCCDS,2020) by :Springer at NIT Kurukshetra / 49–61 / 2021 Subham Kumar Gupta, Meenakshi Tripathi, Jyoti Grover, "Towards an Effective Intrusion Detection System Using Machine Learning Techniques: Comprehensive Analysis and Review" , 2021 9th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions)(ICRITO) by :IEEE at Noida, India / 1-6 / 2021 Shanmukha Sai Sumanth Yenneti, Riti Kushwaha, Smita Naval, Gaurav Singal, "Leading Athlete Following UAV Using Transfer Learning Approach" , International Advanced Computing Conference by :Springer at Panji, India / 424-433 / 2021 ISBN: 978-981-16-0401-0 Lavika Goel, "Travelling Salesman Problem Solution Using Plate Tectonics Based Neighborhood Search Optimization" , 6th International Conference on Sustainable Development (ICT4SD 2021) , Lecture Notes in Networks and Systems, Springer Publications by :Springer at Goa, India / 597-606 / 2021 Lavika Goel, "Path Extraction and Planning for Intelligent Battlefield Preparation Using Particle Swarm Optimization" , International Conference on Intelligent Cyber-Physical Systems (ICPS-2021), Springer Publications by :Springer at IIIT Kota, India / / 2021 Abhishek Agarwal, Vijay Kumari, Yashvardhan Sharma, Lavika Goel, "Ranking Based Question Answering System With a Web and Mobile Application" , Confluence 2021, 11th International Conference on Cloud Computing, Data Science & Engineering by :IEEE at Amity University, Uttar Pradesh, India / 52-58 / 2021 ISBN: 978-0-7381-3160-3 Vijay Kumari, Ayush Jain, Yashvardhan Sharma, Lavika Goel, "Conversational Question Answering System Using RASA Framework" , Global Conference on Artificial Intelligence & Applications (GCAIA-2021) (Accepted). by :CRC Press, Taylor and Francis at Jaipur, India / / 2021 Vijay Kumari, Chinmay Gosavi, Yashvardhan Sharma and Lavika Goel, "Domain-Specific Chatbot Development Using the Deep Learning and AI-Powered RASA Framework" , 3rd International Conference on Communication and Intelligent Systems , ICCIS 2021, Lecture Notes in Networks and Systems, Springer Publications by :Springer at Delhi / -- / 2021 ISBN: -- Himanshu K. Gajera, Mukesh A. Zaveri, Deepak Ranjan Nayak, "Improving the Performance of Melanoma Detection in Dermoscopy Images Using Deep CNN Features" , 19th International Conference on Artificial Intelligence in Medicine (AIME 2021) by :Springer at Porto, Portugal / / 2021 S. Majhi, D. R. Nayak, "Feature Modulating Two-Stream Deep Convolutional Neural Network for Glaucoma Detection in Fundus Images" , 6th IAPR International Conference on Computer Vision & Image Processing (CVIP2021), 2021 by :Springer at IIT Ropar, India / / 2021 Vikash Kumar, Sidra Kalam, Ayan Kumar Das, Ditipriya Sinha, "Attack Detection Scheme Using Deep Learning Approach for IoT" , Advanced Computing and Systems for Security: Volume 14 by :Springer, Singapore at University of Culcutta / / 2021 Sudhir Kumar Pandey, Vikash Kumar, Ditipriya Sinha, Ayan Kumar Das, "GAN-Based Data Generation Approach for IDS: Evaluation on Decision Tree" , Advanced Computing and Systems for Security: Volume 14 by :SPAST at University of Calcutta / / 2021 2020 Monu Verma, Santosh Kumar Vipparthi and Girdhari Singh, "Non-Linearities Improve OrigiNet Based on Active Imaging for Micro Expression Recognition" , The International Joint Conference on Neural Networks (IJCNN- 2020) (Core A) by :IEEE at Glasgow (UK) / / 2020 Virendra Kumar Meghwal, Namita Mittal, Girdhari Singh, "Image Captioning Methodologies Using Deep Learning: A Review" , International Conference on Electronic Systems and Intelligent Computing (ESIC) by :Springer at Arunachal Pradesh, India / / 2020 Saurabh Ranjan Srivastava, Yogesh Kumar Meena, and Girdhari Singh, "Itemset Mining Based Episode Profiling of Terrorist Attacks Using Weighted Ontology" , 5th International Conference on Advanced Machine Learning Technologies and Applications (AMLTA) by :Springer at Jaipur, India / 337-348 / 2020 Monu Verma, Prafulla Saxena, SK Vipparthi, Girdhari Singh, SK Nagar, "DEFINET: PORTABLE CNN NETWORK for FACIAL EXPRESSION RECOGNITION" , Fourth International Conference on Information and Communication Technology for Competitive Strategies (ICTCS-2019). by :CRC Press Taylor and Francis Group at Udaipur, India / 217-226 / 2020 Virendra Kumar Meghwal, Namita Mittal, Girdhari Singh, "Image Captioning Methodologies Using Deep Learning: A Review" , Electronics Systems and Intelligent Computing by :Springer Singapore at Arunachal Pradesh / 507-512 / 2020 Riti Kushwaha and Neeta Nain, "Person Identification Using Footprint Minutiae" , The Third International Conference on Computer Vision and Image Processing, CVIP2019 by :Advances in Intelligent Systems and Computing, Springer at IIIT Jabalpur / 285-299 / 2020 ISBN: 1024 Praveen Kumar Chandaliya, Aditya Sinha, Neeta Nain, "ChildFace: Gender Aware Child Face Aging" , BIOSIG 2020 by :IEEE at Darmstadt, Germany / / 2020 Anjali Saini, Mushtaq Ahmed, Kartikey Sharma, "Detection of Suspicious Activity in ATM Booth" , International Conference on Intelligent Computing Techniques for Smart Energy Systems by :Springer Singapore at Jaipur / 911-925 / 2020 Akash Yadav,Mushtaq Ahmed and Daitule Omkar Vilas, "Exploiting Processor Variability for Efficient Application Mapping" , International Conference on Intelligent Computing and Networking by :Springer Singapore at Mumbai / 1-9 / 2020 Ganpat Singh Chauhan, Yogesh Kumar Meena, Dinesh Gopalani, Ravi Nahta, "An Unsupervised Multiple Word-Embedding Method With Attention Model for Cross Domain Aspect Term Extraction" , 3rd International

Conference on Emerging Technologies in Computer Engineering: Machine Learning and Internet of Things (ICETCE) by :IEEE at Jaipur / 110-116 / 2020 Mayank Kumar Jain, Dinesh Gopalani, Yogesh Kumar Meena, Rajesh Kumar, "Machine Learning Based Fake News Detection Using Linguistic Features and Word Vector Features" , IEEE 7th Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON) by :IEEE at MNNIT Allahabad / / 2020 Rashika Joshi, Meenakshi Tripathi, Amit Kumar, Manoj Singh Gaur, "Object Recognition and Classification System for Visually Impaired" , International Conference on Communication and Signal Processing (ICCSP) by :IEEE at Chennai, India / / 2020 ISBN: 978-1-7281-4989-9 Rukhsar Sultana, Jyoti Grover, Meenakshi Tripathi, "A Novel Framework for Misbehavior Detection in SDN-Based VANET" , 2020 IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS) by :IEEE at New Delhi, India / 1-6 / 2020 ISBN: 978-1-7281-9290-1 Mayank Kumar Jain, Dinesh Gopalani, Yogesh Kumar Meena, Rajesh Kumar, "Machine Learning Based Fake News Detection Using Linguistic Features and Word Vector Features" , 7th IEEE UP Section International Conference on Electrical, Electronics and Computer Engineering (UPCON-2020) by :IEEE at Prayagraj, India / 1-6 / 2020 ISBN: 978-1-6654-4747-8 Ganpat Singh Chauhan, Yogesh Kumar Meena, Dinesh Gopalani, Ravi Nahta, "Aspect-Level Sentiment Extraction Using Public Reviews for Government Schemes" , International Conference on Advances in Systems, Control and Computing (AISCC-2020) by :Springer at Jaipur, India / / 2020 Arunima Sharma, Ramesh Babu Battula, "FOOTREST: Safety on Roads Through Intelligent Transportation System" , The 34th International Conference on Information Networking (ICOIN 2020) by :IEEE at Barcelona, Spain / 818-820 / 2020 Chaitanya Kurra, Vijay Janyani, Ramesh Babu Battula, "FANIC: FArthest Node Initialization Clustering Technique for Controller Placement Problem in Software Defined Networking" , International Conference on Artificial Intelligence and Signal Processing (AISP 20) by :IEEE at Amaravathi, AP, India / / 2020 Arunima Sharma, Ramesh Babu Battula, "Honour:VeHicle to INfrastructure COmmUnication for Indian SmaRt Cities (Accepted)" , 43rd International Conference on Telecommunications and Signal Processing (TSP – 2020) by :IEEE at July 7-9, 2020, Milan, Italy. / / 2020 Lakshminarayana Sadineni, Emmanuel S. Pilli, Ramesh Babu Battula, "Ready-IoT: A Novel Forensic Readiness Model for Internet of Things" , IEEE 7th World Forum on Internet of Things (WF-IoT) by :IEEE at New Orleans, LA, USA / / 2020 P. K. Keserwani, M. C. Govil, E. S. Pilli, "Evidence Building for Ad Click or Web Access on Cloud" , International Conference on Machine Learning, Image Processing, Network Security and Data Sciences (MIND) by :Springer at Silchar, India / 486-500 / 2020 A. K. Mishra, E. S. Pilli, M. C. Govil, "A Taxonomy of Hypervisor Forensic Tools" , XVI IFIP International Conference on Digital Forensics by :Springer at New Delhi, India / 181-199 / 2020 P. K. Keserwani, V. Jha, M. C. Govil, and E. S. Pilli, "Clickedroid: A Methodology Based on Heuristic Approach to Detect Mobile Ad-Click Frauds" , The International Conference on Paradigms of Computing, Communication and Data Sciences (PCCDS) by :Springer at Kurukshetra, India / 853-864 / 2020 S. Narayan, S. K. Vipparthi and A. P. Mazumdar, "Parity Check Based Descriptor for Hand Gesture Detection and Recognition" , IEEE 15th International Conference on Industrial and

Information Systems (ICIIS) by :IEEE at IIT Ropar / 263-268 / 2020 S. Narayan, S. K. Vipparthi and A. P. Mazumdar, "Hand Gesture Recognition With Gaussian Scaling and Kirsch Edge Rotation" , IEEE 15th International Conference on Industrial and Information Systems (ICIIS) by :IEEE at Hand Gesture Recognition With Gaussian Scaling And / / 2020 Jitendra Parmar, Sanskar Soni and Satyendra Singh Chouhan, "OWI: Open-World Intent Identification Framework for Dialog Based System" , The Eighth International Conference on Big Data Analytics (BDA 2020) by :Springer at India / 329-343 / 2020 Shubam Yadav, Santosh Singh Rathore and Satyendra Singh Chouhan, "Authorship Identification Using Stylometry and Document Fingerprinting Decisions" , The Eighth International Conference on Big Data Analytics (BDA 2020) by :Springer at India / 278-288 / 2020 Ritvik Maheshwari, Jyoti Grover, Sumita Mishra , "Investigation of SNR in VLC-Based Intelligent Transportation System Under Environmental Disturbances" , Mobile Radio Communications and 5G Networks by :Springer at India / 45-55 / 2020 ISBN: 978-981-15-7130-5 Sunita Singhal, Hemlata Goyal, Parth Singhal, Jyoti Grover, "Hybrid Genetic Algorithm: Traveling Salesman Problem" , Advances in Decision Sciences, Image Processing, Security and Computer Vision by :Springer at India / 376-384 / 2020 Jyoti Grover, Sunita Singhal, "Performance Assessment of Routing Protocols in Cognitive Radio Vehicular Ad Hoc Networks" , International Conference on Applied Mathematics and Computational Intelligence by :Springer at NIT Agartala / 87-96 / 2020 ISBN: 978-981-19-8194-4 Mahipal Jadeja, Hitarth Kanakia and Rahul Muthu, "Interactive Labeled Object Treemap: Visualization Tool for Multiple Hierarchies" , Eighth Edition of International Conference on Frontiers of Intelligent Computing: Theory and Applications, FICTA 2020 by :Springer Evolution in Computational Intelligence Advances in Intelligent Systems and Computing at National Institute of Technology Karnataka (NITK) / 499-508 / 2020 ISBN: 978-981-15-5788-0 Mahipal Jadeja and Rahul Muthu, "Edgeless Graph: A New Graph Based Information Visualization Technique" , International Conference on Mathematical Modeling, Computational Intelligence Techniques and Renewable Energy by :Springer-Advances in Intelligent Systems and Computing at Pandit Deendayal Petroleum University, Gandhinagar / / 2020 ISBN: 978-981-15-9953-8 Atul Kumar Verma, Mahipal Jadeja and Rahul Saxena , "Network Structural Analysis Based on Graphical Measures and Metrics" , 5th International Conference on Information & Communication Technology for Sustainable Development (ICT4SD 2020) by :Springer at Virtual Mode / 147-156 / 2020 ISBN: 978-981-15-8289-9 Rahul Saxena, Mahipal Jadeja and Atul Kumar Verma, "Efficient Information Flow Based on Graphical Network Characteristics" , Proceedings of the International Conference on Paradigms of Computing, Communication and Data Sciences: PCCDS 2020 by :Springer Singapore at Virtual Mode / 515-526 / 2020 ISBN: 978-981-15-7533-4 Mahipal Jadeja and Gaurav Kabra, "Style Transfer for Videos With Audio" , Proceedings of the International Conference on Paradigms of Computing, Communication and Data Sciences: PCCDS 2020 by :Springer Singapore at Virtual Mode / 607-617 / 2020 ISBN: 978-981-15-7533-4 Rajat Thakur, Sergi Pujades, Lavika Goel, Rolf Pohmann, J■rgen Machann, Michael J Black, "GENTEL : GENerating Training Data Efficiently for Learning to Segment Medical Images" , RFIAP 2020 - Congr■s Reconnaissance Des Formes, Image, Apprentissage Et

Perception, Vannes, France by :RFIAP 2020 - Congr■s Reconnaissance Des Formes, Image, Apprentissage Et Perception, Vannes, France at France / 1-17 / 2020 Suryakant Badde, Vikash Kumar, Kakali Chatterjee, Ditipriya Sinha, "Cyber Attack Detection Framework for Cloud Computing" , Intelligent Data Engineering and Analytics by :Springer Singapore at NIT Surathkal / / 2020 2019 T. Chawla, G. Singh and E. S. Pilli, "HyPSo: Hybrid Partitioning for Big RDF Storage and Query Processing" , ACM India Joint International Conference on Data Science and Management of Data (CoDS-COMAD) 2019 (6th ACM IKDD CoDS and 24th COMAD) by :ACM at Kolkata, India / 188-194 / 2019 ISBN: 978-1-4503-6207-8 Mithlesh Arya, Namita Mittal, Girdhari Singh, "Cervical Cancer Detection Using Single Cell and Multiple Cell Histopathology Images" , International Conference on Emerging Technologies in Computer Engineering by :Springer at Jaipur, India / 205--215 / 2019 Saurabh Ranjan Srivastava, Yogesh Kumar Meena, Girdhari Singh, "Subgame Perfect Equilibrium-Based Framework for Counterterror Solution" , 2nd International Conference on Smart IoT Systems: Innovations and Computing (SSIC) by :Springer at Jaipur, India / 207-218 / 2019 Saurabh Ranjan Srivastava, Yogesh Kumar Meena and Girdhari Singh, "Subgame Perfect Equilibrium-Based Framework for Counterterror Solution Modeling" , Second International Conference on Smart IoT Systems - Innovations in Computing (SSIC-2019) by :Springer at Jaipur, India / 207-218 / 2019 Gaurav Singal, Vijay Laxmi, Manoj Singh Gaur, D. Vijay Rao, Riti Kushwaha, "UAVs Reliable Transmission for Multicast Protocols in FANETs" , Sixth International Conference on Internet of Things: Systems, Management and Security (IOTSMS)October 22-25, 2019 by :IEEE at Granada, Spain / 130-135 / 2019 Sonal Yadav, Vijay Laxmi, Manoj Singh Gaur, Hemangee K. Kapoor, "Improving Static Power Efficiency via Placement of Network Demultiplexer Over Control Plane of Router in Multi-NoCs" , 56th Annual Design Automation Conference (DAC 2019) by :ACM at Las Vegas, NV, USA / 225 / 2019 Rajendra Kumar Solanki, Vijay Laxmi, Manoj Singh Gaur, "MAPPER: Mapping Application Description to Permissions" , 14th International Conference on Risks and Security of Internet and Systems (CRiSIS 2019) by :Springer at Hammamet, Tunisia / 84-98 / 2019 Mithlesh Arya, Namita Mittal, Girdhari Singh, "Cervical Cancer Detection Using Single Cell and Multiple Cell Histopathology Images" , International Conference on Emerging Technologies in Computer Engineering by :Springer, Singapore at JAIPUR / 205-215 / 2019 ISBN: 978-981-13-8300-7 Praveen Kumar Chandaliya, Neeta Nain, "Conditional Perceptual Adversarial Variational Autoencoder for Age Progression and Regression on Child Face" , 2019 International Conference on Biometrics (ICB) by :IEEE at Crete, Greece / 1-8 / 2019 Praveen Kumar Chandaliya, Vardhman KumarMayank HarjaniNeeta Nain, "SCDAE: Ethnicity and Gender Alteration on CLF and UTKFace Dataset" , The Forth International Conference on Computer Vision and Image Processing, CVIp2019 by :Communications in Computer and Information Science, Springer at MNIT Jaipur / 294-306 / 2019 ISBN: 1148 Rahul Paliwal, Shalini Yadav and Neeta Nain, "FaceID: Verification of Face in Selfie and ID Document" , The Forth International Conference on Computer Vision and Image Processing, CVIp2019 by :Communications in Computer and Information Science, Springer at MNIT Jaipur / 443-454 / 2019 ISBN: 1148 Gopal Behera and Neeta Nain, "A Comparative Study of Big Mart Sales

Prediction" , The Forth International Conference on Computer Vision and Image Processing, CVIp2019 by :Communications in Computer and Information Science, Springer at MNIT Jaipur / 421-432 / 2019 ISBN: 1147 Mushtaq Ahmed, Saurabh Goyal, Siddhartha Singh, Jaiprakash Gupta, "An Improved Spray and Wait Routing Protocol for Delay Tolerant Network" , 2019 2nd IEEE Middle East and North Africa COMMunications Conference (MENACOMM) by :IEEE at Manama, Bahrain, Bahrain / 1-6 / 2019 ISBN: 978-1-7281-3688-2 Maninder Singh Nehra, Neeta Nain, Mushtaq Ahmed, Deepa Modi, "POS Tagging and Structural Annotation of Handwritten Text Image Corpus of Devnagari Script" , International Conference on Emerging Technologies in Computer Engineering by :Springer, Singapore at Jaipur / 286-297 / 2019 Kunwar Pal, MC Govil, Mushtaq Ahmed, "Utilization-Based Hybrid Overlay for Live Video Streaming in P2P Network" , Recent Findings in Intelligent Computing Techniques. Advances in Intelligent Systems and Computing by :Springer, Singapore at Goa / 331-338 / 2019 Gaurav Singal, Dinesh Gopalani, Riti Kushwaha, Tapas Badal, "Automatic Parallelization of C Code Using OpenMP" , International Conference on Emerging Technologies in Computer Engineering by :Springer at Jaipur / 298-309 / 2019 Avuthu Avinash Reddy, Ramesh Babu Battula, Dinesh Gopalani, Chaithanya Kurra, "An Adaptive Threshold Energy Detection Mechanism Using Gnu Radio on Usrp" , 11th International Conference on Communication Systems & Networks (COMSNETS) by :IEEE at Bengaluru, India / 251-258 / 2019 Harshit Kr. Agarwal, Meenakshi Tripathi, "OLWS: Optimized Light Weight Secure Clustering Protocol for Wireless Sensor Networks" , 4th International Conference on Information Systems and Computer Networks (ISCON) by :IEEE at Mathura, India / / 2019 ISBN: 978-1-7281-3652-3 Shivam Anand, Amit Kumar, Meenakshi Tripathi, Manoj Singh Gaur, "Human Face Detection Enabled Smart Stick for Visually Impaired People" , Data Science and Big Data Analytics: ACM-WIR 2018 by :Springer at SAIT, Indore / / 2019 Arti Mahore, Meenakshi Tripathi, "Detection of 3d Mask in 2d Face Recognition System Using Dwt and Lbp" , 3rd International Conference on Communication and Information Systems ICCIS by :IEEE at Singapore / / 2019 Avinash Reddy Avuthu, Ramesh Babu Battula, Dinesh Gopalani, and Chaithanya Kurra, "An Adaptive Threshold Energy Detection Mechanism Using GNU Radio on USRP" , 11th International Conference on COMmunication Systems & NETworkS (COMSNETS 2019) by :IEEE at Bengaluru, INDIA / / 2019 Arunima Sharma, Ramesh babu Battula, "Architecture for Waste Management in Indian Smart Cities (AWMINS)" , 10th International Conference Information and Communication Technology Convergence (ICTC 2019) by :IEEE at Jeju Island, South Korea / 1-6 / 2019 L. Sadineni, E. S. Pilli and R. B. Battula, "HFM-IoT: A Holistic Forensic Model for Internet of Things" , Fifteenth Annual IFIP WG 11.9 International Conference on Digital Forensics by :IFIP Springer at Florida, USA / 3-18 / 2019 A. Sharma, E. S. Pilli, A. P. Mazumdar, "RraR: Robust Recommendation Aggregation Using Retraining in Internet of Things" , IEEE 5th World Forum on Internet of Things (WF-IoT) by :IEEE at Limerick, Ireland / 76-80 / 2019 H. Godara, M. C. Govil, E. S. Pilli, "Performance Evaluation of Tree Ensemble Classification Models Towards Challenges of Big Data Analytics" , International Conference on Emerging Technologies in Computer Engineering by :Springer at Jaipur / 141-154 / 2019 P. Mishra, A. Negi, E. S. Pilli, R.

C. Joshi, "VMProtector: Malign Process Detection for Protecting Virtual Machines in Cloud Environment" , International Conference on Advances in Computing and Data Sciences by :Springer at Ghazibad / 360-369 / 2019 Shruthi Srinivasan, Arka Prokash Mazumdar, "Mitigating Content Poisoning in Content Centric Network: A Lightweight Approach" , 10th International Conference on Computing, Communication and Networking Technologies (IEEE-ICCCNT-2019) by :IEEE at IIT Kanpur, India / 1-6 / 2019 Dinesh Kumar Tyagi, VK Chaubey, "Maximum Network Flow Aware Multi-Lightpath Survivable Routing in WDM Networks" , Third International Conference on Information and Communication Technology for Competitive Strategies (ICTCS-2017) by :Springer at Udaipur,India / 737-748 / 2019 ISBN: 978-981-13-0585-6 Ashish Jain, Jyoti Grover, "Performance Assessment of Thirteen Crossover Operators Using GA" , Advances in Intelligent Systems and Computing, Book: Soft Computing for Problem Solving by :Springer at Bhuwneshar / 761-769 / 2019 Kuntal Gaur, Jyoti Grover, "Exploring VANET Using Edge Computing and SDN" , International Conference on Advanced Computational and Communication Paradigms by :IEEE at Gangtok, India / / 2019 Jyoti Grover, Anshul Mehta, "On Demand Multipath Routing Protocol for Emergency Ad Hoc Networks" , International Conference on Advanced Computational and Communication by :IEEE at Gangtok, India / / 2019 Lavika Goel, Joy Mukherjee, "Characterizing High Level LIGO Gravitational Wave Data Using Deep Learning" , Proceedings of SAI Intelligent Systems Conference by :Springer at London, United Kingdom / / 2019 Lavika Goel, Shreedhar Dalal, Swarup N, "Multi-Lingual Paraphrase Detection Using Shared CNN–GRU Model" , ICCCMLA 2019: International Conference on Cybernetics, Cognition, 16th - 17th August 2019, Goa by :Springer at Goa, India / / 2019 Shivangi, Anubhav Johri, Ashish Tripathi, "Parkinson Disease Detection Using Deep Neural Networks" , International Conference on Contemporary Computing (IC3) by :IEEE at Noida / 1-4 / 2019 Avinash Chandra Pandey, Ashish Kumar Tripathi, Raju Pal, Himanshu Mittal, Mukesh Saraswat, "Spiral Salp Swarm Optimization Algorithm" , International Conference on Information Systems and Computer Networks (ISCON) by :IEEE at Mathura / 722-727 / 2019 Ashish Kumar Tripathi, Pranav Saxena, Siddharth Gupta, "MapReduce-Based Dragonfly Algorithm for Large-Scale Data-Clustering" , International Conference on Image Information Processing (ICIIP) by :IEEE at Waknaghat / 171-175 / 2019 ISBN: 978-1-7281-0899-5 Vikash Kumar, Ayan Kumar Das, Ditipriya Sinha, "Statistical Analysis of the UNSW-NB15 Dataset for Intrusion Detection" , Computational Intelligence in Pattern Recognition by :Springer, Singapore at IIEST Shibpur / / 2019 Vikash Kumar, Vivek Kumar, Ditipriya Sinha, Ayan Kumar Das, "Simulation Analysis of DDoS Attack in IoT Environment" , 4th International Conference on Internet of Things and Connected Technologies (ICIoTCT) by :Springer at MNIT Jaipur / / 2019 P. Majumdar, T. De, "An Algorithm Based on Next Shortest Path in Large EON Under Dynamic Traffic Grooming" , International Conference on Computing Analytics and Networking Proceeding of Advances in Intelligent Systems and Computing AISC Series by :Springer at KIIT Bhubneshwar / / 2019 P. Majumdar, T. De, "A Distance-Based Adaptive Traffic Grooming Algorithm in Large EON Under Dynamic Traffic Model" , International Conference on Computing Analytics and Networking Proceeding of Advances in

Intelligent Systems and Computing AISC Series by :Springer at KIIT Bhubneshwar / / 2019 2018 Monu Verma, S. K. Vipparthi, Girdhari Singh, "Region Based Extensive Response Index Pattern for Facial Expression Recognition" , International Conference on Communication, Computing & Internet of Things (IC3IOT-18) by :IEEE at Chennai / / 2018 Monu Verma, Prafulla Saxena, Santosh Kumar Vipparthi, Girdhari Singh, "QUEST:Quadriletral Senary Bit Pattern for Facial Expression Recognition" , IEEE International Conference on Systems, Man, and Cybernetics (SMC-18) (Core B) by :IEEE at Japan / / 2018 S. S. Chauhan, E. S. Pilli, R. C. Joshi, and G. Singh, "UPB: User Preference Based Brokering for Service Ranking and Selection in Federated Cloud" , IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS 2018) by :IEEE at Indore, India / 1--6 / 2018 Monu Verma, Jaspreet Singh, Santosh Kumar Vipparthi, Girdhari Singh, "EXPERTNet: Exigent Features Preservative Network for Facial Expression Recognition" , 11 Th Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP-18) by :IEEE at Hyderabad / 00-00 / 2018 ISBN: 00 Anita Choudhary, Mahesh Chandra Govil, Girdhari Singh, Lalit K. Awasthi, E.S. Pilli, "Task Clustering-Based Energy-Aware Workflow Scheduling in Cloud Environment" , 2018 IEEE 20th International Conference on High Performance Computing and Communications; IEEE 16th International Conference on Smart City; IEEE 4th by :IEEE at Exeter, United Kingdom / 968-973 / 2018 Rajat Goel, M.C. Govil, Girdhari Singh, "A Novel Methodology for Effective Requirements Elicitation and Modeling" , International Conference on Computational Science and Its Applications by :Springer at Melbourne, Australia / 474--487 / 2018 Tanvi Chawla, Girdhari Singh, E.S. Pilli, "JOTR: Join-Optimistic Triple Reordering Approach for SPARQL Query Optimization on Big RDF Data" , IEEE 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT 2018) by :IEEE at Bangalore, India / 1-7 / 2018 Sonal Yadav, Vijay Laxmi, Hemangee K. Kapoor, Manoj Singh Gaur, Mark Zwolinski, "A Power Efficient Crossbar Arbitration in Multi-NoC for Multicast and Broadcast Traffic" , IEEE International Symposium on Smart Electronic Systems (iSES 2018) by :IEEE at Hyderabad, India / 243-248 / 2018 Vineeta Jain, Vijay Laxmi, Manoj Singh Gaur, Mohamed Mosbah, "APPLADroid: Automaton Based Inter-App Privacy Leak Analysis for Android" , Second ISEA International Conference on Security and Privacy (ISEA-ISAP) by :Springer at Jaipur, India / 219-233 / 2018 Mohit Kumar Singh, Vijay Laxmi, Neeta Nain, "Unsupervised Person Re-ID in Surveillance Feed Using Re-Ranking" , Second ISEA International Conference Security and Privacy (ISEA-ISAP) by :Springer at Jaipur, India / 179-192 / 2018 Parvez Faruki, Bharat Buddhadev, Bhavya Shah, Akka Zemmari, Vijay Laxmi, Manoj Singh Gaur, "DroidDivesDeep: Android Malware Classification via Low Level Monitorable Features With Deep Neural Networks." , Second ISEA International Conference Security and Privacy (ISEA-ISAP) by :Springer at Jaipur, India / 125-139 / 2018 Jay Dave, Vijay Laxmi, Parvez Faruki, Manoj Singh Gaur, Bhavya Shah, "Bloom Filter Based Privacy Preserving Deduplication System" , Second ISEA International Conference Security and Privacy (ISEA-ISAP) by :Springer at Jaipur, India / 17-34 / 2018 Shweta Saharan, Vijay Laxmi, Manoj Singh Gaur, Akka Zemmari, "Privacy Preserving Data Offloading Based on Transformation" , 13th International Conference on Risks and Security of

Internet and Systems (CRiSIS) by :Springer at Arcachon, France / 86-92 / 2018 Mithlesh Arya, Namita Mittal, Girdhari Singh, "Fuzzy-Based Classification for Cervical Dysplasia Using Smear Images" , Recent Findings in Intelligent Computing Techniques by :Springer, Singapore at Goa / 441-449 / 2018 ISBN: 978-981-10-8633-5 Chandra Prakash, Rajesh Kumar, Namita Mittal, Gaurav Raj, "Vision Based Identification of Joint Coordinates for Marker-Less Gait Analysis" , International Conference on Computational Intelligence and Data Science ICCIDS 2018 by :Elsevier at Gurugram / 68-75 / 2018 ISBN: 9781510864139 Namita Mittal, Divya Sharma, Manju Lata Joshi, "Image Sentiment Analysis Using Deep Learning" , 2018 IEEE-WIC-ACM International Conference on Web Intelligence WI by :IEEE at Santiago, Chile / 684-687 / 2018 ISBN: 978-1-5386-7325-6 Vivek Kumar, Abhishek Verma, Namita Mittal, Sergey V. Gromov , "Anatomy of Preprocessing of Big Data for Monolingual Corpora Paraphrase Extraction: Source Language Sentence Selection" , Emerging Technologies in Data Mining and Information Security by :Springer at Kolkata / / 2018 ISBN: 978-981-15-9773-2 Chandra Prakash, Uddeshya Mishra, Manas Jain, Rajesh Kumar, Namita Mittal, "Automated Kinematic Analysis Using Holistic Based Human Gait Motion for Biomedical Applications" , 2018 8th International Conference on Cloud Computing, Data Science & Engineering by :IEEE at Noida / 700-706 / 2018 ISBN: 978-1-5386-1719-9 Vijay Kumar Sharma, Namita Mittal , "A Comparative Study of Online Resources for Extracting Target Language Translation" , Recent Findings in Intelligent Computing Techniques by :Springer, Singapore at Goa / 95-101 / 2018 ISBN: 978-981-10-8633-5 Vijay Kumar Sharma, Namita Mittal , "Cross-Lingual Information Retrieval: A Dictionary-Based Query Translation Approach" , Advances in Computer and Computational Sciences: Proceedings of ICCCCS 2016, Volume 2 by :Springer Nature Singapore Pte Ltd. at Thailand / 611-618 / 2018 Debayan Deb, Neeta Nain, Anil K Jain, "Longitudinal Study of Child Face Recognition" , The Eleventh IAPR International Conference on Biometrics by :IEEE at Gold Coast, Australia / / 2018 Ravindra Kumar Saini, Mushtaq Ahmed, "Restricted Turn Model Fault Tolerant Routing Techniques for 3D Mesh Network-on-Chip: An Evaluation" , International Congress on Information and Communication Technology by :Springer, Singapore at Bangkok / 113-122 / 2018 Divya Bairathi, Dinesh Gopalani, "A Novel Swarm Intelligence Based Optimization Method: Harris' Hawk Optimization" , International Conference on Intelligent Systems Design and Applications by :Springer at Vellore, India / 832-842 / 2018 Divya Bairathi, Dinesh Gopalani, "Opposition Based Salp Swarm Algorithm for Numerical Optimization" , International Conference on Intelligent Systems Design and Applications by :Springer at Vellore, India / 821-831 / 2018 Divya Bairathi, Dinesh Gopalani, "An Improved Opposition Based Grasshopper Optimisation Algorithm for Numerical Optimization" , International Conference on Intelligent Systems Design and Applications by :Springer at Vellore, India / 843-851 / 2018 Arti Mahore, Meenakshi Tripathi, "Detection of 3D Mask in 2D Face Recognition System Using DWT and LBP" , 2018 IEEE 3rd International Conference on Communication and Information Systems by :IEEE at Singapore / 18-22 / 2018 Ankur Gupta, Meenakshi Tripathi, "Poster: A Lightweight Mutually Authenticated Key-Agreement Scheme for Wireless Body Area Networks in Internet of Things Environment" , 24th Annual International

Conference on Mobile Computing and Networking by :ACM at New Delhi / 804-806 / 2018 ISBN: 978-1-4503-5903-0 Himanshu Sharma, Meenakshi Triapthi, Amit Kumar, Manoj singh gaur, "Embedded Assistive Stick for Visually Impaired Persons" , IEEE 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT 2018) by :IEEE at Bangalore / / 2018 Kalpana Naidu, Meenakshi Tripathi, Ramesh Babu Battula, "Resource Allocation at MAC to Provide QoS for Cognitive Radio Networks" , Optical and Wireless Technologies (OWT-2018) by :Springer at MNIT Jaipur / / 2018 Ganpat Singh Chauhan, Yogesh Kumar Meena, "Prominent Aspect Term Extraction in Aspect Based Sentiment Analysis" , 2018 3rd International Conference and Workshops on Recent Advances and Innovations in Engineering (ICRAIE) by :IEEE at Jaipur, India / 1-6 / 2018 ISBN: 978-1-5386-4526-0 Mr. Ganpat Singh Chauhan, Dr. Yogesh Kumar Meena, "A Digital Way of Investigating Government Schemes Using Aspect-Based Sentiment Analysis" , International Conference on Information Technology & Digital Applications 2018 by :Springer Nature Singapore Pte Ltd. at Jaipur, India / / 2018 T. Chawla, G. Singh, E. S. Pilli, "JOTR: Join-Optimistic Triple Reordering Approach for SPARQL Query Optimization on Big RDF Data" , Ninth International Conference on Computing, Communication and Networking Technologies (ICCCNT) by :IEEE at Bengaluru, India / 1-7 / 2018 A. K. Mishra, E. S. Pilli, M. C. Govil, "A Taxonomy of Cloud Endpoint Forensic Tools" , Fourteenth Annual IFIP WG 11.9 International Conference on Digital Forensics by :Springer at New Delhi, India / 181-199 / 2018 P. Hiranandani, N. Chand, E. S. Pilli, M. Gupta, C. Ramakrishna, R. C. Joshi, "Big Data Analytics Using Multi-Classifier Approach With Rhadoop" , International Conference on Cloud Computing, Data Science & Engineering (Confluence-2018) by :IEEE at Noida, India / 478-484 / 2018 ISBN: 978-1-5386-1719-9 A. Choudhary, M. C. Govil, G. Singh, L. K. Awasthi, and E. S. Pilli, "Task Clustering-Based Energy-Aware Workflow Scheduling in Cloud Environment" , 2018 IEEE 20th International Conference on High Performance Computing and Communications (HPCC) by :IEEE at Exeter, England / 1-6 / 2018 V. Asati, E. S. Pilli, S. Vipparthi, S. Garg, S. Singhal and S. Pancholi, "RMDD: Cross Layer Attack in Internet of Things" , International Conference on Advances in Computing, Communications and Informatics (ICACCI) by :IEEE at Bangalore, India / 1-6 / 2018 A. Choudhary, H. Duhar, E. S. Pilli, "Discovering Experts in Question Answering Community" , International Conference and Workshops on Recent Advances and Innovations in Engineering (ICRAIE) by :IEEE at Jaipur, India / 1-5 / 2018 ISBN: 978-1-5386-4525-3 H. Godara, M.C. Govil, E.S. Pilli, "Performance Factor Analysis and Scope of Optimization for Big Data Processing on Cluster" , International Conference on Parallel, Distributed and Grid Computing (PDGC) by :IEEE at Solan, Himachal Pradesh, India / 418-423 / 2018 ISBN: 978-1-7281-0646-5 M. Singh, M. C. Govil, E. S. Pilli, "SOD-CHIEF: Salient Object Detection Using Convex Hull With multI-Scale Energy Functions" , Conference on Information and Communication Technology (CICT) by :IEEE at Jabalpur, India / 1--6 / 2018 ISBN: 978-1-5386-8215-9 M. Singh, M. C. Govil, E. S. Pilli, "V-SIN: Visual Saliency Detection in Noisy Images Using Convolutional Neural Network" , Conference on Information and Communication Technology (CICT) by :IEEE at Jabalpur, India / 1--6 / 2018 ISBN: 978-1-5386-8215-9 Dinesh Kumar Tyagi, VK Chaubey, Parth

Khandelwal, "Dynamic Lightpath Protection Through Intelligent Water Drops Based Algorithm in Optical Networks" , 2018 International Conference on Computing, Power and Communication Technologies (GUCON) by :IEEE at Greater Noida,India / 1122-1127 / 2018 Ashish Kumar Patel, Satyendra Singh Chouhan, and Rajdeep Niyogi., "Using Crowd Sourced Data for Music Mood Classification" , Sixth International Conference on Big Data Analytics by :Springer at NIT Warangal / 363-375 / 2018 Lavika Goel, Mallikarjun Swamy, Raghav Mantri, "Swarm and Artificial Immune System-Based Intelligence Techniques for Geo-Spatial Feature Extraction" , International Conference on Computational Intelligence and Data Engineering by :Springer at Andhra Pradesh / / 2018 Tripathi Ashish, Sharma Kapil, Bala Manju, "Parallel Bat Algorithm-Based Clustering Using MapReduce" , International Conference on Recent Advancement in Computer, Communication and Computational Sciences(RACCCS-2016) by :Springer, Singapore at Udaipur / 73-82 / 2018 Deepak Ranjan Nayak, Ratnakar Dash, Zhihai Lu, Siyuan Lu, Banshidhar Majhi, "SCA-RELM: A New Regularized Extreme Learning Machine Based on Sine Cosine Algorithm for Automated Detection of Pathological Brain" , 27th International Symposium on Robot and Human Interactive Communication (RO-MAN 2018) by :IEEE at Nanjing, China / 764-769 / 2018 2017 Mithlesh Arya, Namita Mittal, Girdhari Singh, "Fuzzy-Based Classification for Cervical Dysplasia Using Smear Images" , 5th International Conference on Advanced Computing, Networking, and Informatics (ICACNI) by :Springer at Goa, India / 441-449 / 2017 Tanvi Chawla, Girdhari singh, E.S. Pilli, "A Shortest Path Approach to SPARQL Chain Query Optimisation" , Advances in Computing, Communications and Informatics (ICACCI), 2017 International Conference On by :IEEE at Udupi, India / 1778-1783 / 2017 Jyoti Gajrani, Meenakshi Tripathi, Vijay Laxmi, Manoj Singh Gaur, Mauro Conti, Muttukrishnan Rajarajan, "sPECTRA: A Precise framEwork for Analyzing CrypTographic vulneRabilities in Android Apps" , 2017 14th IEEE Annual Consumer Communications & Networking Conference (CCNC) by :IEEE at Las Vegas, NV, USA / 854-860 / 2017 Anugrah Jain, Vijay Laxmi, Meenakshi Tripathi, Manoj Singh Gaur, Rimpy Bishnoi, "Performance-Enhanced D^2 -LBDR for 2D Mesh Network-on-Chip" , 21st International Symposium on VLSI Design and Test (VDAT) by :Springer at Roorkee, India / 313-323 / 2017 Garima Modi, Vijay Laxmi, Smita Naval, Manoj Singh Gaur, "Improving Leakage Path Coverage in Android Apps" , 16th IEEE International Conference on Trust, Security and Privacy in Computing and Communications (IEEE TrustCom) by :IEEE Computer Society at Sydney, Australia / 355-362 / 2017 Vineeta Jain, Shweta Bhandari, Vijay Laxmi, Manoj Singh Gaur, Mohamed Mosbah, "SniffDroid: Detection of Inter-App Privacy Leaks in Android" , 16th IEEE International Conference on Trust, Security and Privacy in Computing and Communications (IEEE TrustCom) by :IEEE Computer Society at Sydney, Australia / 331-338 / 2017 Shweta Bhandari, Frederic Herbreteau, Vijay Laxmi, Akka Zemmari, Partha S Roop, Manoj Singh Gaur, "SneakLeak: Detecting Multipartite Leakage Paths in Android Apps" , 16th IEEE International Conference on Trust, Security and Privacy in Computing and Communications (IEEE TrustCom) by :IEEE Computer Society at Sydney, Australia / 285-292 / 2017 Jimmy Bondu, Anupal Mishra, Vijay Laxmi, Manoj Singh Gaur, "Flooding in Secure Wireless Sensor Networks (Student Contribution)" , 10th

International Conference on Security of Information and Networks by :ACM at Jaipur, India / 151-156 / 2017 Jay Dave, Parvez Faruki, Vijay Laxmi, Bruhadeshwar Bezawada, Manoj Singh Gaur, "Secure and Efficient Proof of Ownership for Deduplicated Cloud Storage" , 10th International Conference on Security of Information and Networks by :ACM at Jaipur, India / 19-26 / 2017 Ashish Sharma, Yogendra Gupta, Sonal Yadav, Lava Bhargava, Manoj Singh Gaur, Vijay Laxmi, "A Power, Thermal and Reliability-Aware Network-on-Chip" , IEEE International Symposium on Nanoelectronic and Information Systems (iNIS) by :IEEE at Bhopal, India / 243-245 / 2017 Jay Dave, Shweta Saharan, Parvez Faruki, Vijay Laxmi, Manoj Singh Gaur, "Secure Random Encryption for Deduplicated Storage" , 13th International Conference on Information Systems Security (ICISS) by :Springer at Mumbai, India / 164-176 / 2017 Jyoti Gajrani, Vijay Laxmi, Meenakshi Tripathi, Manoj Singh Gaur, Daya Ram Sharma, Akka Zemmari, Mohamed Mosbah, Mauro Conti, "Unraveling Reflection Induced Sensitive Leaks in Android Apps" , 12th International Conference on Risks and Security of Internet and Systems (CRiSIS), September 19-21, 2017 by :Springer at Dinard, France / 49-65 / 2017 Jyoti Gajrani, Li Li, Vijay Laxmi, Meenakshi Tripathi, Manoj Singh Gaur, Mauro Conti, "Detection of Information Leaks via Reflection in Android Apps" , Asia Conference on Computer and Communications Security (AsiaCCS) by :ACM at Abu Dhabi, United Arab Emirates / 911-913 / 2017 Shweta Bhandari, Frédéric Herbreteau, Vijay Laxmi, Akka Zemmari, Partha S. Roop, Manoj Singh Gaur, "Detecting Inter-App Information Leakage Paths" , Asia Conference on Computer and Communications Security (AsiaCCS) by :ACM at Abu Dhabi, United Arab Emirates / 908-910 / 2017 Joshi, M. L., Mittal, N., Joshi, N., "An Insight Into Role of Wordnet and Language Network for Effective IR From Hindi Text Documents" , FIRE 2017 by :CEUR-WS.org at IISC Bangalore / 158-163 / 2017 Gourav Takhar, Chandra Prakash, Namita Mittal, Rajesh Kumar , "Vision Based Gender Recognition Using Hybrid Background Subtraction Technique" , International Conference on Next Generation Computing Technologies by :Springer at Dehradun / 651-662 / 2017 ISBN: 978-981-10-8660-1 C. Prakash, Sujil A, R. Kumar, N. Mittal, "A Linear Prediction Model for Joint Movement of Lower Extremity" , 5th International Conference on Advanced Computing, Networking, and Informatics (ICACNI) by :Springer at Goa / / 2017 Vijay Kumar Sharma, Namita Mittal , "Named Entity Identification Based Translation Disambiguation Model" , 7th International Conference on Pattern Recognition and Machine Intelligence (PReMI'17) by :Springer at Kolkata / 365-372 / 2017 ISBN: 978-3-319-69900-4 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "A Novel Approach of an (N, N) Multi-Secret Image Sharing Scheme Using Additive Modulo" , Proceedings of International Conference on Computer Vision and Image Processing by :Springer at IIT Roorkee / 149-158 / 2017 Vishakha Sharma, Neeta Nain, Tapas Badal, "A Redefined Codebook Model for Dynamic Backgrounds" , Proceedings of International Conference on Computer Vision and Image Processing by :Springer at IIT Roorkee / 463-473 / 2017 Tapas Badal, Neeta Nain and Mushtaq Ahmed, "Multi-Object Trajectory Coupling Using Online Target Specific Decision Making" , 2017 IEEE International Conference on Identity, Security and Behavior Analysis (ISBA) by :IEEE at New Delhi / 1-6 / 2017 Sonu Lamba, Neeta Nain, "Multi-Source Approach for Crowd Density Estimation in Still Images" , 2017 IEEE

International Conference on Identity, Security and Behavior Analysis (ISBA), by :IEEE at New Delhi / 1-6 / 2017 ISBN: 16963870 Harendra Chahar and Neeta Nain, "Deep Convolutional Neural Network for Person Re-Identification: A Comprehensive Review" , The Second IAPR International Conference on Computer Vision & Image Processing by :Springer at IIT Roorkee / 277-288 / 2017 Sandeep K Gupta, Neeta Nain, "Gabor Filter meanPCA Feature Extraction for Gender Recognition" , The Second IAPR International Conference on Computer Vision and Image Processing by :Springer at IIT Roorkee / 79-88 / 2017 Maninder Singh Nehra, Neeta Nain, Mushtaq Ahmed, Prakash Choudhary, Deepa Modi, "Amalgamated Approach for Devanagari Script Corpus for OCR & Demographic Purpose and XML for Linguistic Annotation" , The Thirteenth International Conference on Signal Image Technologies and Internet Based Systems by :IEEE at MNIT Jaipur, India / 249-254 / 2017 Riti Kushwaha, Neeta Nain, Gaurav Singal, "Detailed Analysis of Footprint Geometry for Person Identification" , The Thirteenth International Conference on Signal Image Technologies and Internet Based Systems by :IEEE at MNIT Jaipur / 229-236 / 2017 Tapas Badal, Neeta Nain, Mushtaq Ahmed, "Generalised Spatio Temporal Feature Based Important Activity Synopsis Generation" , The Thirteenth International Conference on Signal Image Technologies and Internet Based Systems by :IEEE at MNIT Jaipur / 319-326 / 2017 Sonu Lamba and Neeta Nain, "A Large Scale Crowd Density Classification Using Spatio-Temporal Local Binary Pattern" , The Thirteenth International Conference on Signal Image Technologies and Internet Based Systems by :IEEE at MNIT Jaipur / 296-302 / 2017 Mushtaq Ahmed, Pankaj Sharma, Kunwar Pal and Mohammed Yaseen Husain, "Unicast Backtracking Route Recovery in ODMRP" , 9th IEEE-GCC Conference and Exhibition by :IEEE at Bahrain / / 2017 T. Badal, N. Nain and M. Ahmed, "Generalised Spatio Temporal Feature Based Important Activity Synopsis Generation" , 13th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS) by :IEEE at Jaipur / 319-326 / 2017 Kunwar Pal, Mushtaq Ahmed, and Mahesh Chandra Govil , "Utilization Based Hybrid Overlay Approach for P2P Live Streaming: A Comparative Analysis" , 23rd International Conference on Parallel and Distributed Processing Techniques and Applications by :Springer at Navada USA / 32-38 / 2017 Kunwar Pal, Mushtaq Ahmed, and Mahesh Chandra Govil , "A Distinctive Analysis of New Hybrid Overlay Approach With Classical Overlay Approaches for P2P Live Streaming" , 23rd International Conference on Parallel and Distributed Processing Techniques and Applications by :Springer at Las Vegas Nevada USA / 32-38 / 2017 Ritu Sharma, Dinesh Gopalani, Yogesh Meena, "Concept-Based Approach for Research Paper Recommendation" , 7th International Conference on Pattern Recognition and Machine Intelligence (PReMI’17) by :Springer at Kolkata, India / 687-692 / 2017 Manish Jain, Dinesh Gopalani, "Domain Specific Language for Automatically Generating Testing Aspects" , International Conference on Emerging Trends in Computing and Communication Technologies by :IEEE at Dehradun, India / / 2017 Divya Bairathi, Dinesh Gopalani, "Opposition-Based Sine Cosine Algorithm (OSCA) for Training Feed-Forward Neural Networks" , SITIS 2017 : The 13th International Conference on Signal Image Technology & Internet Based Systems by :IEEE at Jaipur India, / / 2017 Divya Bairathi, Dinesh Gopalani, "Weight and Bias Optimization for Multilayer

Perceptrons Using Salp Swarm Algorithm" , 7th International Conference Soft Computing for Problem Solving - SocProS 2017 by :Indian Institute of Technology Bhubaneswar at Bhubaneswar, India / / 2017 Ajay Nehra, Meenakshi Tripathi, Manoj Singh Gaur, "Global View in SDN: Existing Implementation, Vulnerabilities & Threats" , 10th International Conference on Security of Information and Networks by :ACM at Jaipur / 303-306 / 2017 Jyoti Gajrani, Vijay Laxmi, Meenakshi Tripathi, Manoj S Gaur, Daya Ram Sharma, Akka Zemmari, Mohamed Mosbah, Mauro Conti, "Unraveling Reflection Induced Sensitive Leaks in Android Apps" , International Conference on Risks and Security of Internet and Systems by :Springer at France / 49-65 / 2017 Ajay Nehra, Meenakshi Tripathi, MS Gaur, "Requirement Analysis for Abstracting Security in Software Defined Network" , 2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT) by :IEEE at Delhi / 1-8 / 2017 Anugrah Jain, Vijay Laxmi, Meenakshi Tripathi, Manoj Singh Gaur, Rimpy Bishnoi, "Performance-Enhanced D^2-LBDR for 2D Mesh Network-on-Chip" , International Symposium on VLSI Design and Test by :Springer at Roorkee, India / 313-323 / 2017 Jyoti Gajrani, Li Li, Vijay Laxmi, Meenakshi Tripathi, Manoj Singh Gaur, Mauro Conti, "Detection of Information Leaks via Reflection in Android Apps" , Asia Conference on Computer and Communications Security by :ACM at Abu Dhabi, UAE / 911-913 / 2017 Meenakshi Tripathi, Kalpana Naidu, Mintu Biswas, "Energy Efficient Semi Grid Based Clustering in Heterogeneous Wireless Sensor Network" , IEEE International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET) by :IEEE at Chennai, India / 278-282 / 2017 Sharang Sharma, Manind Gupta, Amit Kumar, Meenakshi Tripathi, Manoj Singh Gaur, "Multiple Distance Sensors Based Smart Stick for Visually Impaired People" , 2017 IEEE 7th Annual Computing and Communication Workshop and Conference (CCWC) by :IEEE at Las Vegas, NV, USA / 1-5 / 2017 Ajay Nehra, Meenakshi Tripathi, MS Gaur, "FICUR: Employing SDN Programmability to Secure ARP" , 2017 IEEE 7th Annual Computing and Communication Workshop and Conference (CCWC) by :IEEE at Las Vegas, NV, USA / 1-8 / 2017 Manisha Samanta, Yogesh Kumar Meena, Arka Mazumdar, Mahesh Govil, "EDOF: An Open Framework for Event Detection Systems" , International Conference on Computing Communication and Networking by :ACM at Delhi India / / 2017 Battula Ramesh Babu, Avinash Reddy Avuthu, S Venkata Narayana, "SAMAR - Spectrum Aware Token MAc for Cognitive Radio Networks" , The 31st IEEE International Conference on Advanced Information Networking and Applications (AINA-2017) by :IEEE at Taipei,Taiwan / / 2017 P. Mishra, E. S. Pilli, V. Varadharajan, and U. Tupakula, "Out-VM Monitoring for Malicious Network Packet Detection in Cloud" , First ISEA Asia Security and Privacy Conference by :IEEE at Surat, India / 1--10 / 2017 M. K. Gokhroo, M. C. Govil, and E. S. Pilli, "Detecting and Mitigating Faults in Cloud Computing Environment" , 2017 3rd International Conference on Computational Intelligence & Communication Technology (CICT) by :IEEE at Ghaziabad, India / 1--9 / 2017 T. Chawla, G. Singh, E. S. Pilli, "A Shortest Path Approach to SPARQL Chain Query Optimisation" , International Conference on Advances in Computing, Communications and Informatics (ICACCI 2017) by :IEEE at Udupi, India / 1778-1783 / 2017 A. Sharma, E. S. Pilli, A. P. Mazumdar, "Obviating Capricious Behavior in Internet of Things" , International Conference on Advances in

Computing, Communications and Informatics (ICACCI 2017) by :IEEE at Udupi, India / 480-486 / 2017 ISBN: 978-1-5090-6367-3 D. Mittal, E. S. Pilli, M. Gupta, "Efficient Entity Resolution Using Multiple Blocking Keys for Bibliographic Dataset" , International Conference on Intelligent Communication and Computational Techniques (ICCT) by :IEEE at Jaipur, India / 108-113 / 2017 ISBN: 978-1-5386-3030-3 A. Kashyap, G. S. Kumar, S. Jangir, E. S. Pilli, P. Mishra, "IHIDS: Introspection-Based Hybrid Intrusion Detection System in Cloud Environment" , International Conference on Advances in Computing, Communications and Informatics (ICACCI) by :IEEE at Udupi, India / 687-693 / 2017 ISBN: 978-1-5090-6367-3 Avani Sharma, Emmanuel S Pilli, Arka P Mazumdar, "Obviating Capricious Behavior in Internet of Things" , Advances in Computing, Communications and Informatics (ICACCI), 2017 International Conference On by :IEEE at Manipal / 480-486 / 2017 Manisha Samanta, Yogesh K Meena, Arka P Mazumdar, Mahesh C Govil, "EDOF: An Open Framework for Event Detection Systems" , 2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT) by :IEEE at Delhi / 1-7 / 2017 Akash Yadav, Ashok Singh Sairam, Arka Prokash Mazumdar, "Selecting Stable Route in Multipath Routing Protocols" , 2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT) by :IEEE at Delhi / 1-7 / 2017 Jyoti Grover, Ashish Jain, Sunita Singhal, Anju Yadav, "Real Time VANET Applications Using Fog Computing" , International Conference on Smart Systems, Innovations and Computing (SSIC 2017) by :Springer at Jaipur / / 2017 Sunita Singhal, Jyoti Grover, "Hybrid Biogeography Algorithm for Reducing Power Consumption in Cloud Computing" , International Conference on Advances in Computing, Communications and Informatics (ICACCI) by :IEEE at Karnatka / 121-124 / 2017 Ashish Jain, Jyoti Grover, Tarun Jain, "Cuckoo Search Strategies for Solving Combinatorial Problems (Solving Substitution Cipher: An Investigation)" , International Conference on Smart Systems, Innovations and Computing (SSIC 2017) by :Springer at Jaipur / 585-594 / 2017 Jyoti Grover, Ashish Jain, NS Chaudhari, "Unmanned Aerial Vehicles Operated Emergency Ad Hoc Networks" , 7th International Conference on Communication Systems and Network Technologies (CSNT) by :IEEE at IIIT Nagpur / 92-96 / 2017 Mahipal Jadeja and Neelanshi Varia, "Perspectives for Evaluating Conversational AI" , International Workshop on Search-Oriented Conversational AI at ACM ICTIR(SCAI 2017) by :ACM at Amsterdam, Netherlands / / 2017 Mahipal Jadeja, Neelanshi Varia and Agam Shah, "Deep Reinforcement Learning for Conversational AI" , International Workshop on Search-Oriented Conversational AI at ACM ICTIR(SCAI 2017) by :ACM at Amsterdam, Netherlands / / 2017 Garima Modi, Vijay Laxmi, Smita Naval, Manoj Singh Gaur, "Improving Leakage Path Coverage in Android Apps" , 16th IEEE International Conference on Trust, Security and Privacy in Computing and Communications (IEEE TrustCom-17) by :IEEE at Sydney, NSW, Australia / 355-362 / 2017 Aditya Sarma, Anirudh Bhutani, Lavika Goel, "Hybridization of Moth Flame Optimization and Gravitational Search Algorithm and Its Application to Detection of Food Quality" , 2017 Intelligent Systems Conference (IntelliSys) by :IEEE at London, United Kingdom / / 2017 Anuraj Singh, Chirag Chhablani, Lavika Goel, "Moth Flame Optimization for Land Cover Feature Extraction in Remote Sensing Images" , 8th

International Conference on Computing, Communication and Networking Technologies (ICCCNT) by :IEEE at IIT Delhi / / 2017 Lavika Goel, Nilay Jain, Shivin Srivastava, "A Novel PSO Based Algorithm to Find Initial Seeds for the K-Means Clustering Algorithm" , Communication and Computing Systems: Proceedings of the International Conference on Communication and Computing Systems ICCCS by :CRC Press, Taylor and Francis at Gurgaon / / 2017 Sameer Ranjan, Deepak Ranjan Nayak, Kallepalli Satish Kumar, Ratnakar Dash, Banshidhar Majhi, "Hyperspectral Image Classification: A K-Means Clustering Based Approach" , 4th International Conference on Advanced Computing and Communication Systems (ICACCS-17) by :IEEE at Coimbatore, India / 1-7 / 2017 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "An Improved Extreme Learning Machine for Pathological Brain Detection" , 2017 IEEE Region 10 Conference (TENCON-2017) by :IEEE at Penang, Malaysia / 13-18 / 2017 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Pathological Brain Detection Using Extreme Learning Machine Trained With Improved Whale Optimization Algorithm" , 9th International Conference on Advances in Pattern Recognition (ICAPR-2017) by :IEEE at ISI Bangalore / 1-6 / 2017 2016 Mithlesh Arya, Namita Mittal, Girdhari Singh , "Cervical Cancer Detection Using Segmentation on PAP Smear Images" , Proceedings of the International Conference on Informatics and Analytics ICIA2016 by :ACM at Pondicherry / 1-4 / 2016 ISBN: 978-1-4503-4756-3 A. Choudhary, M. C. Govil, G. Singh, L. K. Awasthi, E. S. Pilli and N. Kumar , "Improved Virtual Machine Migration Approaches in Cloud Environment" , International Conference on Cloud Computing in Emerging Markets (CCEM) by :IEEE at Bangalore, India / 17-24 / 2016 ISBN: 978-1-5090-4573-0 T. Chawla, G. Singh, E. S. Pilli, and M.C. Govil, "Research Issues in RDF Management Systems" , International Conference on Emerging Trends in Communication Technologies (ETCT) by :IEEE at Dehradun, India / 1-5 / 2016 ISBN: 978-1-5090-4505-1 Rajat Goel, Mahesh Chandra Govil, Girdhari Singh, "A Secure Software Design Methodology" , 5th International Conference on Advances in Computing, Communications and Informatics (ICACCI 2016) by :IEEE at Jaipur, India / 2484-2488 / 2016 Anita Choudhary, M.C. Govil, Girdhari Singh, L.K. Awasthi, "Energy-Efficient Resource Allocation Approaches With Optimum Virtual Machine Migrations in Cloud Environment" , 4th International Conference on Parallel, Distributed and Grid Computing (PDGC) by :IEEE at Solan, India / 182-187 / 2016 Rajat Goel, M.C. govil, Girdhari Singh, "Modeling Software Security Requirements Through Functionality Rank Diagrams" , International Conference on Computational Science and Its Applications (ICCSA) by :Springer at Beijing, China / 398-409 / 2016 Rajat Goel, M.C. Govil, Girdhari Singh, "Security Requirements Elicitation and Modeling Authorizations" , International Symposium on Security in Computing and Communication (SSCC) by :Springer at Jaipur, India / 239-250 / 2016 Anita Choudhary, M. C. Govil, Girdhari Singh, Lalit K. Awasthi, "Workflow Scheduling Algorithms in Cloud Environment: A Review, Taxonomy, and Challenge" , 4th International Conference on Parallel, Distributed and Grid Computing (PDGC) by :IEEE at Solan, India / 617-624 / 2016 Ashish Sharma, Ruby Ansar, Manoj Singh Gaur, Lava Bhargava, Vijay Laxmi , "Reducing FIFO Buffer Power Using Architectural Alternatives at RTL" , VDAT by :IEEE at Guwahati / 1-6 / 2016 Gaurav Singal, Vijay Laxmi, Manoj Singh Gaur, Swati

Todi, Vijay Rao, Akka Zemmari, "MCLSPM: Multi-Constraints Link Stable Multicast Routing Protocol in Adhoc Networks" , Wireless Days by :IEEE at Toulouse, France / 1-6 / 2016 Sonal Yadav, Vijay Laxmi, Manoj Singh Gaur, "A Power Efficient Dual Link Mesh NoC Architecture to Support Nonuniform Traffic Arbitration at Routing Logic." , 29th VLSI Design 2016 by :IEEE Computer Society at Kolkata, India / 69-74 / 2016 Bharat Buddhdev, Parvez Faruki, Manoj Singh Gaur, Vijay Laxmi, "Android Component Vulnerabilities: Proof of Concepts and Mitigation." , International Conference on Information Networking (ICOIN) by :IEEE Computer Society at Kota Kinabalu, Malaysia / 17-22 / 2016 Vineeta Jain, Manoj Singh Gaur, Vijay Laxmi, Mohamed Mosbah, "Detection of SQLite Database Vulnerabilities in Android Apps" , 12th International Conference on Information Systems Security (ICISS) by :Springer at Jaipur, India / 521-531 / 2016 Ankit Gangwal, Megha Gupta, Manoj Singh Gaur, Vijay Laxmi, Mauro Conti, "ELBA: Efficient Layer Based Routing Algorithm in SDN" , 25th International Conference on Computer Communication and Networks (ICCCN) by :IEEE at Waikoloa, HI, USA / 1-7 / 2016 Parvez Faruki, Akka Zemmari, Manoj Singh Gaur, Vijay Laxmi, Mauro Conti, "MimeoDroid: Large Scale Dynamic App Analysis on Cloned Devices via Machine Learning Classifiers" , 46th Annual IEEE/IFIP International Conference on Dependable Systems and Networks Workshops (DSN Workshops) by :IEEE Computer Society at Toulouse, France / 60-65 / 2016 Lovely Sinha, Shweta Bhandari, Parvez Faruki, Manoj Singh Gaur, Vijay Laxmi, Mauro Conti, "FlowMine: Android App Analysis via Data Flow" , 13th IEEE Annual Consumer Communications & Networking Conference (CCNC) by :IEEE at Las Vegas, NV, USA / 435-441 / 2016 Shweta Bhandari, Vijay Laxmi, Akka Zemmari, Manoj Singh Gaur, "Intersection Automata Based Model for Android Application Collusion" , 30th IEEE International Conference on Advanced Information Networking and Applications (AINA) by :IEEE at Crans-Montana, Switzerland / 901-908 / 2016 Chandra Prakash, Anshul Mittal, Rajesh Kumar and Namita Mittal., "A Framework for Human Recognition Using a Multimodal Gait Analysis Approach" , 2016 International Conference on Advances in Computing, Communications and Informatics (ICACCI 2016) by :IEEE Explore at Delhi / / 2016 Vijay Kumar Sharma, Namita Mittal, "Exploiting Wikipedia API for Hindi-English Cross-Language Information Retrieval" , 12th International Conference on Communication Networks, ICCN 2016, Procedia Computer Science by :Elsevier at Bangalore / 434-440 / 2016 Vijay Kumar Sharma, Namita Mittal, "Exploiting Parallel Sentences and Cosine Similarity for Identifying Target Language Translation" , Twelfth International Conference on Communication Networks, ICCN 2016, Procedia Computer Science by :ELSEVIER at Bangalore / 428-433 / 2016 Chandra Prakash, Rajesh Kumar, Namita Mittal, "Automated Detection of Human Gait Events From Conventional Videography" , IEEE International Conference on Emerging Trends in Communication Technologies ICETCT 2016 by :IEEE at Dehradun / / 2016 ISBN: 978-1-5090-4505-1 Abhishek Singh Kilak, Namita Mittal , "Classification of Emotions From Images Using Localized Subsection Information" , International Conference on Advances in Computing and Data Sciences by :Springer at Ghaziabad / 562-571 / 2016 ISBN: 978-981-10-5427-3 Gourav Takhar, Chandra Prakash, Namita Mittal, Rajesh Kumar, "Comparative Analysis of Background Subtraction Techniques and Applications" , IEEE International

Conference on Recent Advances and Innovations in Engineering (ICRAIE-2016) by :IEEE at Jaipur / 1-8 / 2016 ISBN: 978-1-5090-2807-8 Achin Varshney, Chandra Prakash, Namita Mittal, Pushpendra Singh , "A Multimodel Approach for Schizophrenia Diagnosis Using fMRI and sMRI Dataset" , Intelligent Systems Technologies and Applications 2016 by :Springer at Kochi / 869-877 / 2016 ISBN: 978-3-319-47952-1 Candy Lalrempuii, Namita Mittal, "Sentiment Classification of Crisis Related Tweets Using Segmentation" , Proceedings of the International Conference on Informatics and Analytics ICIA2016 by :ACM at Pondicherry / 1-6 / 2016 ISBN: 978-1-4503-4756-3 Somya Gupta, Namita Mittal, Alok Kumar, "Rake-Pmi Automated Keyphrase Extraction: An Unsupervised Approach for Automated Extraction of Keyphrases" , Proceedings of the International Conference on Informatics and Analytics ICIA2016 by :ACM at Pondicherry / 1-6 / 2016 ISBN: 978-1-4503-4756-3 Harsha Gwalani, Namita Mittal, Ankit Vidyarthi, "Classification of Brain Tumours Using Genetic Algorithms as a Feature Selection Method GAFS" , Proceedings of the International Conference on Informatics and Analytics ICIA2016 by :ACM at Pondicherry / 1-5 / 2016 ISBN: 978-1-4503-4756-3 Chandra Prakash, Anshul Mittal, Shubam Tripathi, Rajesh Kumar, Namita Mittal, "A Framework for Human Recognition Using a Multimodel Gait Analysis Approach" , IEEE International Conference on Computing, Communication and Automation (ICCCA) by :IEEE at Noida / 1-6 / 2016 ISBN: 978-1-5090-1666-2 Vijay Kumar Sharma, Namita Mittal, "Exploring Bilingual Word Vectors for Hindi-English Cross-Language Information Retrieval" , Proceedings of the International Conference on Informatics and Analytics ICIA2016 by :ACM at Pondicherry / 1-4 / 2016 ISBN: 978-1-4503-4756-3 Vishakha Sharma and Neeta Nain, "A Redefined Codebook Model for Dynamic Backgrounds" , International Conference on Computer Vision & Image Processing CVIP2016, IIT Roorkee, Feb.26-28, 2016. by :IEEE at IIT Roorkee / 1-4 / 2016 Tapas Badal, Neeta Nain, Mushtaq Ahmed, "Surveillance Video Synopsis While Preserving Object Motion Structure and Interaction" , International Conference on Computer Vision and Image Processing) Conference Held at IIT-Roorkee on 26-28 Feb 2016. by :Springer at IIT-Roorkee on 26-28 Feb 2016. / 4-8 / 2016 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "An (N, N)-Multi Secret Image Sharing Scheme Using Boolean XOR and Modular Arithmetic" , The 30th IEEE International Conference on Advanced Information Networking and Applications (AINA-2016) by :IEEE at , Crans-Montana, Switzerland. / / 2016 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "A Novel Approach of an (N, N) Multi Secret Image Sharing Scheme Using Additive Modulo" , International Conference on Computer Vision and Image Processing) Conference Held at IIT-Roorkee on 26-28 Feb 2016. by :Springer at IIT-Roorkee / / 2016 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "An Improved (N, N)-Multi Secret Image Sharing Scheme Using Boolean XOR and Reverse Bits" , International Conference on Recent Advances in Information Technology (RAIT-2016) by :IEEE at IIT Dhanbad, India / / 2016 Tapas Badal, Neeta Nain, Mushtaq Ahmed and Vishakha Sharma, "an Improved Multi-Layer Codebook Model to Eliminate Ghost Region" , The Fifth National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics by :IEEE at IIT-Patna / / 2016 Sonu Lamba, Neeta Nain, Harendra Chahar, "A Robust Multi-Model Approach for Face Detection in Crowd" , 12th IEEE

International Conference on Signal Image Technology and Internet Based Systems by IEEE at Naples, by :IEEE at Naples, Italy / 96-103 / 2016 ISBN: 978-1-5090-5698-9 Riti Kushwaha, Neeta Nain, Sandeep Kumar Gupta, "Person Identification on the Basis of Footprint Geometry" , 12th IEEE International Conference on Signal Image Technology and Internet Based Systems by IEEE at Naples, by :IEEE at Naples, Italy / 164-171 / 2016 ISBN: 978-1-5090-5698- Maroti Deshmukh, Neeta Nain and Mushtaq Ahmed, "Enhanced Modulo Based Multi Secret Image Sharing Scheme" , International Conference on Information Systems Security by :Springer at Jaipur / 212-224 / 2016 Maninder Singh Nehra, Neeta Nain and Mushtaq Ahmed, "Handwritten Devnagari Script Database Development for Off-Line Hindi Character With Matra (Modifiers)" , Proceedings of the International Conference on Recent Cognizance in Wireless Communication & Image Processing by :Springer at New Delhi / 233-240 / 2016 Kunwar Pal, Mahesh Chandra Govil, and Mushtaq Ahmed , "Comparative Analysis of New Hybrid Approach for Overlay Construction in P2P Live Streaming" , International Conference on Emerging Research in Computing, Information, Communication and Applications by :Springer at Nitte Meenakshi Institute of Technology, Bengaluru / 239-250 / 2016 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "An Improved N, N Multi Secret Image Sharing Scheme Using Boolean XOR and Reverse Bits" , RAIT (Scopus Indexed) by :IEEE at IIT Dhanbad / / 2016 Maroti Deshmukh, Neeta Nain, Mushtaq Ahmed, "An N, N Multi Secret Image Sharing Scheme Using Boolean XOR and Modular Arithmetic" , The 30th IEEE International Conference on Advanced Information Networking and Applications (AINA-2016) by :IEEE at Crans-Montana, Switzerland / / 2016 Manish Jain, Dinesh Gopalani, "Testing Application Security With Aspects" , 2016 International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT) by :IEEE at Chennai, India / - / 2016 Jyoti Yadav, Yogesh Kumar Meena, "Use of Fuzzy Logic and Wordnet for Improving Performance of Extractive Automatic Text Summarization" , 2016 International Conference on Advances in Computing, Communications and Informatics (ICACCI 2016) by :IEEE Explore at LNMIIT Jaipur / 2071-2077 / 2016 P. Mishra, E. S. Pilli, U. Tupakula, and V. Varadharajan, "Efficient Approaches for Intrusion Detection in Cloud Environment" , International Conference on Computing Communication and Automation (ICCCA 2016) by :IEEE at Greater Noida, India / 1211-1216 / 2016 N. Kumar, M. Singh, M. C. Govil, E. S. Pilli, and A. Jaiswal, "Salient Object Detection in Noisy Images" , 29th Canadian Conference on Artificial Intelligence (Canadian AI 2016) by :Springer at Victoria, Canada / 109-114 / 2016 P. Mishra, E. S. Pilli, V. Varadharajan, and U. Tupakula, "NvCloudIDS: A Security Architecture to Detect Intrusions at Network and Virtualization Layer in Cloud Environment" , 2016 International Conference on Advances in Computing, Communications and Informatics (ICACCI 2016) by :IEEE Explore at Jaipur, India / 56-62 / 2016 P. Mishra, E. S. Pilli, V. Varadharajan, U. Tupakula, "Securing Virtual Machines From Anomalies Using Program-Behavior Analysis in Cloud Environment" , 18th IEEE International Conferences on High Performance Computing and Communications (HPCC) by :IEEE at Sydney, Australia / 991-998 / 2016 R. Sharma, P. Sharma, P. Mishra and E. S. Pilli , "Towards MapReduce Based Classification Approaches for Intrusion Detection" , International Conference on Cloud System and

Big Data Engineering (Confluence) by :IEEE at Noida, India / 361-367 / 2016 ISBN: 978-1-4673-8203-8 R. Grover, C. R. Krishna, A. K. Mishra, E. S Pilli, and M. C. Govil , "A Comparison of Analysis Approaches for Cloud Forensics" , International Conference on Cloud Computing in Emerging Markets (CCEM) by :IEEE at Bangalore, India / 131-135 / 2016 ISBN: 978-1-5090-4573-0 A. Sharma, E. S. Pilli, A. P. Mazumdar, and M. C. Govil, "A Framework to Manage Trust in Internet of Things" , International Conference on Emerging Trends in Communication Technologies (ETCT) by :IEEE at Dehradun, India / 1-5 / 2016 ISBN: 978-1-5090-4505-1 A. Ratnaparkhi, E. S. Pilli, and R. C. Joshi, "Survey of Scaling Platforms for Deep Neural Networks" , International Conference on Emerging Trends in Communication Technologies (ETCT) by :IEEE at Dehradun, India / 1-6 / 2016 ISBN: 978-1-5090-4505-1 S. S. Chauhan, E. S. Pilli and R.C. Joshi, "A Broker Based Framework for Federated Cloud Environment" , International Conference on Emerging Trends in Communication Technologies (ETCT) by :IEEE at Dehradun, India / 1-5 / 2016 ISBN: 978-1-5090-4505-1 N. Chand, P. Mishra, C. R. Krishna, E. S. Pilli and M. C. Govil, "A Comparative Analysis of SVM and Its Stacking With Other Classification Algorithm for Intrusion Detection" , International Conference on Advances in Computing, Communication, & Automation (ICACCA) by :IEEE at Dehradun, India / 1-6 / 2016 ISBN: 978-1-5090-0673-1 Dinesh Kumar Tyagi,V. K. Chaubey,Parth Khandelwal, "Routing and Wavelength Assignment in WDM Network Using IWD Based Algorithm" , 2016 International Conference on Computing, Communication and Automation (ICCCA) by :IEEE at Noida / / 2016 Dinesh Kumar Tyagi, VK Chaubey, "Performance Evaluation of Path Length Based Routing Strategies for Survivable WDM Network" , ACM Second International Conference on Information and Communication Technology for Competitive Strategies by :ACM at Udaipur, India / / 2016 S.S. Chouhan, R. Niyogi , "Multi-Agent Planning With Collaborative Actions" , 29th Australasian Joint Conference on Artificial Intelligence by :Springer at Australia / 609-620 / 2016 Satyendra Singh Chouhan and Rajdeep Niyogi, "Multi-Agent Planning With Quantitative Capability" , 5th IEEE International Conference on Advances in Computing, Communication and Informatics (ICACCI) by :IEEE at Jaipur / 602-606 / 2016 Mahipal Jadeja and Rahul Muthu, "Labeled Object Treemap: A New Technique for Visualizing Multiple Hierarchies" , The 19th Japan-Korea Joint Workshop on Algorithms and Computation by :Conference Proceeding at Hakodate, Japan / / 2016 Ravi Goyal, Mahipal Jadeja, Rahul Muthu and Brijesh Patel, "A New Characterisation of Total Graphs" , The 19th Japan-Korea Joint Workshop on Algorithms and Computation by :Conference Proceeding at Hakodate, Japan / / 2016 Lavika Goel, Anurag Prakash, "Sentiment Analysis of Online Communities Using Swarm Intelligence Algorithms" , 2016 8th International Conference on Computational Intelligence and Communication Networks (CICN) by :IEEE at Tehri, India / / 2016 Lavika Goel, Rashi Khandelwal, Eloy Retamino, Suraj Nair, Alois Knoll, "Application of a Hybrid Relation Extraction Framework for Intelligent Natural Language Processing" , The International Symposium on Intelligent Systems Technologies and Applications by :Springer at Jaipur / / 2016 Lavika Goel, Sunita Singhal, Sharthak Mishra, Satyajit Mohanty, "Hybridization of Gravitational Search Algorithm and Biogeography Based Optimization and Its Application on Grid

Scheduling Problem" , 2016 Ninth International Conference on Contemporary Computing (IC3) by :IEEE at Noida / / 2016 Nupur Bansal, Sanjay Kumar, Ashish Tripathi, "Application of Artificial Bee Colony Algorithm Using Hadoop" , International Conference on Computing for Sustainable Global Development (INDIACom) by :IEEE at Delhi / 3615-3619 / 2016 2015 Mukesh Kumar Gupta, Mahesh Chandra Govil, Girdhari Singh, "Text-Mining Based Predictive Model to Detect XSS Vulnerable Files in Web Applications" , 12th IEEE India International Conference (INDICON 2015) by :IEEE at New Delhi, India / 1-6 / 2015 Vipin Pal, Yogita, Girdhari Singh, R.P Yadav, "Analytical and Simulation Modeling to Analyze Reliability State of Wireless Sensor Networks" , World Conference on Information Systems and Technologies by :Springer at Funchal, Portugal / 1001-1011 / 2015 Mukesh Kumar Gupta, M.C. Govil, Girdhari Singh, "Predicting Cross-Site Scripting (XSS) Security Vulnerabilities in Web Applications" , 12th International Joint Conference on Computer Science and Software Engineering (JCSSE) by :IEEE at Hatyai, Thailand / 162-167 / 2015 Rajat Goel, M.C. Govil, Girdhari Singh, "Security Requirements Elicitation and Assessment Mechanism (SecREAM)" , 4th International Conference on Advances in Computing, Communications and Informatics (ICACCI-2015) by :IEEE at Kochi, India / 1862-1866 / 2015 Mukesh Kumar Gupta, M.C. Govil, Girdhari Singh, Priya Sharma, "XSSDM: Towards Detection and Mitigation of Cross-Site Scripting Vulnerabilities in Web Applications" , 4th International Conference on Advances in Computing, Communications and Informatics (ICACCI-2015) by :IEEE at Kochi, India / 2010-2015 / 2015 L.K. Sharma, N. Mittal, "Topic Oriented Semantic Parsing" , International Conference on Semantic computing(ICSC) by :IEEE at Anaheim, CA / 159-164 / 2015 Chandra Prakash, Kanika, Rajesh Kumar, Namita Mittal, "Fuzzy Logic Based Gait Phase Detection Using Passive Markers" , Fifth International Conference on Soft Computing for Problem Solving (SocPros15) by :Springer at India / 12 / 2015 Chandra Prakash, Rajesh Kumar, Namita Mittal, "Vision Based Gait Analysis Techniques in Elderly Life -Towards a Better Life" , CSI Communication, Computer Society of India Issue by :CSI at Delhi / 5 / 2015 Chandra Prakash, Anshul Mittal, Rajesh Kumar, Namita Mittal, "Identification of Gait Parameters From Silhouette Images" , Eight International Conference on Contemporary Computing (IC3) by :IEEE at Delhi / 5 / 2015 Chandra Prakash, Anusul Mittal, Rajesh Kumar, and Namita Mittal, "Identification of Spatio-Temporal and Kinematics Parameters for 2-D Optical Gait Analysis System Using Passive Markers" , International Conference on Advances in Computer Engineering and Applications (ICACEA) by :IEEE at Ghaziabad / 6 / 2015 Maninder Nehra, Neeta Nain and Mushtaq Ahmed, "Handwritten Devanagari Script Database Development for Offline Hindi Characters With Modifiers" , International Conference on Recent Cognizance in Wireless Communication and Image Processing by :Springer at Jaipur / 233-240 / 2015 Deepa Modi and Neeta Nain, "Part of Speech Tagging of Hindi Corpus Using Rule Based Method" , International Conference on Recent Cognizance in Wireless Communication and Image Processing by :Springer at Jaipur / 241-248 / 2015 Tapas Badal, Neeta Nain, Mushtaq Ahmed, Vishakha Sharma, "An Adaptive Codebook Model for Change Detection With Dynamic Background" , 11th IEEE International Conference on Signal Image Technology and Internet Based Systems by :IEEE at Bangkok, Thailand / 110-116 /

2015 Mohit Singh, Neeta Nain, Subhash Panwar, "Foreground Object Extraction Using Thresholding With Automatic Shadow Removal" , 11th IEEE International Conference on Signal Image Technology and Internet Based Systems by :IEEE at Bangkok, Thailand / 655-662 / 2015 Prakash Choudhary, Neeta Nain, Manindra Nehra, "A Framework for Compilation of Multi-Lingual Handwritten Database: Four Levels XML Ground-Truth" , 11th IEEE International Conference on Signal Image Technology and Internet Based Systems by :IEEE at Bangkok, Thailand / 649-654 / 2015 Shalini Yadav, Neeta Nain, "Fast Face Detection Based on Skin Segmentation and Facial Features" , 11th IEEE International Conference on Signal Image Technology and Internet Based Systems by :IEEE at Bangkok, Thailand / 663-668 / 2015 Tapas Badal, Neeta Nain, Mushtaq Ahmed and Vishakha Sharma, "An Improved Multi-Layer Codebook Model to Eliminate Ghost Region" , National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics) Conference Held at IIT-Patna on 16-19 Dec, 2015. by :IEEE at IIT Patna / 1-5 / 2015 Diwakar Gautam, Mushtaq Ahmed, "Melanoma Detection and Classification Using SVM Based Decision Support System" , 12th IEEE India International Conference (INDICON 2015) by :IEEE at Jamia Millia Islamia, New Delhi / / 2015 Pal. K, Govil M.C, Ahmed M., "A New Hybrid Approach for Overlay Construction in P2P Live Streaming" , International Conference on Advances in Computing, Communications and Informatics (ICACCI) by :IEEE at Kochi / 431–437 / 2015 Tapas Badal, Neeta Nain and Mushtaq Ahmed, "An Improved Multi-Layer Codebook Model to Eliminate Ghost Region Conference Paper · December 2015 With 8 Reads" , Fifth National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG) by :IEEE at Patna / 1-4 / 2015 Ramesh babu B, Manoj Singh Gaur, Dinesh Gopalani,M Tripathi, "Spectrum Aware Distance Utilization Routing Protocol for Cognitive Radio Network" , 12 Th IEEE MICC 2015 by :IEEE at Kuching, Malaysia / 1-7 / 2015 Battula Ramesh Babu, M Tripathi, MS Gaur, D Gopalani, D Singh Ja, "Cognitive Radio Ad-Hoc Networks: Attacks and Its Impact" , International Conference on Emerging Trends in Network and Computer Communication (ETNCC 2015) by :IEEE at Namibia / 125-130 / 2015 Yogesh Kumar Meena, Dinesh Gopalani, "Improvement in Quality of Extractive Text Summaries Using Modified Reciprocal Ranking" , International Conference on Information and Communication Technology for Sustainable Development by :Springer at Ahmadabad, India / / 2015 Meena, Y.K., Deolia, P., Gopalani, D., "Optimal Features Set for Extractive Automatic Text Summarization" , Advanced Computing & Communication Technologies (ACCT) by :IEEE at India / 35-40 / 2015 Ramesh babu B, Manoj Singh Gaur, Dinesh Gopalani, Radhika K , "A Dynamic Medium Access Mechanism for Cognitive Radio Wireless Mesh Networks" , Signal Processing and Communication (ICSC), 2015 International Conference by :IEEE at Noida, India / 434 - 438 / 2015 ISBN: 978-1-4799-6760-5 Ramesh Babu Battula, Dinesh Gopalani, Manoj Singh Gaur, "Path and Load Aware Channel Assignemnt Algorithm for Cognitive Radio Wireless Mesh Networks" , 18th International Symposium on Wireless Personal Multimedia Communications by :IEEE at Hyderabad, India / - / 2015 Mohammed A R Quadri, Ramesh Babu Battula, Manoj Singh Gaur , Dinesh Gopalani,, "Distributed Token Based MAC for Multi-Channel Multi-Interface, Cognitive

Radio WMN" , 18th International Symposium on Wireless Personal Multimedia Communications by :IEEE at Hyderabad, India / - / 2015 Manish Jain, Dinesh Gopalani, "Memory Leakage Testing Using Aspects" , 2015 International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT) by :IEEE at Bengaluru, India / 436-440 / 2015 Manish Jain, Dinesh Gopalani, "Use of Aspects for Testing Software Applications" , 2015 IEEE International Advance Computing Conference (IACC) by :IEEE at Bangalore, India / 282 - 285 / 2015 ISBN: 978-1-4799-8046-8 Jyoti Gajrani, Jitendra Sarswat, Meenakshi Tripathi, Vijay Laxmi, Manoj Singh Gaur, Mauro Conti, "A Robust Dynamic Analysis System Preventing SandBox Detection by Android Malware" , 8th International Conference on Security of Information and Networks by :ACM at Sochi, Russia / 290-295 / 2015 ISBN: 978-1-4503-3453-2 Yogesh Kumar Meena, Peeyush Deolia, Dinesh Gopalani, "Optimal Features Set for Extractive Automatic Text Summarization" , International Conference on Advanced Computing & Communication by :IEEE at Rohtak India / / 2015 Ramesh babu B, Manoj Singh Gaur, Dinesh Gopalani, Radhika K, "A Dynamic Medium Access Mechanisam for Cognitive Radio Wireless Mesh Networks" , International Conference on Signal Processing and Communications (ICSC 2015) by :IEEE at Delhi, INDIA / / 2015 Kakarla, J, Majhi, B, Ramesh babu B, "A Trust Based Secured Coordination Mechanism for WSAN" , Signal Processing, Informatics, Communication and Energy Systems (SPICES) by :IEEE at NIT Calicut / 1-5 / 2015 Ramesh Babu Battula, Manoj Singh Gaur , Dinesh Gopalani, ES Pilli, "Path and Load Aware Channel Assignemnt Algorithm for Cognitive Radio Wireless Mesh Networks" , 18th International Symposium on Wireless Personal Multimedia Communications (WPMC) by :IEEE Explore at Hyderabad / / 2015 Mohammed A R Quadri, Ramesh Babu Battula, Manoj Singh Gaur , Dinesh Gopalani, Meenakshi Tripathi, "Distributed Token Based MAC for Multi-Channel Multi-Interface, Cognitive Radio WMN" , 18th International Symposium on Wireless Personal Multimedia Communications (WPMC) by :IEEE Explore at Hyderabad / / 2015 V. Goyal, A. Agarwal, E. S. Pilli and S. Mehta, "Information Integration for Movies Data Using Graph Database" , IEEE International Conference on Signal Processing, Informatics, Communication and Energy Systems (IEEE SPICES 15) by :IEEE at Calicut / 1-5 / 2015 S. Jain, E. S Pilli, M. C. Govil, D. V. Rao, "Performance Evaluation of Congestion-Aware Routing Protocols for Underwater Sensor Networks With Multimedia Data" , Underwater Technology 2015 by :IEEE at Chennai / 1-6 / 2015 A. Sharma, T. Goyal, E. S. Pilli, A. P. Mazumdar, M. C. Govil, and R. C. Joshi, "A Secure Hybrid Cloud Enabled Architecture for Internet of Things" , 2nd World Forum on Internet of Things (WF-IoT) by :IEEE at Milan, Italy / 274-279 / 2015 P. Sharma, R. Sharma, E. S. Pilli, A. K. Mishra, "A Detection Algorithm for DoS Attack in the Cloud Environment" , 8th Annual ACM India Conference (Compute 2015) by :ACM at Ghaziabad, India / 107-110 / 2015 A. Ratnaparkhi, E. S. Pilli, and R.C. Joshi, "Scaling GMM Expectation Maximization Algorithm Using Bulk Synchronous Parallel Approach" , International Conference on Green Computing and Internet of Things (ICGCIoT) by :IEEE at Noida, India / 558-562 / 2015 ISBN: 978-1-4673-7910-6 Avani Sharma, Emmanuel S Pilli, Arka P Mazumdar, MC Govil, "A Secure Hybrid Cloud Enabled Architecture for Internet of Things" , 2015 IEEE 2nd World Forum on Internet of Things (WF-IoT) by :IEEE at Milan, Italy / 274-279 / 2015 S.S. Chouhan, R.

Niyogi, "Dmapp: A Distributed Multi-Agent Path Planning Algorithm" , Australasian Joint Conference on Artificial Intelligence by :Springer at Australia / 123-135 / 2015 Satyendra Singh Chouhan, Ashutosh Singh, Rajdeep Niyogi, "Multi-Agent Planning With Joint Actions" , 4th International Conference on Advances in Computing, Communications and Informatics (ICACCI-2015) by :IEEE at Kerala / 1284-1290 / 2015 Mahipal Jadeja and Kesha Shah, "Tree-Map: A Visualization Tool for Large Data" , Graph Search and Beyond: SIGIR 2015 by :ACM at Santiago, Chile / / 2015 Lavika Goel, "A 2D Illumination Based Adaptive Gaze Tracking Approach for Varied Head Orientations" , 2015 2nd International Conference on Computing for Sustainable Global Development (INDIACom) by :IEEE at New Delhi, India / / 2015 Satyam Kashyap, Ashish Tripathi, Kapil Sharma, "Analysis and Ranking of Software Engineering Metrics" , International Conference on Computing for Sustainable Global Development (INDIACom 2015), Delhi by :IEEE at Delhi / 1654-1659 / 2015 ISBN: 9781479968329 K Sharma, AK Tripathi, "Improving Software Quality Based on Relationship Among the Change Proneness and Object Oriented Metrics" , International Conference on Computing for Sustainable Global Development (INDIACom 2015), Delhi by :IEEE at Delhi / 1633 - 163 / 2015 ISBN: 9781479968329 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Least Squares SVM Approach for Abnormal Brain Detection in MRI Using Multiresolution Analysis" , International Conference on Computing, Communication and Security (ICCCS) by :IEEE at Mauritius / 1-6 / 2015 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Classification of Brain MR Images Using Discrete Wavelet Transform and Random Forests" , 5th National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG-15) by :IEEE at IIT Patna / 1-4 / 2015 Deepak Ranjan Nayak, Ratnakar Dash, Banshidhar Majhi, "Salt and Pepper Noise Reduction Schemes Using Cellular Automata" , 3rd International Conference on Advanced Computing, Networking and Informatics (ICACNI-15) by :Springer at Bhubaneswar / 427-435 / 2015 2014 Mukesh Kumar Gupta, Mahesh Chand Govil , Girdhari Singh , "Static Analysis Approaches to Detect SQL Injection and Cross Site Scripting Vulnerabilities in Web Applications: A Survey" , IEEE International Conference on Recent Advances and Innovations in Engineering by :IEEE at India / 1-5 / 2014 Mukesh Kumar Gupta, Mahesh Chand Govil, Girdhari Singh, "An Approach to Minimize False Positive in SQLI Vulnerabilities Detection Techniques Through Data Mining" , Signal Propagation and Computer Technology (ICSPCT), 2014 International Conference by :IEEE at Ajmer / 407 - 410 / 2014 ISBN: 978-1-4799-3139-2 Mukesh Kumar Gupta, M.C Govil, Girdhari Singh, "A Context-Sensitive Approach for Precise Detection of Cross-Site Scripting Vulnerabilities" , 10th International Conference on Innovations in Information Technology by :IEEE at Al Ain, UAE / 7-12 / 2014 Mukesh Kumar Gupta, M.C Govil, Girdhari Singh, "An Approach to Minimize False Positive in SQLI Vulnerabilities Detection Techniques Through Data Mining" , International Conference on Signal Propagation and Computer Technology (ICSPCT) by :IEEE at Ajmer, India / 407-410 / 2014 Manoj Bohra, V. Laxmi, MS Gaur, "A Novel Non-Minimal Turn Model for Highly Adaptive Routing in 2D NoCs" , International Conference on Very Large Scale Integration (VLSI-SoC) by :IEEE at Playa Del Carmen, Mexico / / 2014 Chhagan Lal, V. Laxmi, M.S.Gaur, Sakshi Malpani, "Link Stability Driven

Enhancement of QoE of Video Streaming in MANETs" , IEEE International Conference on Computer Communications and Networks by :IEEE at Shanghai, China / / 2014 Parvez Faruki, Ammar Bharmal, Vijay Laxmi, Manoj Singh Gaur, Mauro Conti, "Evaluation of Android Anti Malware Techniques Against Dalvik Bytecode Obfuscation" , 12th IEEE International Conference on Trust, Security and Privacy in Computing and Communications (TrustCom 2014), 24-26 Sept., Beijing, China by :IEEE at Beijing, China / / 2014 Ankit Vidyarthi, Pragati goyal, Harsha Gwalani, Namita Mittal, "ACLIME: Automatic Cluster Identification and Merging (Presented, in Press)" , 5th International Conference Confluence by :IEEE at Noida, India / - / 2014 Ankit Vidyarthi, Namita Mittal, "CLAP- Closely Link Associated Pixel Based Extraction of Tumor in MR Images" , IEEE International Advance Computing Conference by :IEEE at Gurgaon / - / 2014 Ankit Vidyarthi, Namita Mittal, Ankita Kansal, "Text and Non-Text Region Identification Using Texture and Connected Components" , International Conference on Signal Propagation and Computer Technology (ICSPCT) by :IEEE at Ajmer, India / 604-609 / 2014 Ankit Vidyarthi, Namita Mittal,, "Disjoint Tree Based Clustering and Merging for Brain Tumor Extraction" , 2nd International Conference on Advanced Computing, Networking and Informatics (ICACNI) by :Springer at Kolkata, India / 1037- 1040 / 2014 Ankit Vidyarthi, Namita Mittal, "Probabilistic Mutual Information Based Extraction of Malignant Brain Tumors in MR Images (Accepted)" , 9th International Conference on Industrial and Information Systems (ICIIS) by :IEEE at Gwalior, India / - / 2014 Deepti Khanduja and Neeta Nain, "Script Independent Feature Set for Handwritten Text Recognition" , 37th IEEE International Convention, MIPRO2014, Conference on Intelligent Systems by :IEEE at Croatia / 1397-1402 / 2014 Subhash Panwar and Neeta Nain, "An Efficient Feature Extraction Method for Segmented Cursive Characters Recognition" , 37th IEEE International Convention, MIPRO2014, Conference on Intelligent Systems by :IEEE at Croatia / 1403-1408 / 2014 Prakash Chowdhary and Neeta Nain, "An Annotated Urdu Corpus of Handwritten Text Image and Benchmarking of Corpus" , 37th IEEE International Convention, MIPRO2014, Conference on Intelligent Systems by :IEEE at Croatia / 1409-1412 / 2014 Prakash Choudhary, Neeta Nain and Mushtaq Ahmed, "A Unified Approach for Development of Urdu Corpus for OCR and Demographic Purpose" , The 7th International Conference on Machine Vision (ICMV 2014), Milan, Italy by :SPIE at Milan, Italy / 100-104 / 2014 ISBN: Vol 9445, 944526 Tapas Badal, Neeta Nain, and Mushtaq Ahmed , "Video Partitioning by Segmenting Moving Object Trajectories" , The 7th International Conference on Machine Vision (ICMV 2014), Milan, Italy by :SPIE at Milan, Italy / 5 / 2014 ISBN: Vol 9445, 94451B Tapas Badal, Neeta Nain and Mushtaq Ahmed, "Video Synopsis by Multi-Array Representation of Moving Objects" , ICVGIP 2014 Workshop on Applications in Computer Vision, Graphics and Image Processing. by :ACM at IISC Bangalore / 200-204 / 2014 Sharda Godara, Neeta Nain and Mushtaq Ahmed, "Handwritten Urdu Script Segmentation Using Hybrid Approach" , ICVGIP 2014 - Workshop on Document Analysis and Recognition, DAR 2014 by :ACM at IISC Bangalore / 204 - 208 / 2014 Prakash Choudhary and Neeta Nain, "CALAM: Linguistic Structure to Annotate Handwritten Text Image Corpus" , Computational Intelligence in Data Mining by :Springer at Orissa / 449-460 / 2014 ISBN: 978-81-322-2208-8 Prakash Choudhary and Neeta Nain, "A

Structure for Annotation and Ground-Truthing of Urdu Handwritten Text Image Corpus" , 7th International Conference on Corpus Linguistic, CILC2015, Proceeding of Elsevier, University of Valladolid, Spain by :Elsevier at Spain / 84-88 / 2014 ISBN: Vol198 Mushtaq Ahmed, Diwakar Gautam, "Efficient Fuzzy Edge Detection Using Successive Otsu’s Method" , International Conference on Convergence of Technology (I2CT) 2014 by :IEEE at Pune, India / 5 / 2014 ISBN: 978-1-4799-3759-2 Dipika Singh, Diwakar Gautam, Mushtaq Ahmed , "Detection Techniques for Melanoma Diagnosis: A Performance Evaluation" , International Conference on Signal Propagation and Computer Technology (ICSPCT) by :IEEE at Ajmer / 567-572 / 2014 Subhash Panwar, Mushtaq Ahamed, Neeta Nain , "Ligature Segmentation Approach for Urdu Handwritten Text Documents" , Information and Communication Technology for Competitive Strategies -ICTCS14 by :ACM at SGI, Udaipur / 1-5 / 2014 Ramesh babu B, Dinesh Gopalani, Manoj Singh Gaur, Jagdeesh K,, "TMAC — Token Based MAC Protocol for Cognitive Radio Wireless Mesh Network" , Information and Communication Technology Convergence (ICTC)(5th) by :IEEE at BUSAN, South Korea / 151-156 / 2014 Yogesh Kumar Meena, Dinesh Gopalani, "Analysis of Sentence Scoring Methods for Extractive Automatic Text Summarization" , International Conference on Information and Communication Technology for Competitive Strategies (ICTCS 14) by :ACM at Udaipur, India / 1-6 / 2014 Yogesh Kumar Meena, Ashish Jain, Dinesh Gopalani, "Survey on Graph and Cluster Based Approaches in Multi-Document Text Summarization" , IEEE International Conference on I C R a I E - 2 0 1 4 by :IEEE at Jaipur, India / 1-5 / 2014 Ramesh babu B, Dinesh Gopalani, Manoj Singh Gaur, Meenakshi Tripathi, "DAU- Distance-Utilization Routing Protocol for Cognitive Radio Wireless Mesh Networks" , 2014 Annual IEEE India Conference (INDICON) by :IEEE at Pune, India / 1-6 / 2014 ISBN: 978-1-4799-5362-2 babu B, Dinesh Gopalani, Manoj Singh Gaur, Meenakshi Tripathi, , "DAU- Distance-Utilization Routing Protocol for Cognitive Radio Wireless Mesh Networks" , India Conference (INDICON) (11th) by :IEEE at Pune, INDIA / 11-13 / 2014 Jagadeesh Kakarla, Banshidhar Majhi, Ramesh Babu Battula, Tripathi, M.,, "A Multi-Channel MAC Protocol for Actor-Actor Coordination in WSAN" , TENCON by :IEEE at Bangkok, Thailand / 1-6 / 2014 Yogesh Kumar Meena, Ashish Jain, Dinesh Gopalani, "Survey on Graph and Cluster Based Approaches in Multi-Document Text Summarization" , International Conference on Recent Advances and Innovations in Engineering by :IEEE at Jaipur / 1-5 / 2014 ISBN: 978-1-4799-4041-7 M. M. Agarwal, M. C. Govil and A. K. Jhankal, "A Probabilistic Method to Optimize Energy Consumption in Mobile Ad-Hoc Networks" , Recent Advances and Innovations in Engineering (ICRAIE), 2014 by :IEEE at A Probabilistic Method to Optimize Energy Consumpt / / 2014 M. M. Agarwal, M. C. Govil and A. K. Jhankal, "Nature Inspired Routing Protocols to Optimize the Performance of Mobile Ad-Hoc Networks" , National Conference on Advance Computing and Communication for Technologies by :- at Jaipur / / 2014 D. S. Rathore, D. Bordoloi, E. S. Pilli and M. C. Govil, "Virtual Clock Rate Based Time Synchronization for Wireless Sensor Networks" , International Conference on Emerging Research in Computing, Information, Communication and Applications by :- at Banglore / / 2014 Jagadeesh Kakarla, Banshidhar Majhi, Ramesh Babu Battula,, "A Voronoi Diagram Based Efficient Coordination Mechanism for

WSAN" , Networks & Soft Computing (ICNSC) by :IEEE at Guntur, INDIA / 226-230 / 2014 Meenakshi Tripathi, Ramesh Babu Battula, Manoj Singh Gaur, Vijay Laxmi,, "Energy Efficient Clustered Routing for Wireless Sensor Network" , Energy Efficient LEACH-C Protocol for Wireless Sensor Network by :IEEE at China / 330-335 / 2014 D. S. Rathore, D. Bordoloi, E. S. Pilli, and M. C. Govil, "Levelsync: A Hierarchical Time Synchronization Mechanism for Wireless Sensor Networks" , 7th International Conference on Contemporary Computing (IC3-2014) by :IEEE at Noida, India / 276-282 / 2014 S. Gupta, E. S. Pilli, P. Mishra, S. Pundir, and R. C. Joshi, "Forensic Analysis of E-Mail Address Spoofing" , Fifth International Conference on Cloud Security and Big Data (Confluence 2014) by :IEEE at Noida, India / 1-6 / 2014 A. K. Mishra, E. S. Pilli and M. C. Govil, "A Prototype Implementation of Log Acquisition in Private Cloud Environment" , International Conference on Eco-Friendly Computing and Communication Systems (ICECCS 2014) by :IEEE at NITK Surathkal, India / 1-6 / 2014 A. Bijalwan, and E. S. Pilli, "Understanding Botnet on Internet" , International Conference on Computational Intelligence and Computing Research by :IEEE at Coimbatore, India / 1-5 / 2014 ISBN: 978-1-4799-3975-6 Arka Prokash Mazumdar, Ashok Singh Sairam and Joydeep Chandra, "Exploiting Node Heterogeneity for Time Synchronization in Low Power Sensor Networks" , Proceedings of Xerox Research Centre India (XRCI) by :Xerox Research Centre India at Bangalore, India / - / 2014 Shilpi Saxena, Satyendra singh Chouhan, "OFDTs:-An Optimally Fair Dynamic Task Scheduling Algorithm in Cloud Environment"" , 7th International Conference on Contemporary Computing (IC3-2014) by :IEEE at Noida, India / 583-588 / 2014 Smita Naval, Vijay Laxmi, Manoj Singh Gaur, Sachin Raja, Muttukrishnan Rajarajan, Mauro Conti, "Environment-Reactive Malware Behavior: Detection and Categorization" , 7th International Workshop on Autonomous and Spontaneous Security (SETOP -14) Held in Conjunction With ESORICS by :Springer at Wroclaw, Poland / 167-182 / 2014 Neha Gupta, Smita Naval, Vijay Laxmi, Manoj Gaur and Muttukrishnan Rajarajan, "P-SPADE: GPU Accelerated Malware Packer Detection" , 12th International Conference on Privacy, Security and Trust (PST). IEEE, Toronto, Canada by :IEEE at Toronto, Canada / 257-263 / 2014 Smita Naval, Vijay Laxmi, Neha Gupta, Manoj Singh Gaur, Muttukrishnan Rajarajan, "Exploring Worm Behaviors Using DTW" , 7th International Conference on Security of Information and Networks. by :ACM at Glasgow, UK / 379-384 / 2014 ISBN: 978-1-4503-3033-6 Daya Gupta, Lavika Goel, Ashish Chopra, "Enhanced Heuristic Approach for Travelling Tournament Problem Based on Extended Species Abundance Models of Biogeography" , 2014 International Conference on Advances in Computing, Communications and Informatics (ICACCI) by :IEEE at New Delhi, India / / 2014 Tanu Varshney, Lavika Goel, Daya Gupta, VK Panchal, "Efficient Resolution of Mixed Pixels Using Bio-Inspired Heuristics" , 2014 International Conference on Reliability Optimization and Information Technology (ICROIT) by :IEEE at Faridabad, India / / 2014 Ashish Kumar Tripathi, Kapil Sharma, "Optimizing Testing Efforts Based on Change Proneness Through Machine Learning Techniques" , PIICON 2014 by :IEEE at Delhi / 1-4 / 2014 ISBN: 9781479960439 Jahangir Mohammed, Deepak Ranjan Nayak, "An Efficient Edge Detection Technique by Two Dimensional Rectangular Cellular Automata" , International Conference on Information Communication and Embedded

Systems (ICICES) by :IEEE at Chennai / 1-4 / 2014 2013 Vipin Pal, Girdhari Singh, R P Yadav, "Cluster Head Selection Scheme for Data Centric Wireless Sensor Networks" , 3rd IEEE International Advance Computing Conference (IACC 13) by :IEEE at Ghaziabad / 330-334 / 2013 ISBN: 978-1-4673-4527-9 Vipin Pal, Girdhari Singh, R P Yadav, "Network Adaptive Round-Time Clustering Algorithm for Wireless Sensor Networks" , Advances in Computing, Communications and Informatics (ICACCI), 2013 International Conference On by :IEEE at Mysore / 1299-1302 / 2013 ISBN: 978-1-4799-2432-5 Manoj Kumar, Vijay Laxmi, Manoj Gaur, Masoud Daneshtalab, Seok-Bum Ko and Mark Zwolinski, "Low-Cost Highly Adaptive and Congestion-Aware Routing for 3D on Chip Networks" , GLSVLSI by :IEEE at USA / / 2013 Manoj Kumar, Vijay Laxmi, MS Gaur, Masoud Daneshtalab, Pankaj, Seok-Bum Ko and Mark Zwolinski, "A Novel Non-minimal/Minimal Turn Model for Highly Adaptive Routing in NoCs" , 8th International Symposium on Networks-on-Chip, Ferrara Italia, Sep 17-19, 2014 by :IEEE at Ferrara Italia / / 2013 Basant Agarwal, Namita Mittal, Vijay Kumar Sharma, "Feature Extraction Methods for Semantic Orientation Based Approaches to Sentiment Analysis" , In 10th International Conference on Natural Language Processing by :ACL Anthology at Noida / - / 2013 Namita Mittal, Basant Agarwal, Saurabh Agarwal, Subham Agarwal, Pramod Gupta, "A Hybrid Approach for Twitter Sentiment Analysis" , In 10th International Conference on Natural Language Processing (ICON) by :ACL Anthology at Noida / - / 2013 Basant Agarwal, Namita Mittal, "Optimal Feature Selection for Sentiment Analysis" , In 14th International Conference on Intelligent Text Processing and Computational Linguistics by :Springer at Greece / 13-24 / 2013 Basant Agarwal, Vijay Sharma, Namita Mittal, "Sentiment Classification of Review Documents Using Phrases Patterns" , In the International Conference on Advances in Computing, Communications and Informatics (ICACCI by :IEEE at Mysore / 1577-1580 / 2013 Namita Mittal, Basant Agarwal, Nikita Vijay, Adarsh Gupta, "Text Summarization With Semantics Information" , In 10th International Conference on Natural Language Processing (ICON) by :ACL Anthology at Noida / - / 2013 Basant Agarwal, Namita Mittal, Erik Cambria, "Enhancing Sentiment Classification Performance Using Bi-Tagged Phrases" , In 13th IEEE International Conference on Data Mining Workshops (ICDMW 2013) by :IEEE at Texas / - / 2013 Basant Agarwal, Namita Mittal, "Sentiment Classification Using Rough Set Based Hybrid Feature Selection" , In Proceedings of the 4th Workshop on Computational Approaches to Subjectivity, Sentiment and Social Media Analysis (WASSA'13), by :ACL Anthology at Atlanta USA / 115-119 / 2013 Sumit Kumar Verma, Namita Mittal, Basant Agarwal, "Hybrid Recommender System Based on Fuzzy Clustering and Collaborative Filtering" , In 4th International Conference on Computer and Communication Technology, by :IEEE at Allahabad / - / 2013 Namita Mittal, Basant Agarwal, Garvit Chouhan, Prateek Pareek, Nitin Bania, "Discourse Based Sentiment Analysis for Hindi Reviews" , In the 5th International Conference on Pattern Recognition and Machine Intelligence (PReMI'13) by :Springer at Kolkata / 720-725 / 2013 Namita Mittal, Basant Agarwal, Garvit Chouhan, Nitin Bania, Prateek Pareek, , "Sentiment Analysis of Hindi Reviews Based on Negation and Discourse Relation" , In the Proceedings of 6th International Joint Conference on Natural Language Processing (IJCNLP), by :ACL Anthology at Japan / 45-50 / 2013 Ankit

Vidyarthi, Namita Mittal, "A Hybrid Model for Extraction of Tumor in MR Images" , International Conference on Signal Processing and Communication (ICSC) by :IEEE at Noida India / 202-206 / 2013 ISBN: 978-1-4799-1605-4 Ankit Vidyarthi, Namita Mittal, "Comparative Study of Brain Tumor Classification in MR Images" , International Conference on Soft Computing for Problem Solving by :Springer at Noida, IIT Roorkee Ext Centre / 889-897 / 2013 ISBN: - Subhash Panwar and Neeta Nain, "A Simple and Novel Adaptive Binarization Approach for Handwritten Documents" , IEEE Proceedings of International Conference on Intelligent Systems and Signal Processing by :IEEE at Gujarat / 106-110 / 2013 Subhash Panwar and Neeta Nain, "Handwritten Text Line Segmentation Using Connectivity Strength Between Connected Components" , 9th International Conference, Machine Learning and Data Mining 2013 by :Ibai-Publishing at New York, USA / 99-102 / 2013 ISBN: 978-3-942952-25-5 Subhash Panwar, Neeta Nain, Subhra Saxena, P C Gupta, "Language Adaptive Methodology for Handwritten Text Line Segmentation" , 15th International Conference on Computer Analysis of Images and Patterns, CAIP 2013 by :Springer at York - UK / 344-351 / 2013 ISBN: Volume 8047 Deepti Khanduja, Neeta Nain, "Segmentation and Recognition Techniques for Handwritten Devanagari Script" , MUSCLE International Workshop on Computational Intelligence for Multimedia Understanding by :IEEE at Turkey / 105 - 111 / 2013 Sanatan Sukhija, Subhash Panwar, Neeta Nain, "CRAMM: Character Recognition Aided by Mathematical Morphology ," , Second International Conference on Image Information Processing (ICIIP), 2013 by :IEEE at Shimla / 323 -328 / 2013 ISBN: 978-1-4673-6099-9 Subhash Panwar, Neeta Nain, "Cursive Stroke Sequencing for Handwritten Text Documents Recognition" , Fourth National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics 2013 by :IEEE at IIT Jodhpur / 1-4 / 2013 ISBN: 978-1-4799-1586-6 Vinay Kumar Kaushik, Dinesh Gopalani, "Load Balancing in Cloud Computing Using High Level Fragmentation of Dataset" , International Conference on Cloud, Big Data and Trust (ICCBDT - 2013) by :RGPV, Bhopal at Bhopal / 118-126 / 2013 Meenakshi Tripathi,M.S. Gaur, V. Laxmi and R.B. Battula , "Energy Efficient Clustered Routing for Wireless Sensor Network" , IEEE 9th International Conference on Mobile Ad-Hoc and Sensor Networks by :IEEE at Dalian, China / 330-335 / 2013 Meenakshi Tripathi,M.S. Gaur, V. Laxmi and R.B. Battula , "Energy Efficient LEACH-C Protocol for Wireless Sensor Network" , International Conference on Information Technology in Signal and Image Processing (iTSiP) by :IET Digital Library at Mumbai / 46-51 / 2013 Meenakshi Tripathi,M.S. Gaur, V. Laxmi , "Comparing the Impact of Black Hole and Gray Hole Attack on LEACH in WSN" , International Symposium on Intelligent Systems Techniques for Ad Hoc and Wireless Sensor Networks by :Elsevier at Canada / 1101-1107 / 2013 Meenakshi Tripathi,M.S. Gaur, V. Laxmi , "Simulating Snooze Attack on LEACH in WSN" , Third International Conference on Computer Science, Engineering and Applications by :AIRCC at Delhi / 393-399 / 2013 Meenakshi Tripathi,M.S. Gaur, V. Laxmi , "A Novel Attack Simulation on LEACH in WSN" , International Conference on Advance Research Engineering and Technology by :K L University at Vijaywada / 140-143 / 2013 M Tripathi, MS Gaur, V Laxmi, RB Battula, "Energy Efficient LEACH-C Protocol for Wireless Sensor Network" , Third International Conference on Computational

Intelligence and Information Technology (CIIT 2013) by :IET Digital Library at Mumbai, India / 402-405 / 2013 ISBN: 978-1-84919-859-2 Smita Naval, Yogesh Meena, Vijay Laxmi, Vinod P, "Relevant Hex Patterns for Malcode Detection" , International Conference on Intelligent Systems and Signal Processing (ISSP), 2013 by :IEEE at Anand Gujrat India / 334-337 / 2013 ISBN: 978-1-4799-0316-0 M. M. Agarwal, M. C. Govil and A. K. Jhankal, "Application of Solar Power System in Mobile Ad-Hoc Network" , Recent Trends, Technology & Challenges for Renewable Energy Sources & Systems by :- at Jaipur / / 2013 J. K. Deegwal, A. Kumar, M.M. Sharma and M.C. Govil, "Design of Compact Printed 5.5 GHz Band-Notched UWB Antenna With U-Slot" , National Conference on Energy, Materials and Communication Systems by :- at Jaipur / 46 / 2013 J. K. Deegwal, A. Kumar, S. Yadav, M.M. Sharma and M.C. Govil, "Design and Analysis of Compact Printed 3.5/5.5 GHz Dual Band-Notched Ultra-Wideband Antenna" , IEEE Indian Antenna Week by :IEEE at Aurangabad / 75-78 / 2013 Meenakshi Tripathi, RB Battula, MS Gaur, V Laxmi, "Energy Efficient Clustered Routing for Wireless Sensor Network" , 2013 IEEE Ninth International Conference on Mobile Ad-Hoc and Sensor Networks (MSN), by :IEEE Xplore at China / 330-335 / 2013 Meenakshi Tripathi, Manoj Singh Gaur, Vijay Laxmi, Ramesh Babu Battula, "Energy Efficient LEACH-C Protocol for Wireless Sensor Network" , Computational Intelligence and Information Technology by :IEEE at Mumbai / 402-405 / 2013 D. Kapil, E. S. Pilli and R. C. Joshi, "Live Virtual Machine Migration Techniques: Survey and Research Challenges" , 3rd IEEE International Advance Computing Conference (IACC 13) by :IEEE at Ghaziabad, India / 963 - 969 / 2013 B. Priya, E. S. Pilli and R. C. Joshi, "A Survey on Energy and Power Consumption Models for Greener Cloud" , International Advance Computing Conference (IACC) by :IEEE at Ghaziabad, India / 76 - 82 / 2013 ISBN: 978-1-4673-4529-3 P. Tyagi, D. Kapil, E. S. Pilli and R. C. Joshi, "Virtual Machine Portability- a Novel Approach" , International Conference on Cloud Computing and Big Data (CloudCom-Asia) by :IEEE at Fuzhou, China / 240-245 / 2013 H. Chauhan, V. Kumar, S. Pundir and E. S. Pilli, "Comparative Analysis and Research Issues in Classification Techniques for Intrusion Detection" , International Conference on Advanced Computing, Networking, and Informatics (ICACNI-2013) by :Springer at Raipur, India / 40-43 / 2013 A. Kumar, E. S. Pilli, and R. C. Joshi, "An Efficient Framework for Resource Allocation in Cloud Computing" , 4th International Conference on Computing, Communications and Networking Technologies (ICCCNT) by :IEEE Xplore at Tiruchengode, India / 1-6 / 2013 P. Ranjan, P. Mishra, J. S. Rawat, E. S. Pilli, R. C. Joshi, "Improved Technique for Data Confidentiality in Cloud Environment" , International Conference on Networks & Communications by :Springer at Chennai, India / 183-193 / 2013 ISBN: 978-3-319-03692-2 H. Chauhan, V. Kumar, S. Pundir, E. S. Pilli, "A Comparative Study of Classification Techniques for Intrusion Detection" , International Symposium on Computational and Business Intelligence by :IEEE at New Delhi, India / 40-43 / 2013 ISBN: 978-0-7695-5066-4 Anandghan Waghmare, Arka Prokash Mazumdar, and Ashok Singh Sairam, "Time Synchronization Protocol for 6LoWPAN" , International Conference on Advances in Computing, Communications and Informatics (ICACCI) by :IEEE at Mysore, India / 1855-1860 / 2013 Vinod, P., Vijay Laxmi, Manoj Singh Gaur, Smita Naval, and Parvez Faruki, "MCF: MultiComponent

Features for Malware Analysis" , 27th International Conference on Advanced Information Networking and Applications Workshops (WAINA) by :IEEE at Barcelona, Spain / 1076-1081 / 2013 Smita Naval, Vijay Laxmi, Yogesh Meena, Vinod, P. , "Relevant Hex Patterns for Malcode Detection." , International Conference on Intelligent Systems and Signal Processing (ISSP), 2013 by :IEEE at Vallabh Vidyanagar, Anand, Gujarat INDIA / 334-337 / 2013 Daya Gupta, Lavika Goel, Abhishek, "An Efficient Biogeography Based Face Recognition Algorithm" , 2nd International Conference on Advances in Computer Science and Engineering (CSE 2013) by :Atlantis Press at Los Angeles, CA, USA / / 2013 Daya Gupta, Lavika Goel, Vipin Aggarwal, "A Hybrid Biogeography Based Optimization on Traveling Tournament Problem" , Third International Conference on Contemporary Computing by :IEEE at Noida, India / / 2013 2012 Vipin Pal, Girdhari Singh, R P Yadav, "Energy Efficient Cluster Head Selection Scheme: A Change in Node Death Scenario of LEACH for Surveillance Wireless Sensor Networks" , International Conference on Parallel Distributed and Grid Computing (PDGC), 2012 2nd IEEE International Conference On by :IEEE at Shimla, India / 865 - 869 / 2012 ISBN: 978-1-4673-2922-4 Vipin Pal, Girdhari Singh, R. P. Yadav, "Genetic Algorithm Based Method for Analyzing Reliability State of Wireless Sensor Networks" , Proceedings of the International Conference on Frontiers of Intelligent Computing: Theory and Applications (FICTA) 2012 (Advances in Intelligent Syste by :Springer at Odisha, India / 583-591 / 2012 ISBN: 978-3-642-35313-0 Vipin Pal, Girdhari Singh and R P Yadav, "Optimizing Number of Cluster Heads in Wireless Sensor Networks for Clustering Algorithms" , Proceedings of the Second International Conference on Soft Computing for Problem Solving by :Springer India at Jaipur, India / 1267-1274 / 2012 ISBN: 978-81-322-1601-8 Basant Agarwal, Namita Mittal, "Hybrid Approach for Detection of Anomaly Network Traffic Using Data Mining Techniques" , In 2nd International Conference on Communication, Computing Security (ICCCS-2012). by :Elsevier at Rourkela / 996-1003 / 2012 Basant Agarwal, Namita Mittal, "Text Classification Using Machine Learning Methods- a Survey" , In 2nd International Conference on Soft Computing for Problem Solving (SocPros-2012 by :Springer at Jaipur / - / 2012 Basant Agarwal, Namita Mittal, "Comparative Study of Feature Reduction and Machine Learning Techniques for Spam Detection" , In 2nd International Conference on Soft Computing for Problem Solving (SocPros-2012 by :Springer at Jaipur / - / 2012 Basant Agarwal , Namita Mittal, "Categorical Probability Proportion Difference (CPPD): A Feature Selection Method for Sentiment Classification" , SAAIP Workshop With 24th International Conference on Computational Linguistics by :ACL Anthology at Mumbai / 17-26 / 2012 Subhash Panwar Neeta Nain, "A Novel Approach of Skew Normalization for Handwritten Text Lines and Words" , The 8th International Conference on SIGNAL IMAGE TECHNOLOGY & INTERNET BASED SYSTEMS by :IEEE at Sorrento - Naples, Italy / 149-154 / 2012 Subhash Panwar and Neeta Nain, "Handwritten Text Documents Binarization and Skew Normalization Approaches" , IEEE Proceedings of Fourth International Conference on Intelligent Human Computer Interaction by :IEEE at IIT Kharagpur, India / 100-105 / 2012 Mushtaq Ahmed, Rakesh Kumar, "Parameterized Path-Based, Randomized, Oblivious,Minimal Routing in 3D Mesh NoC" , IEEE Tencon 2012 by :IEEE at Cebu, Philippines / 1-6 / 2012 ISBN:

2159-3442 Parvati Bhurani, Mushtaq Ahmed and Yogesh Kumar Meena, "New Measure of Interestingness for Efficient Extraction of Association Rules" , International Conference on Information Systems Design and Intelligent Application by :Springer Berlin Heidelberg at Visakhapatnam, India / 103-110 / 2012 ISBN: 978-3-642-27442-8 Dinesh Gopalani, M.C. Govil, K.C. Jain, "A Type System and Type Soundness for the Calculus of Aspect-Oriented Programming Languages" , International MultiConference of Engineers and Computer Scientists 2012 by :IMECS, IAENG at Hongkong / 263-268 / 2012 ISBN: 978-988-19251-1-4 Dinesh Gopalani, M.C. Govil, "Modeling Crosscutting Applications in Untyped Aspect Calculus" , IEEE Symposium on Computers & Informatics (ISCI 2012) by :IEEE at Penang, Malaysia / 224-227 / 2012 Vinod Jatav,Meenakshi Tripathi,M.S. Gaur,V.Laxmi , "Wireless Sensor Networks: Attack Models and Detection" , International Conference on Network and Computer Science (ICNCS 2012), HongKong (10-12 March 2012) by :IACSIT Press Singapore at Hongkong / 144-149 / 2012 Meenakshi Tripathi,Rohit K. Batwara, M.S. Gaur,V.Laxmi , "An Approach for Prolonging the Life Time of Wireless Sensor Network" , 2012 International Conference on Information and Computer Networks by :IACSIT Press Singapore at Singapore / 264-268 / 2012 Urvashi Garg, Yogesh Kumar Meena, "User Authentication Using Keystroke Recognition" , International Conference on Advances in Computing Advances in Intelligent Systems and Computing by :Springer Berlin Heidelberg at Bangalore / 131-136 / 2012 ISBN: 978-81-322-0739-9 Parwati Bhurani, Mushtaq Ahmed, Yogesh Kumar Meena, "New Measure of Interestingness for Efficient Extraction of Association Rules" , International Conference on Information Systems Design and Intelligent Applications by :Springer at Vizag India / 103-110 / 2012 ISBN: 978-3-642-27443-5 J. K. Deegwal, A. Kumar, S. Yadav, M. M. Sharma and M. C. Govil, "Ultra-Wideband Truncated Rectangular Monopole Antenna With Band-Notched Characteristics" , IEEE Symposium on Wireless Technology and Applications by :IEEE at Bandung / 254-257 / 2012 J. K. Deegwal, A. Kumar, M.M. Sharma and M.C. Govil, "CPW-Fed Parasitically Loaded Circular Monopole Antenna for WLAN Applications" , National Conference on Recent Trends on Microwave Techniques and Applications by :- at Jaipur / 77 / 2012 A. K. Mishra, P. Matta, E. S. Pilli and R. C. Joshi, "Cloud Forensics: State-of-the-Art and Research Challenges" , International Symposium on Cloud and Services Computing 2012 (ISCOS 2012) by :IEEE at NITK Surathkal, India / 164 - 170 / 2012 A. Kumar and E. S. Pilli, "University Wide M-Learning Using Cloud Environment" , International Symposium on Cloud and Services Computing 2012 (ISCOS 2012) by :IEEE at NITK Surathkal, India / 118 - 123 / 2012 P. Mishra, E. S. Pilli and R.C. Joshi, "Forensic Analysis of E-Mail Date and Time Spoofing" , International Conference on Computer and Communication Technology (ICCCT 2012) by :IEEE at MNNIT Allahabad, India / 309 - 314 / 2012 Vishwanath Pratap Singh, Arka Prokash Mazumdar, and Ashok Singh Sairam, "On Energy Consumption Analysis for Ad Hoc Routing Protocols" , International Conference on Advances in Computing, Communications and Informatics (ICACCI) by :ACM at Chennai, India / 300-306 / 2012 Dinesh Kumar Tyagi, Virendra Singh Shekhawat, V. K. Chaubey, "Resource Efficient Survivability Approach for Resilient WDM Optical Networks" , International Conference on Advances in Computing, Communications and Informatics by :ICACCI at Chennai /

619-624 / 2012 Satyendra Singh Chouhan, Rajdeep Niyogi, "Multi-Agent Planning in Grid World Domain" , International Conference on Advanced Computing & Communication by :IEEE at India / 117-122 / 2012 Jyoti Grover, M. S. Gaur, V. Laxmi, Rakesh Kumar, "Detection of Incorrect Position Information Using Speed and Time Span Verification in VANET" , 5th International Conference on Security of Information and Networks (SIN 2012) by :ACM at MNIT, Jaipur / 53-59 / 2012 Smita Naval, Vijay Laxmi, M. S. Gaur, and P. Vinod, "ESCAPE: Entropy Score Analysis of Packed Executable" , 5th International Conference on Security of Information and Networks (SIN 2012) by :ACM at MNIT Jaipur / 197-200 / 2012 ISBN: 978-1-4503-1668-2 Smita Naval, Vijay Laxmi, Manoj Singh Gaur, and P. Vinod, "SPADE: Signature Based PAcker DEtection" , First International Conference on Security of Internet of Things by :ACM at Kollam India / 96-101 / 2012 ISBN: 978-1-4503-1822-8 Lavika Goel, Daya Gupta, VK Panchal, "Biogeography Based Anticipatory Computing Framework for Intelligent Battle Field Planning" , 2012 12th International Conference on Hybrid Intelligent Systems (HIS) by :IEEE at Pune, India / / 2012 Lavika Goel, Daya Gupta, VK Panchal, Ajith Abraham, "Taxonomy of Nature Inspired Computational Intelligence: A Remote Sensing Perspective" , 2012 Fourth World Congress on Nature and Biologically Inspired Computing (NaBIC) by :IEEE at Mexico City, Mexico / / 2012 Lavika Goel, Daya Gupta, Vinod Panchal, "Extended Species Abundance Models of Biogeography Based Optimization" , 2012 Fourth International Conference on Computational Intelligence, Modelling and Simulation by :IEEE at Kuantan, Malaysia / / 2012 Lavika Goel, Daya Gupta, VK Panchal, "Dynamic Model of Blended Biogeography Based Optimization for Land Cover Feature Extraction" , International Conference on Contemporary Computing by :Springer Berlin Heidelberg at Noida, India / / 2012 Lavika Goel, Daya Gupta, VK Panchal, "Biogeography and Plate Tectonics Based Optimization for Water Body Extraction in Satellite Images" , Proceedings of the International Conference on Soft Computing for Problem Solving (SocProS 2011) December 20-22, 2011 by :Springer Berlin Heidelberg at IIT Roorkee, India / / 2012 2011 K R Yadav, Vipin Pal, Girdhari Singh and R P Yadav, "Variable Frame Slot Clustering Scheme for Data Gathering Wireless Sensor Networks" , 2nd Int. Conf. on Current Trends in Technology (NUiCONE 2011) by :IEEE at Ahmedabad, Gujarat / 1 - 5 / 2011 ISBN: 978-1-4577-2169-4 Vipin Pal, Girdhari Singh, R P Yadav, "A Restricted Tree Based Clustering Approach for Data Gathering Wireless Sensor Network" , Int. Conf. on Advances, Modeling, Optimization, and Computation (AMOC-2011) by :- at IIT Roorkee, India / 850-855 / 2011 Namita Mittal, Gaurav Gupta, Hemant Mangal, "Ontology-Based Retrieval System Using Semantic Indexing" , 5th IICAI by :IEEE at Tumkur, Karnataka , India / 850-862 / 2011 Namita Mittal, P. Ashok Rao, Srinivas Jinde, Abhinav Gupta, K. Adhikari, "Clustering of XML Documents on the Basis of Content and Structure" , 5th IICAI by :IEEE at Tumkur, Karnataka India / 1737-1746 / 2011 Sandeep K. Gupta, Shubhlaxmi, Yogesh K. Meena, Neeta Nain , "A Hybrid Method of Feature Extraction for Facial Expression Recognition" , The Seventh IEEE International Conference on Signal Image Technology & Internet-Based Systems by :IEEE at Dijon, France / 422-425 / 2011 Mushtaq Ahmed, Vijay Laxmi, M. S. Gaur, Yogesh Meena , "Parameterized Path Based Randomized Oblivious Minimal Path Routing With Fault Tolerance in 2D Mesh

Network on Chip" , 2nd International Congress on Computer Applications and Computational Science (CACS2011) by :Springer-Verlag GmbH Berlin Heidelberg at Bali, Indonesia / 63-70 / 2011 ISBN: 978-3-642-28307-9 Manju Rani, Yogesh Kumar Meena, "An Efficient Feature Extraction Method for Handwritten Character Recognition" , International Conference on Fuzzy and Neural Computing by :Springer-Verlag GmbH Berlin Heidelberg at Vizag India / 302-209 / 2011 ISBN: 978-3-642-27242-4 Sachin Jain, Yogesh Kumar Meena, "Byte Level N-Gram Analysis for Malware Detection" , International Conference on Information Processing by :Springer Berlin Heidelberg at Bangalore / 51-59 / 2011 ISBN: 978-3-642-22786-8 P. Dadhich, K. Dutta and M. Govil, "Formalizing Soft Trust Management" , Computational Intelligence and Information Technology: Springer by :- at Pune / 534-536 / 2011 P. Dadhich, K. Dutta and M. C. Govil, "On the Approach of Combining Trust and Security for Securing Mobile Agents: Trust Enhanced Security" , 2nd International Conference on Computer and Communication Technology (ICCCT) by :IEEE at - / / 2011 P. Dadhich and M. C. Govil, "Trust Secure Models for Mobile Agents- a Perspective Study" , International Conference on Advances in Computing & Communication by :- at Rohtak / / 2011 J. K. Deegwal, A. Kumar, S. Yadav, M.M. Sharma and M.C. Govil, "A Dual-Band Printed Circular Patch Antenna With Two Parasitic Stubs for Bluetooth and WLAN Applications" , International Conference on Microwaves, Antenna, Propagation & Remote Sensing by :- at Jodhpur / / 2011 A. Kumar,J. K. Deegwal, N. C. Bajia, S. Yadav, M.M. Sharma and M.C. Govil, "Printed Monopole UWB Antennas With Dual Band-Notched Characteristics" , International Conference on Microwaves, Antenna, Propagation & Remote Sensing by :- at Jodhpur / / 2011 P. Dadhich, K. Dutta and M. C. Govil, "Reputation-Based Trust for Mobile Agents" , International Conference on Advanced Computing, Networking and Security by :- at Surathkal / / 2011 B. Ramesh Babu, P.V. Vara Prasad,Ch.Jyosthna Devi, K.R.Ramya, "A Decentralized MAC Protocol for Opportunistic Spectrum Access in Cognitive Wireless Networks" , ICDC 2011 by :IEEE Xplore at Hyderabad / 131-134 / 2011 E. S. Pilli, R. C. Joshi and R. Niyogi, "Router and Interface Marking for Network Forensics" , Seventh Annual IFIP WG 11.9 International Conference on Digital Forensics by :Springer Berlin Heidelberg at Orlando, Florida, USA / 209-220 / 2011 E. S. Pilli, R. C. Joshi and R. Niyogi, "Data Reduction by Identification and Correlation of TCP/IP Attack Attributes for Network Forensics" , International Conference and Workshop on Emerging Trends in Technology (ICWET 2011) by :ACM at Mumbai, India / 276-283 / 2011 Arka Prokash Mazumdar, and Ashok Singh Sairam, "PBFS: A Technique to Select for-Warders in Opportunistic Routing" , TENCON by :IEEE at Bali, Indonesia / 149-153 / 2011 Arka Prokash Mazumdar, and Ashok Singh Sairam, "Opportunistic Routing: Opportunities and Challenges" , Proceedings of ICNCC by :IACSIT at New Delhi, India / 191-195 / 2011 Jyoti Grover, M.S Gaur, V. Laxmi , "Position Forging Attacks in Vehicular Ad Hoc Networks: Implementation, Impact and Detection" , 7th International Wireless Communications and Mobile Computing Conference (IWCMC 2011) by :IEEE at Istanbul, Turkey / 701-706 / 2011 Jyoti Grover, Nitesh Prajapati, M.S Gaur, V. Laxmi, "Machine Learning Approach for Multiple Misbehavior Detection in VANET" , International Conference on Advances in Computing and Communications (ACC 2011) by :Springer-Verlag GmbH Berlin

Heidelberg at Kochi, India / 644-653 / 2011 Jyoti Grover, M. S. Gaur, V. Laxmi, "A Sybil Attack Detection Approach Using Neighboring Vehicles in VANET" , 4th International Conference on Security of Information and Networks (SIN 2011) by :ACM at Sydney, Australia / 151-158 / 2011 Jyoti Grover, M.S Gaur, V. Laxmi , "Misbehavior Detection Based on Ensemble Learning in VANET" , International Conference on Advanced Computing , Networking and Security (ADCONS' 11) by :Springer-Verlag GmbH Berlin Heidelberg at Surathkal, Karnatka / 602-611 / 2011 Vijay Laxmi, Manoj Singh Gaur, Parvez Faruki, and Smita Naval, "PEAL-Packed Executable Analysis" , International Conference on Advanced Computing , Networking and Security (ADCONS' 11) by :Springer-Verlag GmbH Berlin Heidelberg at Surathkal India / 237-243 / 2011 Lavika Goel, Daya Gupta, VK Panchal, "Performance Governing Factors of Biogeography Based Land Cover Feature Extraction: An Analytical Study" , 2011 World Congress on Information and Communication Technologies by :IEEE at Mumbai, India / / 2011 2010 Vipin Pal, Girdhari Singh, R P Yadav, "Sleep-Wake-Up Scheduling Algorithms for Wireless Sensor Networks: A Survey" , International Conference on Emerging Trends in Robotics and Communication Technologies (INTERACT 2010) by :- at Chennai, India / - / 2010 Mittal Namita, Aditi Agarwal, Arti Mangal , "Effective Information Retrieval Using NER" , International Conference on Advance Computing & Communication Technologies by :IEEE at Panipat (2010) / 498-501 / 2010 Mittal Namita, Nayak Richi, Govil MC, Jain KC, "Dynamic Query Expansion for Efficient Information Retrieval" , International Conference on Web Information Systems and Mining by :ACM at China / 211-215 / 2010 Mittal Namita, Nayak Richi, Govil MC, Jain K C, "Recommender System Framework Using Clustering and Collaborative Filtering" , Intl Conference on Emerging Trends in Engineering and Technology by :IEEE at Goa / 555-558 / 2010 Namita Mittal, Richi Nayak, Mahesh Chandra Govil, Kamal Chand Jain, "Evaluation of a Hybrid Approach of Personalized Web Information Retrieval Using the FIRE Data Set" , A2CWiC by :ACM at India / 52 / 2010 ISBN: 978-1-4503-0194-7 Namita Mittal, Richi Nayak, Mahesh Chandra Govil, Kamal Chand Jain, "A Hybrid Approach of Personalized Web Information Retrieval" , Web Intelligence by :IEEE at Toronto / 308-313 / 2010 ISBN: 978-0-7695-4191-4 Mushtaq Ahmed. Rameshan N. V. Laxmi, M.S. Gaur, K.K. Paliwal, "Minimal Path, Fault Tolerant, QoS Aware Routing With Node and Link Failure in 2-D Mesh NoC" , Defect and Fault Tolerance in VLSI Systems (DFT) 2010 IEEE 25th International Symposium by :IEEE at Kyoto, Japan / 60 -66 / 2010 ISBN: 1550-5774 Mushtaq Ahmed, V. Laxmi, M.S. Gaur, "Cross-Base Routing Over Diagonalized Mesh" , IRAST International Congress on Computer Applications and Computational Science (CACS 2010), ; 02/2013 by :IRAST International Congress on Computer Applications and Computational Science at Singapore / 13-17 / 2010 ISBN: 978-981-08-6846-8 Navaneeth Rameshan, Mushtaq Ahmed, M.S.Gaur, and V. Laxmi, "Minimal Path, Fault Tolerant Routing in 2-D Mesh NoC" , VLSI Design and Test (VDAT) Symposium by :VLSI Society of India at Chitkara Univ. Chandigarh / 279-288 / 2010 ISBN: 978-81-920249-4-3 Mushtaq Ahmed, M. S. Gaur, Vijay Laxmi, "Adaptive Routing Over the 2D Hexagonal NoC" , International Conference on Embedded Systems (ICES 2010) by :Coimbatore Institute of Technology, Coimbatore at Coimbatore Institute of Technology, Coimbatore / 5 / 2010 N. Rameshan, Mushtaq Ahmed, M.S. Gaur, V. Laxmi, K.K. Paliwal, "Minimal Path, Fault Tolerant, QoS Aware Routing in 2D Mesh NoC" , IEEE Reliability Aware System Design and Test (RASDAT 2010) Workshop by :MNIT and IISc Bangalore at IISc Bangalore / 62-66 / 2010 Dinesh Gopalani, M.C. Govil, "Untyped Aspect Calculus : Formal Theory of Aspect-Oriented Programming Languages" , 2nd International Advance Computing Conference (IACC) by :IEEE Xplore at Patiala / 195-200 / 2010 Vinod Jatav,Meenakshi Tripathi,M.S. Gaur,V.Laxmi , "Weighted Interference Aware Fair Rate Control in Wireless Sensor Networks" , International Conference on Electronics, Information and Communication Systems Engineering by :MBM Jodhpur at Jodhpur / 1-4 / 2010 P. Dadhich, M. Govil and K. Dutta, "Security Measures to Protect Mobile Agents" , International Conference on Methods and Models in Science and Technology by :- at Jaipur / 298-302 / 2010 P. Dadhich and M. C. Govil, "Agent: A View to Automated Software Engineering" , International Conference on Next Generation Communication & Computing Systems by :- at India / / 2010 P. Dadhich and M. C. Govil, "Fault Tolerance: Reliability Mechanism for Transactional Mobile Agent Execution" , International Conference on Computer Engineering& Technology by :- at India / / 2010 Ramesh Babu Battula,Pavan Kumar Ponnapalli, Pavan Kumar Tummala, Srikanth Vemuru, "Wireless Mesh Networks: Routing Protocols and Challenges." , CNSA 2010 by :Springer LNCS at Chennai / 143-151 / 2010 Ramesh Babu Battula, Srikanth Vemuru, Rajasekhara rao Kurra, Pavan Kumar Tummala, "On-Demand Table-Driven Topo-Aware Routing Protocol for Wireless Mesh Networks" , WiMoN 2010 by :Springer LNCS at Chennai / 296-305 / 2010 Srinivasara Rao Dh, Ramesh Babu Battula, Srikanth Vemuru, Rajasekhara rao Kurra, "Energy Efficient Routing Protocol for Wireless Sensor and Actor Networks" , NeCoM 2010 by :Springer LNCS at Chennai / 114-123 / 2010 E. S. Pilli, R. C. Joshi and R. Niyogi, "An IP Traceback Model for Network Forensics" , Second International Conference on Digital Forensics and Cyber Crime (ICDF2C 2010) by :Springer LNICST at Abu Dhabi, UAE / 129-136 / 2010 A. K. Kaushik, E. S. Pilli and R. C. Joshi, "Network Forensic System for Port Scanning Attack" , 2nd International Advance Computing Conference (IACC) by :IEEE Xplore at Patiala, India / 310-315 / 2010 E. S. Pilli, R. C. Joshi and R. Niyogi, "A Framework for Network Forensic Analysis" , International Conference on Advances in Information and Communication Technologies (ICT 2010) by :Springer LNICST at Kochi, India / 142-147 / 2010 A. K. Kaushik, E. S. Pilli, and R. C. Joshi, "Network Forensic Analysis by Correlation of Attacks With Network Attributes" , International Conference on Advances in Information and Communication Technologies by :Springer, Berlin, Heidelberg at Kochi, India / 124-128 / 2010 ISBN: 978-3-642-15766-0 Jyoti Grover, M.S Gaur, V. Laxmi , "A Novel Defense Mechanism Against Sybil Attacks in VANET" , 3rd International Conference on Security of Information and Networks by :ACM at Taganrog, Russia / 249-255 / 2010 ISBN: 978-1-4503-0234 Jyoti Grover, Deepak Kumar, Sargurunathan M, M.S Gaur, V. Laxmi, "Performance Evaluation and Detection of Sybil Attacks in Vehicular Ad-Hoc Networks" , Recent Trends in Network Security and Applications (CNSA 2010) by :Springer LNCS at Chennai, India / 473-482 / 2010 ISBN: 978-3-642-14478-3 Jyoti Grover, Nitesh Prajapati, M.S Gaur, V. Laxmi, "RSS-Based Sybil Attack Detection in

VANETs" , TENCON 2010 by :IEEE at Fukuoka, Japan / 2278-2283 / 2010 ISBN: 978-1-4244-6888-1 Nitesh Prajapati, Jyoti Grover, V. Laxmi, "Implementation of Temporal Attacks in Vehicular Ad Hoc Networks" , International Conference on Electronics, Information and Communication Systems Engineering (ICEICE 2010) by :IIE at Jodhpur, India / / 2010 2009 Mittal Namita et al., "Effective Template Detection Technique and Optimal Wrapper Generation" , International Conference on Innovative Technology by :IEEE at Haryana India / 176-177 / 2009 Mittal Namita, Govil MC, Nayak Richi, Jain N, "Reconstruction of Web Forums for Effective Information Retrieval" , ICM2CS by :IEEE at New Delhi / 229-234 / 2009 Navaneeth Rameshan, M. Ahmed, M.S. Gaur, Vijay Laxmi and Anurag Biyani, "QoS Aware Minimally Adaptive XY Routing for NoC" , Seventeenth Annual International Conference on Advanced Computing and Communications (ADCOM 2009) by :Advanced Computing and Communications Society at IISc Bangalore / 300-302 / 2009 D. Gopalani and M. C. Govil, "Interpreter for Untyped Imperative Object Calculus" , National Conference on Advanced Computing by :- at India / / 2009 N. Mittal and M. C. Govil, "Effective Template Detection Technique and Optimal Wrapper Generation" , International Conference on Innovative Technology by :- at India / 176-177 / 2009 2008 Mittal Namita, Govil MC, Nayak Richi, "Information Retrieval Based on User Modeling Using (Semi) Automatic Extraction of User Interests" , International Conference on Data Management (ICDM-2008) by :IEEE at Ghaziabad, India / 193-200 / 2008 Mittal Namita, Govil M C, Nayak Richi, Rajesh Kumar, Himanshu, Dwipayan,, "A Hybrid Clustering Based Filtering Approach With Efficient Sequencing" , International Conference on Data Mining Application (ICDMA -08) by :IAENG at Hong Kong / 517-520 / 2008 Neeta Nain, Vijay Laxmi, Bhavitavya Bhadviya, "Fast Feature Point Detector" , Fourth IEEE, International Conference on Signal-Image Technology & Internet Based Systems, Pp. , 30th November- 3rd December, 2008 by :IEEE at Bali, Indonesia. / 301 – 30 / 2008 ISBN: 9781424440962 Neeta Nain, Deepak B M, Bhavitavya Bhadviya, Dinesh Kumar, "A Fast Fingerprint Classification Algorithm by Tracing Ridge-Flow Patterns" , Fourth IEEE, International Conference on Signal-Image Technology & Internet Based Systems, Pp. , 30th November- 3rd December, 2008 by :IEEE at Bali, Indonesia / 235-238 / 2008 ISBN: 9781424440962 Neeta Nain, Vijay Laxmi, Bhavitavya Bhadviya, "Corner Detection on Curves" , International Conference on Computer Graphics Theory and Applications by :GRAPP at Funchal, Madeira –Portugal / 122-125 / 2008 Neeta Nain, Vijay Laxmi, Bhavitavya Bhadviya, "A Gray Level Feature Detector and Its Hardware Architecture" , International Conference on Signal and Image Technologies by :WCE at London, UK / 135-145 / 2008 Neeta Nain and Vijay Laxmi and Bhavitavya Bhadviya and B. M. Deepak and Mushtaq Ahmed, "Fast Feature Point Detector" , 4th IEEE International Conference on Signal Image Technology and Internet Based Systems (SITIS 08) by :IEEE at Bali, Indonesia / 301-306 / 2008 ISBN: 978-0-7695-3493-0 Dinesh Gopalani, M.C. Govil, "A Comparative Study of Language Constructs for Implementation of Separation of Crosscutting Concerns" , National Conference on Architecturing Future IT Systems by :Devi Ahilya University, Indore at Indore, India / 101-105 / 2008 N. Mittal, M. C. Govil and R. Nayak, "Information Retrieval Based on User Modeling Using (Semi) Automatic Extraction of User Interests" , International Conference on

Data Management by :-- at Ghaziabad / 193-200 / 2008 N. Mittal, M. C. Govil, R. Nayak, R. Kumar and H. Dwipayan, "A Hybrid Clustering Based Filtering Approach With Efficient Sequencing" , International Conference on Data Mining Application by :-- at Hong Kong / / 2008 G. Singh, M. C. Govil, S. S. Agarwal and P. Jain, "Modeling of Intelligent Agent Based Real Time Systems" , International Conference on Intelligent Systems & Networks by :-- at - / / 2008 N. Mittal and M. C. Govil, "E-Commerce: A Commercial Perspective Approach" , International Conference on Networks by :IEEE at New Delhi / / 2008 Virendra Singh Shekhawat , Dinesh Kumar Tyagi , V.K. Chaubey, "Weight Based Edge Disjoint Path Routing and Wavelength Assignment (Wedp-Rwa) Algorithm for Wdm Networks" , 2008 IEEE Region 10 and the Third International Conference on Industrial and Information Systems by :IEEE at Kharagpur, India / / 2008 2007 Girdhari Singh, Mahesh Chand Govil, Siddharth S. Agarwal and Prateek Jain, "Modeling of Intelligent Agent Based Real Time Systems" , International Conference on Intelligent Systems & Networks by :- at Haryana / 89-94 / 2007 Girdhari Singh, Mahesh Chand Govil, Prateek Jain and Siddharth S. Agarwal, "Modeling of Agent Based Real Time Systems" , International Conference on Soft Computing and Intelligent Systems (ICSCIS-07) by :- at Jabalpur,India / 42-48 / 2007 Girdhari Singh, Mahesh Chand Govil, Prateek Jain and Siddharth S. Agarwal, ""DeMy_ARTs" Development Methodology for Agent Based Real Time Systems" , International Conference on Recent Applications of Soft Computing in Engineering & Technology (RASIET-07) by :- at Alwar, India / 247-252 / 2007 Mittal Namita, Shreedharan H., Govil M C, "XML Processing Using Java" , National Conference on Recent Advancement in Information Technology by :IEEE at Coimbatore / 65-71 / 2007 Mittal Namita et al., "Ontology Based Personalized Web Search" , 2nd International Conference on Advance Computing & Communication Technologies ICACCT 2007 by :IEEE at Panipat, Haryana / 147-150 / 2007 Neeta Nain, Vijay Laxmi, Bhavitavya Bhadviya, "Corner Detection Using Difference Chain Code as Curvature" , The Third IEEE, International Conference on Signal-Image Technology & Internet Based Systems by :IEEE at Shanghai, China / 821-825 / 2007 ISBN: 9781424432448 Neeta Nain, Vijay Laxmi, Bhavitavya Bhadviya, "Optimizing Task Distribution for Heterogeneous Desktop" , World Congress in Computer Science, Computer Engineering, and Applied Computing by :CSREA at Las Vegas, USA / 535-540 / 2007 Neeta Nain, Vijay Laxmi, Bhavitavya Bhadviya, "Transformation Invariant Robust Shape Analysis" , Image Processing and Computer Vision by :CSREA at Las Vegas / 275-281 / 2007 Dinesh Gopalani, M.C. Govil, "Client-Side Filter Object Model" , International Conference on Soft Computing and Intelligent Systems by :Jabalpur Engineering College at Jabalpur / 232-234 / 2007 G. Singh, M. C. Govil, P. Jain and S. S. Agarwal, "DeMy_ARTs: Development Methodology for Agent Based Real Time Systems" , International Conference on Recent Applications of Soft Computing in Engineering & Technology by :- at Alwar / 47-52 / 2007 D. Gopalani and M. C. Govil, ""Client-Side Filter Object Model" , International Conference on Soft Computing and Intelligent Systems by :- at Jabalpur / 232-234 / 2007 N. Mittal and M. C. Govil, "Ontology Based Personalized Web Search" , International Conference on Advance Computing & Communication Technologies by :- at Panipat / 147-150 / 2007 G. Singh, M. C. Govil, P. Jain and S. S. Agarwal, "Modeling of Agent

Based Real Time Systems" , International Conference on Soft Computing and Intelligent Systems by :- at Jabalpur / 42-48 / 2007 M. C. Govil, G. Day, L. Sharma, S. Bhattacharya and S. Bansal, "Applying Mobile Agents to Intrusion Detection and Response" , National Conference on Emerging Trends and Application in Computer Engineering by :- at Ajmer / - / 2007 N. Mittal and M. C. Govil, "Concurrency Control Design Protocol in Real Time Distributed Databases" , National Conference on Emerging Trends and Computing & Communication by :- at Hamirpur / 155-160 / 2007 N. Mittal, H. Shreedharan and M. C. Govil, "XML Processing Using Java" , National Conference on Recent Advancement in Information Technology by :- at Coimbatore / 65-71 / 2007 Virendra Singh Shekhawat, Dinesh Kumar Tyagi, V K Chaubey, "WDM Network Topologies-a Probabilistic Model", Advanced Computing and Communications" , International Conference on Advanced Computing & Communication by :International Conference on Advanced Computing & Communication at Guwahati / 733–737 / 2007 2006 Neeta Nain, Vijay Laxmi, Ankur Kumar Jain, Rakesh Agarwal, "Morphological Edge Detection and Corner Detection Algorithm Using Chain Encoding" , Image Processing and Computer Vision by :CSREA at Las Vegas, USA / 520-525 / 2006 M. C. Govil, D. Gopalani, R. Jain, R. Ladha and S. Sharma, "Evolution of TCP Over Wireless Links" , National Symposium on Emerging Trends in Broadband Communication by :- at Jaipur / 8-9 / 2006 S. Chauhan, W. R. Khan, M. C. Govil and C. S. Rai, "Real-Time Traffic Biased Random Early Detection Algorithm" , National Conference on Emerging Systems and Technologies by :- at Alwar / 44-50 / 2006 2005 V. Laxmi, M.S. Gaur, Mushtaq Ahmed, "Support Vector Machine for the Gate Classification" , Vision, Graphics and Image Processing by :- at JNNCE Shimoga / 6 / 2005 Mushtaq Ahmed, V. Laxmi, M. S. Gaur, "Routing in Hexagonal NoC" , 23rd National Convention and Seminar on Recent Advances in Computational Science and Engineering by :IEI at Jodhpur / / 2005 M. C. Govil, P. Agrawal and S. Chelawat, "Dual Level Data Encryption Using Image Segmentation and AES for Combating Piracy" , International Conference on Information Security by :- at Pondicherry / 106-108 / 2005 2001 M. C. Govil, P. Kumar and K. Singh, "New Strategies for Allocating Tasks in Real-Time Multiprocessor Systems" , International Conference on Advanced Computing and Communications by :- at Bhubaneshwar / 125-128 / 2001 2000 M. C. Govil, P. Kumar and K. Singh, "Acceptance Test Based Scheduling of Hard Deadline Tasks in Real-Time Systems" , National Systems Conference by :- at Bangalore / 402-409 / 2000 M. C. Govil, P. Kumar and K. Singh, "On-Line Scheduling of Hard Deadline Aperiodic Tasks in Real-Time Systems" , International Conference on Communications, Computers & Devices by :- at Kharagpur / 63-66 / 2000 1999 M. C. Govil, P. Kumar and K. Singh, "Scheduling of Periodic and Aperiodic Tasks in Real-Time Systems" , International Conference on Cognitive Systems by :- at New Delhi / 434-445 / 1999 Book/Chapter Publications (79) 2024 Book Chapter"Improving Machine Learning classifiers using Hybrid Deep learning and Nature Inspired Optimization models for Efficient Plant disease detectionISBN:0 published by - CRC Press, Taylor and Francis Publications Year 2024 Authors- Vivek Jain, Janhavi Satpute, Lavika Goel Reference Book"Smart Systems: Innovations in ComputingISBN:9789819736898 published by - Springer Nature Year 2024 Authors- S. Bhattacharya, R. K. Gupta, A. P. Mazumdar, A.

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Chapter"Metamorphic Malware Analysis and Detection Methods" (Chapter 13, Pages 178-202) in "Cyber Security, Cyber Crime and Cyber Forensics: Applications and PerspectivesISBN:ISBN13: 9781609601232 published by - IGI Global Year 2011 Authors- Vinod, P., V. Laxmi, M.S. Gaur Book Chapter"Sybil Attacks in VANET: Detection and PreventionISBN:978-1-4398-1919-7 published by - Auerbach Publications CRC Press, Taylor & Francis Group, USA Year 2011 Authors- J Grover, MS Gaur, V Laxmi 2010 Reference Book"SOFTWARE ENGINEERINGISBN:978-9380311043 published by - Genius Publication Year 2010 Authors- GIRDHARI SINGH, SHALINI PURI Book Chapter"Sybil Attack in VANETs Detection and Prevention In "Security of Self-Organizing Networks MANET, WSN, WMN, VANET"ISBN:9781439819197 published by - Auerbach Publications, Taylor in and Francis Group, CRC Press Year 2010 Authors- Jyoti Grover, V. Laxmi, MS Gaur Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773528 Department of Computer Science & Engineering (Projects) ■■■■■■■ ■■■■■■■■■■ ■■■■■■■■■■■■■ ■■■■■■■■ ■■■■■■(■■■■■■■■■■ ■■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Projects Research Projects Testing & Consultancy Projects Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773531 Department of Computer Science & Engineering (Patents) ■■■■■■■ ■■■■■■■■■■ ■■■■■■■■■■■■■ ■■■■■■■■ ■■■■■■(■■■■■■■■■■ ■■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Patents "A BLUETOOTH BASED ANTI-THEFT SYSTEM", Jyoti Gajrani, Meenakshi Tripathi, Vikas Kumar Jain, Aniket Patel, Pulkit Sharma , Reg.No. 202411093785 A [The Patent Office,Government Of India]PublishedDt.20-12-2024 "BLOCKCHAIN-INTEGRATED DEVICE FOR NETWORK SECURITY", Vikas Kumar Jain, Dr. Meenakshi Tripathi, Lav Upadhyay,Devraj Vishnu , Reg.No. 186965 [The Patent Office,Government Of India]PublishedDt.12-09-2024 "SILICO-AI: An AI-Based Portable Computer-Aided Diagnostic System for Silicosis Disease", Kuldeep Singh, Faisel Mushtaq, Satyendra S Chouhan, Sandeep Mandia, Rajesh Kumar,Priyanka Harjule , Reg.No. 202311063986 [Controller General of Patents, Designs & Trade Marks, Govt. of India]FiledDt.23-09-2023 "A computationally efficient classification system for classifying nonlinear temporal patterns without a hidden layer", Irshed Hussain, Vikash Kumar, Dalton Meitei Thounaojam , Reg.No. 202023104383 [German Patent and Trade Mark Office]Patent GrantedDt.21-08-2023 "BLOCKCHAIN AND IOT

BASED ELECTRONICS HEALTH RECORD DEVICE", 1.Jitendra Goyal 2. Dr. Mushtaq Ahmed 3.Dr. Dinesh Gopalani 4.Dr. Aditi Sharma 5.Akash Yadav , Reg.No. 372608-001 [The Patent Office, Government of India]AwardedDt.23-12-2022 "Trusted and secure configuration and validation of data for public IoT devices using block chain technology", Dumka, Ankur; Ashok, Alaknanda; Sharma, Aditi; Sarkar, Achyuth; Kumar, Vivek; Kumar, Naresh; Bansal, Pravesh Kumar; Ahmed, Mushtaq and Baheti, Prashant Kumar , Reg.No. 2020103294 [IP Australia (Australian Govt.)]Patent GrantedDt.23-02-2020 " THE SMART GAIT ANALYZER", Dr Rajesh kumar, Chandra Prakash, Dr Namita Mittal , Reg.No. .201711014157 [Govt. of India]Patent GrantedDt.21-04-2017 Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773532 Department of Computer Science & Engineering (Event Organized) [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Event Organized National FDP onQT-02: Foundations of Quantum Technologies (EICT Online FDP in partnership with AICTE, DST-NQM and IBM)at Malaviya National Institute of Technology, Jaipur, India from 11-04-2025 to 03-05-2025 National FDP onQT-01: Quantum Technologies and Applications (EICT Winter Online FDP in partnership with AICTE, DST-NQM and IBM)at Malaviya National Institute of Technology, Jaipur, India from 28-02-2025 to 22-03-2025 National FDP onGenerative AI and Its Use Casesat MNIT Jaipur, Jaipur, India from 11-01-2025 to 02-02-2025 International Conference onIEEE ComSoc International Conference on Advanced Networks and Telecommunications Systems 2023at MNIT, Jaipur, India from 17-12-2023 to 20-12-2023 International Conference on5th International Conference on Communication and Intelligent Systems (ICCIS 2023at Malaviya National Institute of Technology , Jaipur, India from 16-12-2023 to 17-12-2023 International Conference onThe 17th International Conference on Signal Image Technology & Internet based Systemsat King Mongkuts University of Technology Thonburi, Thailand, Bangkok, Thailand from 08-11-2023 to 10-11-2023 International Short Term Course onSummer School on " Artificial Intelligence and Machine Learning for Engineering and Social Science and Research"at MNIT, Jaipur, India from 04-09-2023 to 08-09-2023 National Seminar onMachine Learning Enabled Signal Processing for Medical Applicationsat MNIT, Jaipur, India from 14-08-2023 to 14-08-2023 National FDP onTWO WEEKS HYBRID MODE FDP On Supply Chain Management and Logisticsat MNIT, Jaipur, India from 06-03-2023 to 17-03-2023 National FDP on"TWO WEEKS HYBRID MODE FDP On Advanced Computational Intelligence Techniques for Engineering and Science Applicationsat MNIT, Jaipur, India from 09-01-2023 to 20-01-2023 National Seminar onAgent-based Distributed Artificial Intelligence Frameworkat MNIT Jaipur, Jaipur, India from 12-12-2022 to 12-12-2022 International FDP onIEEE CIS Summer School on Research Trends in

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to 09-12-2017 International Conference onThe Thirteenth International Conference on Signal Image Technologies and Internet Based Systemsat MNIT Jaipur, Jaipur, India from 04-12-2017 to 07-12-2017 National Workshop onFDP on "Object Oriented Programming"at MNIT Jaipur, Jaipur, INDIA from 20-11-2017 to 29-11-2018 National Workshop onIntel Nervana Programat MNIT, Jaipur, India from 18-11-2017 to 18-11-2017 National Short Term Course onReal Time Systemsat MNIT, Jaipur, India from 07-11-2017 to 09-11-2017 National Workshop onProteus vsm Embedded System Workshopat MNIT, Jaipur, India from

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Real Time Embedded Systems & Applicationsat Malaviya National Institute of Technology, Jaipur, India from 15-09-2015 to 15-09-2015 National Workshop onCyber security and Cyber crimeat Malaviya National Institute of Technology, Jaipur, India from 12-09-2015 to 12-09-2015 National Workshop onCode Modernization and Parallel Computingat Malaviya National Institute of Technology, Jaipur, India from 25-08-2015 to 26-08-2015 National Workshop onData Analyticsat MNIT Jaipur, JAipur, India from 21-05-2015 to 23-05-2015 International Conference onElsevier Third International Conference on Recent Trends in Computing (ICRTC) organized by the Dept. of CSE, SRM Universityat Dept. of CSE, SRM University , Ghaziabad, India from 12-03-2015 to 13-03-2015 National Conference onNational Conference on Mathematical Analysis and Computation 2015at MNIT Jaipur, Jaipur, India from 20-02-2015 to 21-02-2015 National Seminar onRecent Trends in Image Processingat Malaviya National Institute of Technology , Jaipur, India from 07-02-2015 to 07-02-2015 National Seminar onon NLPat MNIT, Jaipur, India from 12-12-2014 to 14-12-2013 National Workshop onParallel (GPU CUDA and OpenCL) and Heterogeneous Computingat Malaviya National Institute of Technology, Jaipur, India from 10-11-2014 to 11-11-2014 International Short Term Course onNS2at K L University, Vijayawada, INDIA from 26-09-2014 to 27-09-2014 National Workshop onDissemination of national knowledge network and national mission on education through Information and Communication Technologyat Delhi Technological University organized by the Dept. of Computer Engineering. , New Delhi, India from 09-09-2014 to 09-09-2014 National Workshop onAdvanced Wireless Networksat MNIT, Jaipur, INDIA from 30-07-2014 to 02-08-2014 National Workshop onConduct, rules - regulations and research proposal writing for faculty members of MNIT Jaipurat MNIT , Jaipur, India from 08-07-2014 to 09-07-2014 National Short Term Course onComputer Awareness for Staff of MNIT Jaipurat MNIT , Jaipur, India from 07-07-2014 to 11-07-2014 National Workshop onFaculty Development Program on Advanced Wireless Networksat Malaviya National Institute of Technology Jaipur, Jaipur, India from 30-06-2014 to 04-07-2014 National Workshop onApplication of Wireless Sensor Networks for Disaster Managementat Malaviya National Institute of Technology, Jaipur, India from 17-06-2014 to 18-06-2014 National Short Term Course on“Computer Awareness Program”at MNIT, Jaipur, India from 12-05-2014 to 16-05-2012 National Workshop onEmbedded Systemsat MNIT, Jaipur, India from 10-03-2014 to 14-03-2014 National Workshop onBiometrics and Privacy Protectionat MNIT Jaipur, Jaipur, India from 23-12-2013 to 25-12-2013 National Workshop onBiometric and privacy protectionsat MNIT, Jaipur, India from 22-12-2013 to 24-12-2013 National Seminar onChallenges and Future Research Direction in Natural Language Processingat MNIT, Jaipur, India from 12-12-2013 to 13-12-2013 National Workshop onChallenges in BIG Data Researchat Malaviya National Institute of Technology, Jaipur, India from 09-11-2013 to 13-11-2013 National Workshop onChallenges in Big Data Researchat MNIT, Jaipur, India from 05-11-2013 to 08-11-2013 International Symposia onINTERNATIONAL SYMPOSIUM ON VLSI DESIGN AND TEST (VDAT)at MNIT JAIPUR, Jaipur, India from 27-07-2013 to 30-07-2013 National Short Term Course onPattern Recognition Techniquesat MNIT, Jaipur, India from 13-05-2013 to 17-05-2013 National Workshop onsemantic webat

MNIT Jaipur, Jaipur, India from 23-04-2013 to 25-04-2013 International Conference onINTERNATIONAL CONFERENCE ON SECURITY OF INFORMATION AND NETWORKS (SINCONF)at MNIT JAIPUR, Jaipur, India from 25-10-2012 to 27-10-2012 International Conference onIEEE conference on Computational Intelligence, Modelling and Simulation (CIMSim), IEEE Xplore and CSDL, Kuantan, Malaysiaat Organized by Nottingham Trent University, U.K. , Kuantan, Malaysia from 25-09-2012 to 27-09-2012 National Short Term Course onMachine Intelligenceat Malaviya National Institute of Technology, Jaipur, Jaipur, India from 10-09-2012 to 14-09-2012 National Workshop onWireless Sensor Networks (UCOST Sponsored Faculty Development Workshop)at Graphic Era University, Dehradun, India from 04-08-2012 to 05-08-2012 National Short Term Course onNetwoork Simulation using ns-2at Graphic Era University, Dehradun, India from 25-02-2012 to 26-02-2012 National Workshop onNatural Language processingat Malaviya National Institute of Technology, Jaipur, India from 20-02-2012 to 24-02-2012 National Workshop onTraining for Banchmark Lan Trainer kitsat MNIT, Jaipur, India from 30-01-2012 to 31-01-2012 National Workshop onScientific Computing using Pythonat MNIT, Jaipur, India from 02-04-2010 to 03-04-2010 National Short Term Course onSoft Computing Skills in Engineeringat MNIT, Jaipur, India from 11-12-2008 to 24-12-2008 National Short Term Course onEmerging Trends and Tools in Open Source Computingat MNIT, Jaipur, India from 14-07-2008 to 26-07-2008 National Short Term Course onFinishing School for Engineering Graduates, MNIT Jaipurat MNIT, Jaipur, India from 23-05-2007 to 28-07-2007 National Short Term Course onAcademic Exchange Program under Institutional Networking of TEQIP, MNIT Jaipurat MNIT, Jaipur, India from 12-04-2007 to 13-04-2007 National Short Term Course onMatlab Programming and Its Applicationsat MNIT , Jaipur, India from 12-09-2006 to 18-09-2006 National Short Term Course onTraining program for Technicians & other staff of the departments/sections on â€œComputer Awarenessâ€■at MNIT, Jaipur, India from 06-06-2006 to 16-06-2006 National Short Term Course onTraining program for Administrative & Account section staff on â€œComputer Awarenessat MNIT, Jaipur, India from 23-05-2006 to 02-06-2006 National Workshop onIn-house workshop on TEQIPat MNIT, Jaipur, India from 17-05-2006 to 17-05-2006 National Workshop onWorkshop on â€œCyber Lawsâ€■at MNIT, Jaipur, India from 21-04-2006 to 23-04-2006 International Conference onInternational Conference on Energy and Environmental Technologiesat Gold Palace Reorts, Jaipur, India from 08-10-2003 to 10-10-2003 National Short Term Course onTraining program for Pfizer India Ltd.at MNIT, Jaipur, India from 25-02-2003 to 27-02-2003 National Workshop onIssues in Real Time computer Systems (ISTE-AICTE sponsored)at MNIT, Jaipur, India from 23-12-2002 to 04-01-2003 Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: 18773533 Department of Computer Science & Engineering (Awards & Honors) ■■■■■■■ ■■■■■■■■■■ ■■■■■■■■■■■■■ ■■■■■■■ ■■■■■(■■■■■■■■■■ ■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of

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Journal, Elsevier2017 "Dr. Ashish Kumar Tripathi", Qualified National Eligibility Test for Eligibility for Assistant Professor for given by UGC-Net2017 "Dr. Mahipal Jadeja", Travel Grant of 400 euros for attending and presenting my work at SCAI17 workshop which was held at Amsterdam, Netherlands. given by Microsoft, Facebook and Google2017 "Dr. Neeta Nain", Best Application Oriented Paper for Best Research Paper given by IETE â€“ The Institution of Electronics and Telecommunications Engineers2016 "Dr. Deepak Ranjan Nayak", Best Paper Award for International Conference on Advance Computing, Networking and Informatics given by ICACNI 20152015 "Dr. Lavika Goel", Qualified National Eligibility Test for Eligibility for Assistant Professor given by CBSE-UGC2015 "Dr. Satyendra Singh Chouhan", Travel Grant for Paper Presentation given by Microsoft Research(MSR)2015 "Dr. Lavika Goel", Young Scientist Award for Engineering/Artificial Intelligence given by Venus International Foundation at the VIFRA Annual Research Meet, Chennai2015 "Prof. Vijay Laxmi ", Distinguished Engineer Awards for given by Institution of Engineers2013 "Dr. Pilli Emmanuel Shubhakar", Information Security Education and Awareness Project Fellowship for Research in Information Security given by Department of Information Technology, Government of India2011 "Dr. Ramesh Babu Battula", Undavalli Vidya Ratna for Education given by Undavalli Association2010 "Dr. Prasanta Majumdar", Gold Medalist for Awarder for being first class first in the M Tech examination given by University of Kalyani, WB2009 "Dr. Neeta Nain", Best Paper Award for National Conference on Advancements in Information Technology and Internet Security given by AITIS 20082008 "Dr. Ramesh Babu Battula", GATE for 98+ given by MOE2007 "Dr. Ramesh Babu Battula", TA through GATE for 99%+ given by MOE2006 "Prof. Vijay Laxmi ", Career Award for Young Teachers Achievement for CAYT given by All India Council for Technical Education2004 "Dr. Namita Mittal", CAYT- Career Award for Young Teachers for Conducting research work given by AICTE2004 "Dr. Neeta Nain", Certificate of Merit for II Position in MCA given by Banasthali Vidya Peeth1991 "Dr. Neeta Nain", Among top 10 University Topper for Graduation given by MDU University Rohtak1988 "Dr. Neeta Nain", Best Cadet Award for National Integration Camp given by National Cadet Corps, Govt of India1985 Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in 18773534 Department of Computer Science & Engineering (Placements) [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Placements Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in 18773535 Department of Computer Science & Engineering (Photo Gallery) [redacted]([redacted])Malaviya National

Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Photo Gallery Inaugration of ACM chapter series2021-02-01 To Curriculum development workshop held in Feb 2020To Department day organized in Sep 2019To Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773536 Department of Computer Science & Engineering (Contacts) [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Contact Us Dr. Namita MittalHead, Department of Computer Science & EngineeringMalaviya National Institute of TechnologyJLN Marg, Jaipur-3020170141-2713340hod.cse@mnit.ac.in Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773538 Namita Mittal [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Namita Mittal (Head) 42 Journal Publications 75 Conference Publications 7 Research Projects 17 PhD Research Supervised 1 Awards & Honours Qualifications Research Interests Information Retrieval, Data Mining, Natural Language Processing, Machine Learning, Data Science, Generative AI. Brief Research Profile Dr. Namita Mittal is working as Associate Professor in Department of Computer Science and Engineering. She is a recipient of Career Award for Young Teachers (CAYT) by AICTE. Her Current research areas are Data Science, Information Retrieval, Generative AI, and Natural Language Processing. She has published several research papers in reputed international conferences and journals, and two books in Springer Publication. She is also a member of review committees for Refereed journals/ conferences. She is Senior Member of IEEE, Member of ACM, CCICI, and SCRS. She has conducted various FDPs/Conferences/Workshops like Ph.D. Colloquium FIRE 2017, GIAN Course on Advances on Data and Web Analytics 2017, International Workshop on Text analytics and Retrieval (WI 2018), WIRe (FIRE Track 2020) and GIAN on AI and Information Retrieval 2022. She is guiding 5 PhD students currently and 12 PhD have been awarded under her guidance. One PhD scholar received prestigious PMRF scholarship. Professional Background Teaching Engagements Teaching Engagements Research Lab(s) Developed Research Lab(s) Developed Journal

Publications (42) Journal Publications (42) 2024 2023 2022 2021 2020 2019 2018 2017 2016 2015 2014 2011 Conference Publications (75) Conference Publications (75) 2023 2022 2021 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011 2010 2009 2008 2007 Book Publications (3) Book Publications (3) Book-Chapter Publications (5) Book-Chapter Publications (5) Academic Exposure Academic Exposure Joint Research Work Joint Research Work Events Organized (28) Events Organized (28) Events Attended (5) Events Attended (5) Professional Affiliations (6) Professional Affiliations (6) PhD Research Supervised (17) PhD Research Supervised (17) Awarded Ongoing PG Research Supervised (30) PG Research Supervised (30) 2024-2025 2023-2024 2022-2023 2021-2022 2020-2021 2019-2020 2018-2019 2017-2018 2016-2017 2015-2016 2014-2015 2013-2014 2012-2013 UG Research Supervised (53) UG Research Supervised (53) Research Projects (7) Research Projects (7) Consultancy Projects (1) Consultancy Projects (1) Administrative Responsibilities Administrative Responsibilities Patents Patents Awards & Honours Awards & Honours Invitation/Academic Visit (50) Invitation/Academic Visit (50) Outreach Activities (4) Outreach Activities (4) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in 18773539 Mahesh Chandra Govil [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Prof. Mahesh Chandra Govil (On Deputation) 17 Journal Publications 46 Conference Publications 13 PhD Research Supervised Qualifications Research Interests Real Time Systems, Parallel & Distributed Systems, Fault Tolerant Systems, Cloud Computing. Journal Publications (17) Journal Publications (17) 2014 2012 2011 2010 2008 2006 2005 2004 Conference Publications (46) Conference Publications (46) 2014 2013 2012 2011 2010 2009 2008 2007 2006 2005 2001 2000 1999 Events Organized (11) Events Organized (11) Professional Affiliations (3) Professional Affiliations (3) PhD Research Supervised (13) PhD Research Supervised (13) Awarded Ongoing Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in 18773540 Manoj Singh Gaur [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Prof. Manoj Singh Gaur (On Deputation) 7 Research Projects 17 PhD Research Supervised Qualifications Research Interests Network Security, Embedded Systems, Information Security, Computer Networks, Multi-Core And Cloud Computing. Brief Research Profile I am currently interested in the following areas: 1. Networks on Chip (Fault Tolerant, 2 D and 3 D Architectures) 2. Dynamic and Static Analysis of Malware on Desktop and Mobile Platforms 3. Simulation and Emulation of QoS/QoE aware Streaming Protocols 4. Network Attack models and countermeasures Professional Affiliations (4) Professional Affiliations (4) PhD Research Supervised (17) PhD Research Supervised (17) Awarded Ongoing Research Projects (7) Research Projects (7) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: 18773541 Girdhari Singh [redacted] ([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Prof. Girdhari Singh 23 Journal Publications 45 Conference Publications 11 PhD Research Supervised Qualifications Research Interests Software Engg., Intelligent Systems. Journal Publications (23) Journal Publications (23) 2021 2020 2019 2018 2017 2016 2015 2012 2011 Conference Publications (45) Conference Publications (45) 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011 2010 2007 Book Publications (1) Book Publications (1) Events Organized (9) Events Organized (9) PhD Research Supervised (11) PhD Research Supervised (11) Awarded Ongoing Administrative Responsibilities Administrative Responsibilities Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: 18773542 Vijay Laxmi [redacted] ([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Prof. Vijay Laxmi 47 Journal Publications 35 Conference Publications 13 Research Projects 27 PhD Research Supervised 2 Awards & Honours Qualifications Research Interests Information Security, Machine Vision, Embedded Systems, AI in Cyber Security. Brief Research Profile https://orcid.org/0000-0002-3662-8487 Teaching Engagements Teaching Engagements Journal Publications (47) Journal Publications (47) 2020 2019 2018 2017 2016 2015 2014 2013 2011 2009 2008 2006 Conference Publications (35) Conference Publications (35) 2019 2018 2017 2016 2014 2013 Book-Chapter Publications (10) Book-Chapter Publications (10) Professional Affiliations (3) Professional Affiliations (3) PhD Research Supervised (27) PhD Research Supervised (27) Awarded Ongoing Research Projects (13) Research Projects (13) Awards & Honours Awards & Honours Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: 18773543 Dinesh Gopalani [redacted]

■■■■■(■■■■■■■■■■ ■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Dinesh Gopalani 33 Journal Publications 42 Conference Publications 4 Research Projects 11 PhD Research Supervised 1 Awards & Honours Qualifications Research Interests Theoretical Computer Science, Compilers And Programing Languages, Aspect Oriented Systems, Formal Theory Of Programming Languages, Natural Language Processing. Brief Research Profile Dinesh Gopalani has more than 24 years of teaching and research experience. His research interests are Programming Languages, Compilers, Database Management Systems, Natural Language Processing, and Blockchain Technology. He has published more than fifty research articles in reputed journals and conference proceedings in the above-mentioned research areas. He has guided 9 Ph.D. Thesis and 30 M.Tech. Dissertations. Presently, he is supervising 4 Ph.D. scholars and 4 M.Tech. students in Sentiment Analysis, Fake News Detection, Recommender Systems, etc. Professional Background Teaching Engagements Teaching Engagements Journal Publications (33) Journal Publications (33) 2025 2024 2023 2022 2021 2020 2019 2017 2016 2015 2014 2013 2011 2010 Conference Publications (42) Conference Publications (42) 2024 2023 2022 2021 2020 2019 2018 2017 2016 2015 2014 2013 2012 2010 2008 2007 Book-Chapter Publications (3) Book-Chapter Publications (3) Academic Exposure Academic Exposure Events Organized (5) Events Organized (5) Professional Affiliations (4) Professional Affiliations (4) PhD Research Supervised (11) PhD Research Supervised (11) Awarded Ongoing PG Research Supervised (11) PG Research Supervised (11) 2021-2022 2020-2021 2019-2020 2018-2019 UG Research Supervised (4) UG Research Supervised (4) Research Projects (4) Research Projects (4) Administrative Responsibilities Administrative Responsibilities Patents Patents Awards & Honours Awards & Honours Outreach Activities (2) Outreach Activities (2) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773545 Meenakshi Tripathi ■■■■■■ ■■■■■■■■■■ ■■■■■■■■■■■■■ ■■■■■■■ ■■■■■(■■■■■■■■■■ ■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Meenakshi Tripathi 34 Journal Publications 50 Conference Publications 2 Research Projects 11 PhD Research Supervised 4 Awards & Honours Qualifications Research Interests Secure Routing In Wireless Sensor Networks, Network Security, Wireless Sensor Networks, Wireless Ad hoc Networks, Opportunistic Networks, Software Defined Networks, Blockchain, Cyber Security, Information Security, Internet of Things. Brief Research Profile Meenakshi Tripathi is an Associate Professor in the department of computer science and engineering at MNIT Jaipur. She received her

Ph.D. degree in Computer Science and Engineering from the MNIT in 2015 . She has more than 15 years of teaching/research experience in computer science and information security. She has published more than 100 research articles in leading journals, conference proceedings and books including IEEE Transactions, IJCS, Computer networks, journal of supercomputing etc.. Under her guidance 4 students have already awarded their Ph.D. degree and 5 more are working with her. She has supervised around 33 PG students and more than 60 UG students for their project work. She holds several professional designations including Dean at Rajasthan Skilled University Jaipur, BoS member of university of Kota, Ex- chairman of CSI Jaipur chapter, BoS member of Central University of Rajasthan etc. She was the organizing chair for various FDPs/conferences/workshops such as ANTS■23, ICDLAIR-2019, ATAL FDP on "Cyber Security", FDP on "Software Defined Networks", FDP on "Technical Writing: Tools and techniques" etc. She has also received funding from IEEE CIS for organizing Summer School in 2022 and 2023 respectively. She is a senior member of IEEE, member of ACM and lifelong member of CSI. Her research interests include information security, wireless sensor networks, IoT, Software Defined Networks, blockchain etc. Professional Background Online Course(s) Developed Online Course(s) Developed Research Lab(s) Developed Research Lab(s) Developed Journal Publications (34) Journal Publications (34) 2025 2024 2023 2022 2021 2020 2019 2018 2017 2015 2013 2012 Conference Publications (50) Conference Publications (50) 2024 2023 2022 2021 2020 2019 2018 2017 2015 2014 2013 2012 2010 Book-Chapter Publications (6) Book-Chapter Publications (6) Academic Exposure Academic Exposure Joint Research Work Joint Research Work Events Organized (16) Events Organized (16) Events Attended (4) Events Attended (4) Professional Affiliations (7) Professional Affiliations (7) PhD Research Supervised (11) PhD Research Supervised (11) Awarded Ongoing PG Research Supervised (31) PG Research Supervised (31) 2023-2024 2022-2023 2021-2022 2020-2021 2019-2020 2018-2019 2017-2018 2016-2017 2015-2016 2014-2015 2012-2013 2011-2012 2009-2010 UG Research Supervised (10) UG Research Supervised (10) Research Projects (2) Research Projects (2) Consultancy Projects (1) Consultancy Projects (1) Administrative Responsibilities Administrative Responsibilities Patents Patents Awards & Honours Awards & Honours Invitation/Academic Visit (16) Invitation/Academic Visit (16) Outreach Activities (14) Outreach Activities (14) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773546 Mushtaq Ahmed ■■■■■■ ■■■■■■■■■ ■■■■■■■■■■■■■ ■■■■■■■ ■■■■■(■■■■■■■■■■ ■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Mushtaq Ahmed 31 Journal Publications 57 Conference Publications 3 Research Projects 14 PhD Research Supervised 4 Awards & Honours Qualifications Research Interests Network on Chip , Computer Networks, Embedded Systems, Multi-Core And Cloud Computing, Wireles

Sensor Networks, Fault Tolerant Systems, High speed Overlay Networking,, Blockchain, Network router design and algorithms, Wireless Ad hoc Networks, Opportunistic Networks. Brief Research Profile Dr Mushtaq Ahmed is a faculty in Computer Science and Engg. Department MNIT Jaipur for the past 25 years. He did his PhD from MNIT in 2012. He is teaching UG and PG Courses like Advanced Computer Architecture, Embedded System Design, VLSI Algorithms, Wireless Sensor Networks, Distributed Computing, etc. His research areas are High-Performance Computing, Wireless Sensor Networks, Cloud Computing, Embedded Systems Design, and Advanced Computer Architecture. He has published more than 80 peer-reviewed Journals and conference papers. He has Two patents. He has guided 6 Ph.D. and presently he is guiding seven research scholars in the area of Parallel Compilers, High-Speed Overlay Networking, Fault-Tolerant Systems, Wireless Sensor Networks, Multi-Core Architecture, Cloud Computing, and Blockchain. Dr. Mushtaq is a Fellow IE, Life Member of ACM, Life member of ISTE, Life Member of ACCS, Member of IEEE, and Member of IEANG. Professional Background Teaching Engagements Teaching Engagements Journal Publications (31) Journal Publications (31) 2025 2024 2023 2021 2019 2018 2017 2016 2015 2011 Conference Publications (57) Conference Publications (57) 2025 2024 2023 2022 2021 2020 2019 2018 2017 2016 2015 2014 2012 2011 2010 2009 2008 2005 Academic Exposure Academic Exposure Events Organized (25) Events Organized (25) Events Attended (39) Events Attended (39) Professional Affiliations (7) Professional Affiliations (7) PhD Research Supervised (14) PhD Research Supervised (14) Awarded Ongoing PG Research Supervised (22) PG Research Supervised (22) 2023-2024 2022-2023 2021-2022 2020-2021 2019-2020 2018-2019 2017-2018 2016-2017 2013-2014 Research Projects (3) Research Projects (3) Administrative Responsibilities Administrative Responsibilities Patents Patents Awards & Honours Awards & Honours Invitation/Academic Visit (56) Invitation/Academic Visit (56) Outreach Activities (16) Outreach Activities (16) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773552 Neeta Nain [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Neeta Nain 48 Journal Publications 73 Conference Publications 5 Research Projects 11 PhD Research Supervised 9 Awards & Honours Qualifications Research Interests Image Processing, Pattern Recognition, Computer Graphics, Machine Learning, Deeplearning. Brief Research Profile Neeta Nain, PhD, presently working as Associate Professor, Department of Computer Science and Engineering, Malaviya National Institute of Technology Jaipur, has a teaching experience of over 23 years. Her research area is Pattern Recognition, Machine Learning and Biometrics. She has published more than eighty papers on these topics for various International Journals and conferences like Elsevier Pattern Recognition, Elsevier Journal of Visual Comm.

Infor. Representation, ACM Transactions on Asian Language Information Processing, IETE Journal of Research, Indian Academy of Sciences Sadhana, Springer Multimedia Tools and Applications, The Visual Computer, Artificial Intelligence Review, IEEE Computer Magazine etc. Program Chair, of The 13th, 14th and 15th IEEE International Conference on SIGNAL IMAGE TECHNOLOGY & INTERNET BASED SYSTEMS (SITIS2017, SITIS2018, SITIS2019). Program Chair, of the Fourth IAPR Endorsed International Conference on Computer Vision and Image Processing, CVIP2019. She has several sponsored Research projects under her supervision. Journal Publications (48) Journal Publications (48) 2024 2023 2022 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011 2009 2008 Conference Publications (73) Conference Publications (73) 2025 2024 2023 2022 2021 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011 2008 2007 2006 Joint Research Work Joint Research Work Events Organized (21) Events Organized (21) Professional Affiliations (4) Professional Affiliations (4) PhD Research Supervised (11) PhD Research Supervised (11) Awarded Ongoing Research Projects (5) Research Projects (5) Administrative Responsibilities Administrative Responsibilities Awards & Honours Awards & Honours Invitation/Academic Visit (8) Invitation/Academic Visit (8) Outreach Activities (2) Outreach Activities (2) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: 18773553 Pilli Emmanuel Shubhakar [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Pilli Emmanuel Shubhakar 38 Journal Publications 76 Conference Publications 10 Research Projects 16 PhD Research Supervised 1 Awards & Honours Qualifications Research Interests Security, Privacy and Forensics, Cloud Computing, Big Data, Internet of Things, Blockchain, Quantum Computing. Brief Research Profile Pilli Emmanuel Shubhakar has 25 years of teaching, research and administrative experience. He was awarded PhD from Indian Institute of Technology, Roorkee for the thesis on "A Framework for Network Forensic Analysis in 2012. He has coauthored two books - "Fundamentals of Network Forensics - A Research Perspective" for Springer in 2016 and "Cloud Security - Attacks, Techniques, Tools, and Challenges" for CRC Press (Taylor and Francis) in 2021. He has supervised 9 PhD Thesis and 44 M. Tech dissertations. He is presently guiding 3 M. Tech and 7 Ph. D students in Security & Forensics, Cloud Computing, Big Data, IoT, Blockchain and Quantum Computing. He is Convenor, Department (CSE) PG Committee and the Co - Principal Investigator of Electronics and ICT Academy Phase - II in MNIT. He has an additional role of Dean (Academic Affairs) and Dean (Faculty Welfare) in Indian Institute of Information Technology Kota. He is an Honorary Dean (Network & Hardware) in Vishvakarma Skills University, Jaipur. He is Senior Member of both IEEE and ACM. He is member of Cloud Computing Innovation Council of India (CCICI), Quantum Ecosystems Technology Council of India (QETCI) and Digital

Forensic Research WorkShop (DFRWS). Professional Background Teaching Engagements Teaching Engagements Research Lab(s) Developed Research Lab(s) Developed Journal Publications (38) Journal Publications (38) 2025 2024 2023 2022 2021 2020 2019 2018 2017 2010 Conference Publications (76) Conference Publications (76) 2025 2024 2023 2022 2021 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011 2010 Book Publications (3) Book Publications (3) Book-Chapter Publications (3) Book-Chapter Publications (3) Academic Exposure Academic Exposure Joint Research Work Joint Research Work Editorial Services Editorial Services Events Organized (22) Events Organized (22) Events Attended (30) Events Attended (30) Professional Affiliations (11) Professional Affiliations (11) PhD Research Supervised (16) PhD Research Supervised (16) Awarded Ongoing PG Research Supervised (34) PG Research Supervised (34) 2023-2024 2022-2023 2021-2022 2020-2021 2019-2020 2018-2019 2017-2018 2016-2017 2015-2016 2014-2015 2013-2014 UG Research Supervised (30) UG Research Supervised (30) Research Projects (10) Research Projects (10) Consultancy Projects (1) Consultancy Projects (1) Administrative Responsibilities Administrative Responsibilities Awards & Honours Awards & Honours Invitation/Academic Visit (126) Invitation/Academic Visit (126) Outreach Activities (4) Outreach Activities (4) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: 18773554 Ramesh Babu Battula [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Ramesh Babu Battula 30 Journal Publications 38 Conference Publications 9 Research Projects 5 PhD Research Supervised 5 Awards & Honours Qualifications Research Interests Information Security, Secure Communication, Next Generation (xG) Networks, Computer Security, Intelligent Communication and Networks (5G and Beyond 5G). Brief Research Profile Ramesh Babu Battula, PhD, is an Associate Professor at Malaviya National Institute of Technology Jaipur. His expertise lies in decentralized learning for security, focusing on AI for Blockchain and Blockchain for AI, as well as next-generation distributed ledgers. With a background in Computer Science and Engineering, he holds a PhD from MNIT Jaipur, an M.Tech(CSE) from IIT Guwahati, and a B.Tech(IT) from Acharya Nagarjuna University. His research interests span computer security, intelligent communication and networks (including 5G and beyond, IOV, etc.), and he is an active member of ACM Communications, IEEE, IEEE Future Networks, TIMES, IENG, among others. Ramesh has authored numerous articles in prestigious journals such as IEEE/IET, ACM, Elsevier, and Springer, and has secured several research- funded projects from DST, MeitY, as well as consultancy projects. Professional Background Teaching Engagements Teaching Engagements Journal Publications (30) Journal Publications (30) 2025 2024 2023 2022 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011 Conference Publications (38) Conference

Publications (38) 2024 2023 2022 2021 2020 2019 2017 2015 2014 2013 2011 2010 Book-Chapter Publications (7) Book-Chapter Publications (7) Events Organized (6) Events Organized (6) Professional Affiliations (4) Professional Affiliations (4) PhD Research Supervised (5) PhD Research Supervised (5) Awarded Ongoing Research Projects (9) Research Projects (9) Consultancy Projects (3) Consultancy Projects (3) Administrative Responsibilities Administrative Responsibilities Awards & Honours Awards & Honours Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773558 Yogesh Kumar Meena [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Yogesh Kumar Meena 18 Journal Publications 24 Conference Publications 2 Research Projects 5 PhD Research Supervised Qualifications Research Interests Natural Language Processing, Information Retrieval, Data Mining, Neural Networks. Brief Research Profile My research interests are Natural Language Processing, Neural Networks, Data Mining and Information Retrieval. I have published 12 International Journal (SCI) papers and 35 international conference papers. I have supervised 04 Ph.D scholars (Doctoral Scholars) and Currently supervising 06 Ph.D scholars. I have supervised 35 Masters students (M.Tech) and 40 Bachelor students (B.Tech) in last 10 years in the above mentioned research areas. I have received financial grants in the form of research projects from DST Rajasthan and SERB DST India. Professional Background Teaching Engagements Teaching Engagements Journal Publications (18) Journal Publications (18) 2024 2023 2022 2021 2020 2018 2016 2015 Conference Publications (24) Conference Publications (24) 2022 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011 Book-Chapter Publications (4) Book-Chapter Publications (4) Events Organized (16) Events Organized (16) Professional Affiliations (5) Professional Affiliations (5) PhD Research Supervised (5) PhD Research Supervised (5) Awarded Ongoing PG Research Supervised (9) PG Research Supervised (9) 2021-2022 2020-2021 2019-2020 2018-2019 2017-2018 UG Research Supervised (8) UG Research Supervised (8) Research Projects (2) Research Projects (2) Administrative Responsibilities Administrative Responsibilities Invitation/Academic Visit (4) Invitation/Academic Visit (4) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773562 Arka Prokash Mazumdar [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Arka Prokash Mazumdar 18

Journal Publications 24 Conference Publications 4 Research Projects 10 PhD Research Supervised 1 Awards & Honours Qualifications Research Interests Computer Networks, Wireless Sensor Networks, Wireless Ad hoc Networks, Opportunistic Networks, Internet of Things, Intelligent Transportation Systems. Professional Background Teaching Engagements Teaching Engagements Journal Publications (18) Journal Publications (18) 2025 2024 2023 2022 2021 2020 2018 2014 2013 2012 2010 Conference Publications (24) Conference Publications (24) 2023 2022 2021 2020 2019 2017 2016 2015 2014 2013 2012 2011 Book Publications (3) Book Publications (3) Book-Chapter Publications (2) Book-Chapter Publications (2) Academic Exposure Academic Exposure Events Organized (9) Events Organized (9) Professional Affiliations (6) Professional Affiliations (6) PhD Research Supervised (10) PhD Research Supervised (10) Awarded Ongoing Research Projects (4) Research Projects (4) Administrative Responsibilities Administrative Responsibilities Awards & Honours Awards & Honours Invitation/Academic Visit (16) Invitation/Academic Visit (16) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773564 Ashish Kumar Tripathi [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Ashish Kumar Tripathi 31 Journal Publications 11 Conference Publications 3 Research Projects 6 PhD Research Supervised 1 Awards & Honours Qualifications Research Interests Big Data, Soft computing techniques, Data Clustering, Machine Learning, Computer Vision. Professional Background Teaching Engagements Teaching Engagements Journal Publications (31) Journal Publications (31) 2025 2024 2023 2022 2021 2020 2019 2018 Conference Publications (11) Conference Publications (11) 2023 2022 2019 2018 2016 2015 2014 Joint Research Work Joint Research Work Professional Affiliations (1) Professional Affiliations (1) PhD Research Supervised (6) PhD Research Supervised (6) Awarded Ongoing PG Research Supervised (8) PG Research Supervised (8) 2024-2025 2023-2024 2022-2023 2021-2022 UG Research Supervised (3) UG Research Supervised (3) Research Projects (3) Research Projects (3) Administrative Responsibilities Administrative Responsibilities Awards & Honours Awards & Honours Invitation/Academic Visit (12) Invitation/Academic Visit (12) Recent Research Recent Research A novel fuzzy clustering-based method for human activity recognition in cloud-based industrial IoT environmentRead more.. Technological Revolutions in Smart Farming: Current Trends, Challenges & Future DirectionsRead more.. Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773565 Deepak Ranjan Nayak [redacted]([redacted])Malaviya National Institute of

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Teaching Engagements Teaching Engagements Journal Publications (20) Journal Publications (20) 2024 2023 2022 2021 2020 2015 2014 2013 Conference Publications (30) Conference Publications (30) 2024 2023 2022 2021 2020 2019 2017 2012 2011 2010 Book Publications (1) Book Publications (1) Book-Chapter Publications (4) Book-Chapter Publications (4) Joint Research Work Joint Research Work Events Organized (5) Events Organized (5) Professional Affiliations (3) Professional Affiliations (3) PhD Research Supervised (4) PhD Research Supervised (4) Awarded Ongoing PG Research Supervised (12) PG Research Supervised (12) 2023-2024 2022-2023 2021-2022 2020-2021 UG Research Supervised (11) UG Research Supervised (11) Research Projects (1) Research Projects (1) Administrative Responsibilities Administrative Responsibilities Invitation/Academic Visit (9) Invitation/Academic Visit (9) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773571 Lavika Goel [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Lavika Goel 26 Journal Publications 42 Conference Publications 3 Research Projects 5 PhD Research Supervised 5 Awards & Honours Qualifications Research Interests Artificial Intelligence, Bio And Nature Inspired Algorithms, Computational Intelligence, Evolutionary Computing, Intelligent Systems, Machine Learning, Optimization, Remote sensing, Image processing and pattern recognition. Brief Research Profile Dr. Goel has published around 101 research papers in SCI-indexed International conferences, journals & book chapters,, including Elsevier, IEEE, T&F;, Springer, etc. She has written a textbook on Artificial Intelligence for UG students, which was published in January 2021 by Wiley Publications and is amongst the top 10 bestseller books globally on the Amazon website to date. She received in August 2019 and in October 2022, external fundings of Rs. 40 lakhs and Rs. 30 lakhs, respectively, as Co-Principal Investigator (Co-PI) and Principal Investigator from the Department of Science and Technology, Interdisciplinary Cyber-Physical Systems division and SERB-CRG (Science and Engineering Research Board- Core Research Grant) divisions. She is also a life member of the Institution of Engineers India Ltd. and Machine Intelligence & Research Labs, USA, a Senior member of IEEE, and a Senior member of IEEE Computational Intelligence Society. She was awarded the prestigious Young Scientist Award by the VIFRA International Foundation in 2015. She is also the Joint Winner of the IEEE India Best Women Professional Award given by IEEE India Council, 2021, at the IEEE Flagship conference INDICON held at the Indian Institute of Technology, Guwahati. This achievement of hers was featured as an article in the Dainik Bhaskar newspaper on 20th Jan 2022. Her research interests include nature-inspired optimization, machine learning, hybrid intelligence, pattern recognition and remote sensing. Professional Background Teaching Engagements Teaching Engagements Journal Publications (26) Journal Publications (26) 2024 2023 2022 2021 2020 2019 2018 2015 2013 2012 2011 2010 Conference Publications (42) Conference Publications (42) 2024 2023 2022 2021 2020 2019 2018 2017 2016 2015 2014 2013 2012 2011 Book Publications (2) Book Publications (2) Book-Chapter Publications (11) Book-Chapter Publications (11) Joint Research Work Joint Research Work Editorial Services Editorial Services Events Organized (5) Events Organized (5) Professional Affiliations (5) Professional Affiliations (5) PhD Research Supervised (5) PhD Research Supervised (5) Awarded Ongoing PG Research Supervised (9) PG Research Supervised (9) 2024-2025 2023-2024 2022-2023 2021-2022 Research Projects (3) Research Projects (3) Administrative Responsibilities Administrative Responsibilities Awards & Honours Awards & Honours Invitation/Academic Visit (22) Invitation/Academic Visit (22) Outreach Activities (26) Outreach Activities (26) Recent Research Recent Research Design and Implementation of a Hybrid Nature Inspired and Machine Learning Based Intelligent Optimization Model for Crop Recommendation in Rajasthan, India.Read more.. Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773572 Mahipal Jadeja [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Mahipal Jadeja 14 Journal Publications 14 Conference Publications 7 PhD Research Supervised 2 Awards & Honours Qualifications Research Interests Theoretical Computer Science, Graph Theory, Algorithms, Information Visualisation, Graph Visualisation, Machine Learning on Graphs, Social Network Analysis, Graph Neural Networks, Generative AI in Education. Brief Research Profile Dr. Mahipal Jadeja received his Ph.D. degree from Dhirubhai Ambani Institute of Information and Communication Technology (DA-IICT) in the field of Theoretical Computer Science. He currently works at MNIT Jaipur as an assistant professor. His research interests include Theoretical Computer Science, Social Network Analysis, Machine Learning on Graphs (Graph Neural Networks) and

Generative AI in education. He has published several journal articles, book chapters and a reference book (Springer) in these domains. His research work is presented at reputed international conferences including GSB-SIGIR 2015 (Chile), WAAC 2016 (Japan), SCAI-ICTIR 2017 (Netherlands) and ICAAE 2023 (Australia). He has supervised 3 Ph.D. students, 12 M.Tech students and currently, he is supervising 4 Ph.D. students and 3 M.Tech students. On his YouTube Channel-CS Simplified, he has uploaded more than 150 academic videos. To date, the channel has received more than 3,50,000 views. He has also developed a Massive Open Online Courese (MOOC) on Python Programming, which has attracted over 1500 learners and boasts an impressive average rating of 4.8 out of 5. Dr. Mahipal Jadeja has delivered numerous expert talks at prestigious venues including a session on AI-powered advancements in education, organised by Dr. Rea Lavi from the Massachusetts Institute of Technology(MIT), the top-ranked institute of the world (QS #1 since 2012). Teaching Engagements Teaching Engagements Online Course(s) Developed Online Course(s) Developed Journal Publications (14) Journal Publications (14) 2024 2023 2021 2017 Conference Publications (14) Conference Publications (14) 2023 2022 2020 2017 2016 2015 Book Publications (1) Book Publications (1) Book-Chapter Publications (5) Book-Chapter Publications (5) Academic Exposure Academic Exposure Events Organized (8) Events Organized (8) PhD Research Supervised (7) PhD Research Supervised (7) Awarded Ongoing PG Research Supervised (12) PG Research Supervised (12) 2024-2025 2023-2024 2022-2023 2021-2022 Administrative Responsibilities Administrative Responsibilities Awards & Honours Awards & Honours Invitation/Academic Visit (72) Invitation/Academic Visit (72) Outreach Activities (4) Outreach Activities (4) Recent Research Recent Research CB-SAGE: A novel centrality based graph neural network for floor plan classificationRead more.. Dr. Prasanta Majumdar 4 Journal Publications 2 Conference Publications 1 Awards & Honours Qualifications Research Interests Design and analysis of traffic grooming algorithms, Behaviroul analysis of dynamically generated traffic demands, Fragmentation problems in spectrum domain under EON. Brief Research Profile Design and analysis of traffic grooming algorithms, Behavioural analysis of dynamically generated traffic demands, Fragmentation problems in spectrum domain under EON. Journal Publications (4) Journal Publications (4) 2020 2019 2018 2015 Conference Publications (2) Conference Publications (2) 2019 Awards & Honours Awards & Honours

Institute of Technology Jaipur 18773575 Malaviya National Institute of Technology Jaipur [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Sadbhawna . 4 Journal Publications 1 Research Projects Qualifications Research Interests Computer Vision, Image Processing, Deep Learning, Image/Video Super Resolution, Quality Assessment of Synthesized Views. Brief Research Profile I have received a Ph.D. in Computer Science from the Indian Institute of Technology Jammu in 2023. After PhD, I have also worked as an institute post-doc fellow at IIT Madras. I have a keen interest in super- resolution, visual perception, multimedia perceptual quality, image processing, quality assessment and enhancement, and artificial intelligence. My contributions to the field have been published in various high-impact journals and conferences. I was also part of the runner-up team in the IEEE ICASSP 2021 Signal Processing Grand Challenge on COVID-19 Diagnosis. I am also the recipient of the prestigious PhD Industrial Exposure Fellowship offered by Indo-German Science Technology Centre (IGSTC), 2021. My Webpage: https://sadbhawnathakur.github.io/ Professional Background Teaching Engagements Teaching Engagements Journal Publications (4) Journal Publications (4) 2024 2022 Research Projects (1) Research Projects (1) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773577 Satyendra Singh Chouhan [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Satyendra Singh Chouhan 25 Journal Publications 17 Conference Publications 3 Research Projects 8 PhD Research Supervised 1 Awards & Honours Qualifications Research Interests Artificial Intelligence , Natural Language Processing, Deep Learning, Continual Machine Learning, Open-world Machine Learning. Brief Research Profile Dr. Satyendra Singh Chouhan earned his Ph.D. in Artificial Intelligence from Computer Science and Engineering at the Indian Institute of Technology Roorkee, where his research focused on finding out algorithmic solutions for AI Planning problems. His research areas include emerging techniques in AI, such as Continual ML and Open-World ML. His innovative work has been published in several renowned international journals, contributing significantly to the academic discourse in his field. He has more than 7 years of experience in Academics and Research. Before MNIT, he worked as an Assistant professor at SGSITS Indore. He is a senior member of IEEE, and he has been a reviewer/TPC member of international conferences and reputed journals, including IEEE Transactions. He is currently executing various research projects sponsored by different government departments and industries such as DRDO, DST-National Supercomputing Mission (NSM), and the government of Rajasthan. He has supervised 4 PhD & 9 M.Tech students, and currently, he is supervising 5 PhD students and three M.Tech students. Teaching Engagements Teaching Engagements Journal Publications (25) Journal Publications (25) 2025 2024 2023 2022 2021 2017 2015 Conference Publications (17) Conference Publications (17) 2024 2023 2022 2021 2020 2018 2016 2015 2014 2012 Book Publications (1) Book Publications (1) Book-Chapter Publications (2) Book-Chapter Publications (2) Joint Research Work Joint Research Work Events Organized (7) Events Organized (7) Professional Affiliations (2) Professional Affiliations (2) PhD Research Supervised (8) PhD Research Supervised (8) Awarded Ongoing Research Projects (3) Research Projects (3) Administrative Responsibilities Administrative Responsibilities Patents Patents Awards & Honours Awards & Honours Invitation/Academic Visit (7) Invitation/Academic Visit (7) Outreach Activities (1) Outreach Activities (1) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in 18773581 Smita Naval [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Smita Naval 5 Journal Publications 13 Conference Publications 3 Research Projects 3 PhD Research Supervised Qualifications Research Interests Information Security, Malware Analysis, Privacy Breach, Pattern Recognition, Machine Learning. Professional Background Teaching Engagements Teaching Engagements Journal Publications (5) Journal Publications (5) 2024 2021 2018 2015 Conference Publications (13) Conference Publications (13) 2024 2023 2021 2017 2014 2013 2012 2011 Book-Chapter Publications (1) Book-Chapter Publications (1) Events Organized (1) Events Organized (1) Professional Affiliations (1) Professional Affiliations (1) PhD Research Supervised (3) PhD Research Supervised (3) Ongoing PG Research Supervised (4) PG Research Supervised (4) 2022-2023 2021-2022 Research Projects (3) Research Projects (3) Administrative Responsibilities Administrative Responsibilities Invitation/Academic Visit (5) Invitation/Academic Visit (5) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in 18773582 Malaviya National Institute of Technology Jaipur [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Dr. Vikash Kumar 6 Journal Publications 6 Conference Publications Qualifications

Research Interests Intrusion Detection System, Cyber Security, Network Security, Machine and Deep Learning for Security, Generative Modeling. Professional Background Teaching Engagements Teaching Engagements Journal Publications (6) Journal Publications (6) 2023 2022 2021 2020 Conference Publications (6) Conference Publications (6) 2022 2021 2020 2019 Book-Chapter Publications (1) Book-Chapter Publications (1) Professional Affiliations (1) Professional Affiliations (1) Patents Patents Invitation/Academic Visit (2) Invitation/Academic Visit (2) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773584 Malaviya National Institute of Technology Jaipur ■■■■■■ ■■■■■■■■■ ■■■■■■■■■■■■ ■■■■■■■ ■■■■■(■■■■■■■■■ ■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Prof. Virendra Singh Qualifications Research Interests Cyber Security, Computer Architecture, Processor architecture & micro-architecture, Memory system design, Reconfigurable computing, Adaptive computing/architectures, Compiler support for modern architectures, Fault-tolerant computing, Robust design and architectures, Self-healing system design, VLSI testing and design for testability, SoC/NoC design and test, Post silicon debug, High level synthesis, Formal verification, Trusted computing, FPGA based acceleration, Trusted hardware design, Cyber physical systems, Network router design and algorithms, Software defined networking (SDN), Blockchain. Brief Research Profile Faculty member, Indian Institute of Technology Bombay (Since Dec 2011) Faculty member, SERC, Indian Institute of Science (IISc), Bangalore (May 2007 - Dec 2011) Scientist, Central Electronics Engg. Research Institute (CEERI), Pilani (Mar 1997 - May 20) Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773586 Malaviya National Institute of Technology Jaipur ■■■■■■ ■■■■■■■■■ ■■■■■■■■■■■■ ■■■■■■■ ■■■■■(■■■■■■■■■ ■■■■■ ■■ ■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Prof. Vudutala China Venkata Rao Qualifications Research Interests Distributed Parallel Computing, BigData Processing,, High Performance Computing, Application and System Benchmarks on Distributed Parallel Processing Platforms, HPC for AI and AI for HPC technologies programming Environment and Libraries, Digital Twin ■ Modeling and Simulation, Implementation aspects for 5G/6G Tele traffic Engineering Applications - Linear Programming and Optimization. Brief Research Profile I worked in the Centre for Development of Advanced Computing (C-DAC), Pune/Bnagalore on "High Performance Computing (HPC) Technologies" from the year 1993 onwards. My superannuation was in December 2020 as a Senior Director, at C-DAC, Pune. I've been working as Consultant in C-DAC, Pune from January 2021 onwards on "National Supercomputing Mission (NSM) Projects. Most of my project work at C-DAC, Pune has been related to Distributed Parallel Computing Technologies - Hardware, Software, Testing Distributed Parallel Computing Systems, Parallelization of large-scale applications, Application and System Benchmarks on PARAM Series of Supercomputers. I also worked as an Adjunct /Visiting Faculty in the Dept.. of CSE IIITDM-Kurnool (2020- 2024), NIT-Warangal (2023-24) and MNIT Jaipur (2023-24) & earlier.I was a visiting Faculty in the Dept of Computer Sciences at University of Minnesota (UofM) Minneapolis and Post Doctoral Fellow at Army High Performance Computing Centre at UofM (1997-1998). I worked on "Distributed Parallel Computing and Parallel Algorithms implementation for Graph Theory /Sparse Matrix Computations while I was at UofM. I received my Ph.D in Mathematics from III-Kanpur in the year 1992-93 with joint guidance from Dept of Mechanical Engineering and Department of Mathematics. I worked on implementation of Finite Element Adaptive Meshing (Grid Generation) algorithms for certain class of CFD applications. Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773588 Malaviya National Institute of Technology Jaipur [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment M. Tech. Program in Computer Science & Engineering Programme Description M.Tech CSEis a two-year post-graduate programme offered to students who are interested in advanced learning and research in the field of computer science. This is a 60-credit degree programme, which covers four semesters.HighlightsDuration of the Program2 YearsAdmission ThroughGATEIntake27 Aims and Objectives Programme Highlights Scheme and Syllabus Information Brochure Contact Details 1stYear CoordinatorDr. Pilli Emmanuel ShubhakarPhone: 01412713376 (O), E-mail: espilli.cse@mnit.ac.in2ndYear CoordinatorDr. Namita MittalPhone: 01412713324 (O), E-mail: nmittal.cse@mnit.ac.in Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773590 Malaviya National Institute of Technology Jaipur [redacted]([redacted])Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment M. Tech. Program in Computer Science & Information Security Programme Description M.Tech CS&ISis; a two-year post-graduate programme offered to students who are interested in learning advanced concepts and research in the field of information security. This is a 60-credit degree programme, which covers four semesters.HighlightsDuration of the Program2 YearsAdmission ThroughGATEIntake25 Aims and Objectives Programme Highlights Scheme and Syllabus Information Brochure Contact Details 1stYear CoordinatorDr. Dinesh Kumar TyagiPhone: 01412713571 (O), E-mail: dktyagi.cse@mnit.ac.in2ndYear CoordinatorDr. Arka Prokash MazumdarPhone: 01412713452 (O), E-mail: apmazumdar.cse@mnit.ac.in Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773592 2022_CSE_UG.pdf Scheme & Syllabi of B. Tech. (Computer Science and Engineering) July 2023 DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

1 Contents 2 Tentative UG(CSE) Scheme Department of Computer Science and Engineering First Semester S. No Code Subject L-T-P Credit Type Institute Core Subjects 19 IC 22CPT10 3 Problem Solving using C 2-0-0 2 PC 22CPT10 4 Discrete Mathematics 3-0-0 3 PC 22CPP10 5 Problem Solving Using C Lab 0-0-2 1 PC 25 Second Semester S. No Code Subject L-T-P Credit Type Institute Core Subjects 18 IC 22CPT10 6 Data Structures 3-0-0 3 PC 22CPT10 7 Logic System Design 2-0-0 2 PC 22CPP10 8 Data Structures Lab 0-0-2 1 PC 22CPP10 9 Logic System Design Lab 0-0-2 1 PC 25 Third Semester S. No Code Subject L-T-P Credits Type 22CPT201 Data Communications 3-0-0 3 PC 22CPT202 Design and Analysis of Algorithms 3-0-0 3 PC 22CPT203 Digital Circuits and Microprocessors 3-0-0 3 PC 22CPT204 Foundation of Learning 3-0-0 3 PC 22CPT205 Object Oriented Analysis and Design 3-0-0 3 PC 22CPT206 Technical

Writing 1-0-0 1 PC 22HST2 41 Social Sciences and Professional Ethics 3-1-0 4 BS 3 22CPP207 Design and Analysis of Algorithms Lab 0-0-4 2 PC 22CPP208 Digital Circuits and Microprocessors Lab 0-0-2 1 PC 22CPP209 Object Oriented Analysis and Design Lab 0-0-2 1 PC 22CPP210 Technical Writing Lab 0-0-2 1 PC 25 Fourth Semester S. No Code Subject L-T-P Credits Type 22CPT211 Computer Networks 3-0-0 3 PC 22CPT212 Computer Organization and Architecture 3-1-0 4 PC 22CPT215 Theory of Computation 3-1-0 4 PC 22CPT213 Database Information Systems 3-0-0 3 PC 22CPT214 Machine Learning 3-0-0 3 PC 22BMT201 Basics of Managements 3-0-0 3 MM 22CPP216 Computer Networks Lab 0-0-4 2 PC 22CPP217 Database Information Systems Lab 0-0-4 2 PC 22CPP218 Machine Learning Lab 0-0-2 1 PC 25 Fifth Semester S. No Code Subject L-T-P Credits Type 22CPT301 Compiler Design 3-0-0 3 PC 22CPT302 Cryptography 3-0-0 3 PC 22CPT303 Operating System 3-0-0 3 PC 22CPT304 Software Engineering 3-0-0 3 PC 22CPT305 Emerging Technologies for CS 3-0-0 3 PC 22CPTxxx Program Elective -1 3-0-0 3 PE 22CPP306 Compiler Design Lab 0-0-2 1 PC 22CPP307 Cryptography Lab 0-0-2 1 PC 22CPP308 Operating System Lab 0-0-2 1 PC 21 4 Honors 22CPTxxx Advance Data Structures and Algorithms 3 22CPTxxx Honors Elective -1* 3 6 Minor CSE 22CPT10 6 Data Structures 3 PC 22CPT303 Operating System 3 PC 6 Sixth Semester S. No Code Subject L-T-P Credits Type 22CPT309 Artificial Intelligence 3-0-0 3 PC 22CPT310 Computer and Network Security 3-0-0 3 PC 22CPT311 Digital Image Processing 3-0-0 3 PC 22CPT312 Parallel and Distributed Computing 3-0-0 3 PC 22EET313 Smart Grid 3-0-0 3 PLEAS 22CPTxxx Program Elective -2 3-0-0 3 PE 22CPP313 Computer and Network Security Lab 0-0-2 1 PC 22CPP314 Digital Image Processing Lab 0-0-2 1 PC 22CPP315 Parallel and Distributed Computing Lab 0-0-2 1 PC 21 Honors 22CPTxxx Honors Elective -2* 3 22CPTxxx Honors Elective -3* 3 6 Minor CSE 22CPT211 Computer Networks 3 PC 22CPT213 Database Information Systems 3 PC 6 5 Seventh Semester S. No Code Subject L-T-P Credits Type 1 22CPS401 Training Seminar 0-0-4 2 PC 2 22CPD402 Minor Project 0-0-6 3 PC 3 22CPTxxx Program Elective -3 3-0-0 3 PE 4 22CPTxxx Program Elective -4 3-0-0 3 PE 5 22CPTxxx Program Elective -5 3-0-0 3 PE 6 22CPTxxx Program Elective -4 Lab 0-0-2 1 PE 7 22CPTxxx Program Elective -5 Lab 0-0-2 1 PE 8 Open Elective – 1 3-0-0 3 OE 19 Honors 22CSTxxx Honors Elective -4* 3 3 Minor CSE 22CPT304 Software Engineering 3 PC 3 Eighth Semester S. No Code Subject L-T-P Credit s Type 1 22CPD403 Major Project 0-0-16 8 PC 2 22CPTxxx Program Elective -6 3-0-0 3 PE 3 22CPTxxx Program Elective -7 3-0-0 3 PE 4 22CPPxxx Program Elective -6 Lab 0-0-2 1 PE 5 22CPPxxx Program Elective -7 Lab 0-0-2 1 PE 6 Open Elective – 2 3-0-0 3 OE 19 6 Honors 22CSTxxx Honors Elective -5* 3 3 Minor CSE 22CPT309 Artificial Intelligence 3 PC 3 * Honors Elective courses will be taken from PG departmental subject pool 7 Semester -wise Scheme and Syllabus Scheme and Syllabus of 1st Year Institute Core Subjects Programming with Python Prerequisite: Nil L T P C Total hours: 28 2 0 0 2 Course Content Hrs. Unit 1 Introduction to computer system and binary number systems – addition, subtraction (2's complement), multiplication, left shifting and right shifting. 4 Unit 2 Introduction to Python: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc. Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, for loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks. 6 Unit 3 Python Complex data types: Using string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary. 6 Unit 4 Building blocks of python programs: string manipulation methods, List manipulation, Dictionary manipulation, Programming using string, list and dictionary in-built functions. Python Functions, Organizing python codes using functions, Introduction to classes. 6 Unit 5 Python File Operations: Reading files, Writing files in python, Case study: development of mini projects using libraries like matplotlib, numpy, etc. 6 References 1. Wesley J. Chun, “Core Python Applications Programming”, 3rd Edition , Pearson Education, 2016. 2. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley, 2015. 3. Jeeva Jose &P.SojanLal;, “Introduction to Computing and Problem Solving with PYTHON”, Khanna Publishers, New Delhi, 2016. 4. Downey, A. et al., “How to think like a Computer Scientist: Learning with Python”, John Wiley, 2015. 5. Mark Lutz, “Learning Python”, 5th edition, Orelly Publication, 2013, ISBN 978- 1449355739 6. John Zelle, “Python Programming: An Introduction to Computer Science”, Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978 - 1590282410 7. Michel Dawson, “Python Programming for Absolute Beginers” , Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1435455009 8. David Beazley, Brian Jones., “Python Cookbook”, Third Edition, Orelly Publication, 2013, ISBN 978- 1449340377 8 Programming with Python Lab Prerequisite: L T P C Total hours: 28 0 0 2 1 Course Content Hrs. The following proposed coverage are broad guiding areas lab. The programs mentioned here just sample programs and they are just for reference purpose. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with concerned theory course. 1. Installation of Python Tool, Introduction to Python programming, and python datatypes [1 Lab] 2. Data types, Input/Output and library imports [1 Lab] 3. Python strings operations, Doc strings [1 Lab] 4. Objects - List, Tuples and Dictionaries [3 Lab] 5. Control flow, functions working and some advanced functions [2 Lab] 6. Python File Operations: Reading files, Writing files in python [1 Lab] 7. Introduction to classes [1 Lab] 8. Numpy, Matlabplotlib utility functions [2 Lab] References: 1. Core Python Applications Programming: Wesley J. Chun, Pearson Education, 2016. 2. Introduction to Computer Science using Python: Charles Dierbach, Wiley, 2015 3. Python for Programmers: Paul J. Deitel, Harvey Deitel , Pearson, 2020 . 4. Learning Python: Mark Lutz, Orelly Publication, 2013 5. Python Programming: An Introduction to Computer Science: John Zelle, Course Technology Cengage Learning Publications, 2013. 9 Scheme and Syllabus of 1st Semester First Semester S. No Code Subject L-T-P Credit Type Institute Core Subjects 19 IC 22CPT101 Discrete Mathematics 3-0-0 3 PC 22CPT102 Problem Solving using C 2-0-0 2 PC 22CPP103 Problem Solving Using C Lab 0-0-2 1 PC 25 10 Discrete Mathematics Prerequisite: Nil L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Logic: Truth Tables, Conditionals ($P \Rightarrow Q$), and Bi -conditionals ($P \Leftrightarrow Q$), Negation, Converse, and Contrapositive, Existential and Universal Quantifiers ($\forall$,$\exists$, $\exists!$), Proof Techniques (Contrapositive, Contradiction, Induction), Counterexamples, and Proving Statements with Quantifiers, Predicate logic, first order logic, Logical Inferences. 8 Unit 2 Set Theory: Sets and Set Notation, the Empty Set, the Power Set, Cardinality rules and infinite sets, Union, Intersection, Complement, Subsets , Proving sets are equal, Axioms of Naïve Set Theory. 6 Unit 3 Relations: Cartesian Products and Relations, Equivalence Relations and Partitions, Partial Orderings, Lattices. 6 Unit 4 Functions: Definition of a Function, Domains and Co-domains, Composition and Inverses, Well -Defined, Injective, Surjective, and Bijective Functions, Recurrence Relations, Generating functions. 6 Unit 5 Abstract Algebra: Groups -Binary operation, and its properties, Definition of a group, Groups as symmetries, cyclic, dihedral, symmetric, matrix groups, Subgroups, Cosets, normal subgroups and quotient groups, Conjugacy classes, Lagrange's theorem, Monoid. 8 Unit 6 Number Theory: Prime Numbers, Euclid's Algorithm for GCD, The GCD - LCM product theorem, Extended Euclid's Algorithm, Linear Diophantine Equations, Modular Arithmetic, Chinese Reminder Theorem, Fast Modular Exponentiation, Fermat's little theorem, Euler's totient theorem, Euler's theorem. 8 References 1. Ronald L. Graham, Donald E. Knuth, Oren Patashnik ,Concrete Mathematics: A Foundation for Computer Science (2nd Edition) 2. K. Rosen, Discrete Mathematics and Its Applications, 7th edition, McGraw -Hill, 2011. 3. M. Lipson, Schaum's Outline of Discrete Mathematics, revised 3rd edition, 2009. 4. D. Velleman, How to Prove it: A Structured Approach. Cambridge University Press, 1994 11 Problem solving using C Prerequisite: :NiL L T P C Total hours: 28 2 0 0 2 Course Content Hrs Unit 1 Introduction to Computers, Basic Computer Organization, Computational Thinking and problem solving, Planning the Computer Program - Debugging, Types of errors, Techniques of Problem. Aspects of programming language: Syntax, semantics. System Software, Application Software. Compiler - Compilation process - Compiler and interpreter. Basics: C language introduction, C language Standards, Data Types and Storage Classes: Different data types, Storage Classes – auto, static, extern, register. Reserved words, operators, constants in C, identifiers, printf/scanf (formatted printf/scanf), assignment statement, built -in data types – int, char, float, double; usage of sizeof(), integer arithmetic, typecasting 6 Unit 2 IF/IF.. ELSE control construct through maximum of two numbers, ternary operator for maximum of three numbers. SWITCH statement through figure to words problem Swapping of variables, Solving problem of gcd of two numbers. Introduction to 1D arrays in C, implementation of strings as char array, string function implementation: example problem could be palindrome. Loop constructs: significance of initialization, terminating condition and increment/decrement (pre/post increment/decrement operator usage). Usage of FOR/WHILE/DO..WHILE in problems like sum /maximum/ deviation of N numbers. Illustration of loops for solving computation of sin of a number 8 Unit 3 Problem Solving: Sorting an array consisting of zeros and ones, Partitioning an array, merging two sorted arrays, computation of square root of a number Recurrence through Factorial problem, binary search to illustrate divide and conquer approach, Fibonacci through recursion and problems with this approach, Fibonacci through storing previous values – introduction to dynamic programming, Nested loops through sorting methods; use of break and continue Bit vector implementation of set and usage of bitwise operators for testing membership (withing set), union and intersection of two sets. Macro & Preprocessor in C Unit 4 Structures in C: struct and typedef through implementation of complex numbers Functions: Passing arguments in main() function, Call by value, Call by reference. Function for implementing raising a number to large power (logarithmic complexity) Multi -dimensional array (example problem can be matrix transpose/ addition) Command line arguments in C Passing variable number of arguments 6 Unit 5 Pointers: Introduction to pointers, pointer arithmetic, void *, pointers v/s array, malloc() – case study linked list. Pointer to array versus array of pointers, pointers to structures, array of pointers, Pointer to functions. Enum operator. File Handling in C: Basics of working with text files, File read, write, append and other similar operations. 8 References 1. Education Solutions Limited, I. T. L. (2004). Introduction to Computer Science. India: Pearson Education. 2. How to Solve it by Computer, RG Dromey, PHI 3. The C Programming Language, Brian W. Kernighan and Dennis Ritchie, Latest Edition, Prentice Hall. 4. Programming in ANSI C, E. Balagurusamy, Latest Edition, McGraw Hill 5. Let us C, YashavantKanetkar, Latest Edition, BPB Publication 12 Problem solving using C Lab Prerequisite: L T P C Total hours: 28 0 0 2 1 Course Content Hrs. Unit 1 The following proposed coverage are broad guiding areas lab. The programs mentioned here just sample programs and they are just for reference purpose. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with concerned theory course. 1. Basic C commands and First C program -printing hello world on the screen, programs related to basic arithmetic operations, swapping of numbers etc. (2 lab) 2. C Expressions: Programs involving concepts of C expressions like finding roots of quadratic equation, area of circle and simple interest calculation. (1 lab) 3. C operators: Programs requiring in -depth knowledge of various C operators (especially conditional operator, bitwise operators and sizeof operator). (1 lab) 4. Conditional statements: Programs with applications of c conditional statements: if, if else, nested if else, switch -case (1 lab) 5. Arrays and Loops: C programs for performing various operations (finding maximum, second -maximum, minimum, reversing an array etc) on 1 -D arrays and Applications of concepts of loops (leap year, palindrome, displaying prime numbers etc). (2 lab) 6. Functions and Recursions: Programs demonstrating use of functions (like adding N numbers, calculator etc) and Recursion (factorial, Fibonacci, GCD, binary search etc). (1 lab) 7. Strings, Pointers and Structures: Programs related to the following concepts: String manipulations, pointer to arrays, and pointer to functions and Structures (3 lab) File Management: Programs related to file handling (Finding the number of characters, words and lines of given text file and File handling programs) (1 lab) References: 1. Education Solutions Limited, I. T. L. (2004). Introduction to Computer Science. India: Pearson Education. 2. How to Solve it by Computer, RG Dromey, PHI 3. The C Programming Language, Brian W. Kernighan and Dennis Ritchie, Latest Edition, Prentice Hall. 4. Programming in ANSI C, E. Balagurusamy, Latest Edition, McGraw Hill 5. Let us C, Yashavant Kanetkar, Latest Edition, BPB Publication 13 Scheme and Syllabus of 2nd Semester Second Semester S. No Code Subject L-T-P Credit Type Institute Core Subjects 18 IC 22CPT104 Data Structures 3-0-0 3 PC 22CPT105 Logic System Design 2-0-0 2 PC 22CPP106 Data Structures Lab 0-0-2 1 PC 22CPP107 Logic System Design Lab 0-0-2 1 PC 25 14 Data Structures Prerequisite: :Nil L T P C Total hours: 42 3 0 0 3

Course Content Hrs Unit 1 Fundamentals of Data Structures, Memory Allocation, Abstract Data Types, Arrays, Lists Stack Implementation, Stack applications. Queue Implementation, Sequential, Circular, and Dequeue representation, Dynamic Queue implementation, Queue applications. 8 Unit 2 Searching and Sorting: Linear and Binary search, Bubble Sort, Selection Sort, Insertion Sort, Merge sort, Quick sort, Counting sort, Bucket sort, Radix sort, Heap sort, comparisons of sorting algorithms. 8 Unit 3 Hashing and Hash Tables: Hash functions, Open and closed hashing, Dynamic and extendible hashing, Hash collision, chaining, Hash Tables and Probing Techniques 8 Unit 4 Trees: Binary Tree and its representations, Tree traversal, Binary Search Tree, Threaded binary trees, Representing list as binary trees, Dynamic implementation of Binary tree and AVL tree, Tree applications, Interval tree, M-way search Tree, B-Tree and its variants , B+ Tree , Heaps and its applications 10 Unit 5 Graphs: Fundamentals of Graph, Adjacency Matrix and List; Graph Traversal using DFS and BFS. Dijkstra and Prims algorithms. 8 References 1. T. Cormen , C. Lieserson, R. Rivest, and C. Stein, “Introductions to Algorithms”, Prentice -Hall/India, 3rd edition, 2009 2. Aaron M. Tenenbaum, Y. Langsam, Moshe J. Augenstein, Data Structures Using C 3. Introduction to Algorithms ,Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein,PHI,2nd Edition. 4. Aho A.V., J.E. Hop croft, J.D. Ullman, Data Structures and algorithms, Addison Wesley 5. Introduction to design & Analysis of Algorithms,Anany Levitin,2ndEdition,Pearson. 15 Logic System Design Prerequisite: L T P C Total hours: 28 2 0 0 2 Course Content Hrs. Unit 1 Number Systems and Codes: Representation of Negative Numbers; 1’s Complement and 2’s Complement, Complement Arithmetic, BCD Arithmetic, Digital Codes - Excess -3 code, Gray code, Binary to Excess - code conversion and vice versa, ASCII code, EBCIDIC code, Err or Detection Codes 7 Unit 2 Logic Gates, Universal Gates and their characteristic: K -Map, SOP, POS 4 Unit 3 Combinational circuits: Adders, Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Comparator, Decoder and Encoder. 4 Unit 4 Sequential Circuits: Latches, Flip -Flops: RS, D Type, JK, and T Type and their conversion, Master -Salve Flip and Race Conditions. 5 Unit 5 Registers: Design of shift registers and their operations. 4 Unit 6 Counters: Asynchronous and Synchronous counters, Applications of counters. 4 References: 1. Herbert Taub, Donald L. Schilling, Digital Integrated Electronics, McGraw -Hill. 2. Fredrick J. Hill, Gerald R. Peterson, Computer aided logical design with emphasis on VLSI, Wiley 3. M. Morris Mano, Digital Logic and Computer Design, Person Education. 4. Malvino & Leach, Digital Principles and Applications 5. R P Jain, Modern Digital Electronics 16 Data Structures Lab Prerequisite: L T P C Total hours: 28 0 0 2 1 Course Content Hrs. Unit 1 The following topics are broad areas. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with concerned theory courses. Arrays and Linked List: Programs involving creation of arrays, singly, double and circular linked list and performing various operations on them (updating/adding/deletion an element in the begin/middle/end of the list and linear search). Stack and Queue: P rograms involving implementationsand applications of stacks and queues (array and linked list implementations, Dynamic Queue implementation, applications like balanced brackets problem, infix to postfix conversion) Unit 2 Comparison based sorting algorithms: Programs requiring in -depth knowledge of various comparison based sorting algorithms (bubble, insertion, merge, quick etc). Linear time sorting algorithms: Programs with applications of linear time sorting algorithms (c ounting sort, radix sort, bucket sort). Heaps: Programs involving creation of heap from the given list of elements, conversion of min heap to max heap (and vice versa), heap -sort Unit 3 Hashing: Programs demonstrating applications of hashing and hash functions (like phonebook problem). Tree traversals and binary search tree: Programs related to in order, pre order and post order traversals, creation of binary search tree, searching/insert ing/deletion in binary search tree. Unit 4 AVL trees and B+ Trees: Programs in which efficient implementation of various key operations (insertion/deletion/updation/searching) on AVL trees and B+ Trees are required. Unit 5 Graphs: Programs demonstrating implementations and applications of graph traversal methods (BFS, DFS) and minimum spanning tree problem (Dijkstra and Prims algorithms) References: 1. Introductions to Algorithms, T. Cormen, C. Lieserson, R. Rivest, and C. Stein,, Prentice Hall/India, 3rd edition, 2009. 2. Introduction to Algorithms, , Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, MIT Press, 3rd Edition, 2009 3. Fundamentals of Data Structures in C++, Ellis Horowitz, Sartaj Sahni and Dinesh P. Mehta, Galgotia Press, 2009 17 Logic System Design Lab Prerequisite: L T P C Total hours: 42 0 0 2 1 Course Content Hrs. Lab 1. Design and test a 2 -bit and 4 -bit half adder. Lab 2. Design and test a 2 -bit and 4 -bit adder (ripple, carry look ahead). Lab 3. Design and test of encoder/decoder (binary -gray, self -complementing). Lab 4. Design and test of parity generator and detector. Lab 5. Design and test of one bit error detecting and correcting circuit. Lab 6. Design and test of a 2 -bit multiplier. Lab 7. Design and test of n -bit comparator. Lab 8. Design and test of flip flops – RS/JK/D/T. Lab 9. Design and test of SISO and PIPO shift registers. Lab 10. Design and test of counters. Lab 11. Implementation and simplification of k -map (upto 3 variables) Lab 12. Implementation of Quine -Mckluskey's method. References: 1. Herbert Taub, Donald L. Schilling, Digital Integrated Electronics, McGraw -Hill. 2. Fredrick J. Hill, Gerald R. Peterson, Computer aided logical design with emphasis on VLSI, Wiley 3. M. Morris Mano, Digital Logic and Computer Design, Person Education. 4. Malvino & Leach, Digital Principles and Applications 5. R P Jain, Modern Digital Electronics 18 Scheme and Syllabus of 3rd Semester Third Semester S. No Code Subject L-T-P Credits Type 22CPT201 Data Communications 3-0-0 3 PC 22CPT202 Design and Analysis of Algorithms 3-0-0 3 PC 22CPT203 Digital Circuits and Microprocessors 3-0-0 3 PC 22CPT204 Foundation of Learning 3-0-0 3 PC 22CPT205 Object Oriented Analysis and Design 3-0-0 3 PC 22CPT206 Technical Writing 1-0-0 1 PC 22HST201 Social Sciences and Professional Ethics 3-1-0 4 BS 22CPP207 Design and Analysis of Algorithms Lab 0-0-4 2 PC 22CPP208 Digital Circuits and Microprocessors Lab 0-0-2 1 PC 22CPP209 Object Oriented Analysis and Design Lab 0-0-2 1 PC 22CPP210 Technical Writing Lab 0-0-2 1 PC 25 19 Data Communications Prerequisite: Nil L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction to Data Communication: Overview of communication systems, Analog vs. digital communication, Elements of a digital communication system, Data Representation Communication channels and noise 6 Unit 2 Physical Layer: Signals - representation, sampling, aliasing, quantization, transformations; filters, spectral analysis. Analog and Digital transmissions, conversions. Pulse transmission over Band limited signals, sampling theory; Pulse Modulations, metrics - bit transmission, signalling rate, error probability, S/N ratio, bandwidth requirement. Other Modulation. 8 Unit 3 Data Communication Network: OSI Model Physical layer: Importance, bit, bit rate, Signal Rate, bit Interval, Data Rate: Shannon Capacity, Nyquist bit rate, Line Configuration & Line Coding Schemes, Data Transmission: simplex, half -duplex or full -duplex mode , Topology, Signals: Period, frequency, phase, bandwidth. 10 Unit 4 Transmission Media: Guided and Unguided Media, Transmission Medium, Transmission Impairments; Multiplexing - FDM & TDM; Switching: Circuit, Message, Packet, Datagram, Virtual Networks, and DSL. Fiber Optic Communication Principles, loss, dispersion, light s ource and detectors. Spread spectrum, Multiple access: reservation based – TDMA, FDMA, CDMA; random access – Aloha, CSMA, ISMA; hybrid schemes; digital modulation schemes. Examples: Token Bus, Token Ring, Ethernet, including Gigabit Ethernet and Wi - Fi (802 .11). 10 Unit 5 Data Link Layer: Flow Control, Error, Error Control; Error Detection: Simple parity checking, 2D Parity Checking, arithmetic checksum, CRC. Error Correction Codes: Information theory, Shannon's theorem, Source coding, error control coding, (Block codes, Cy clic codes, Linear code, checksum). Flow Control, Sliding Window and Stop and Wait protocols. 8 References 1. Forouzan, Data Communications and Networking, McGraw Hill. 2. Tanenbaum, Computer Networks, Pearson India. 3. Haykins, Analog and Digital Communications, Wiley Publications. 4. Haykins, Digital Communication Systems, Wiley Publications. 5. B.P.Lathi: Modern Digital Communication, Oxford. 20 Digital Circuits and Microprocessors Prerequisite: Nil L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Sequential Circuits: Fundamental Mode Circuits Analysis, Synthesis of Flow Tables, Minimization, Transition Tables, Excitation maps, Output Maps, Clock Input Control, Extended State Table, Program Description, Synthesis, vector Operations, Logical Functions of Vectors, Incompletely Specified Sequential Circuits 20 Unit 2 Microprocessor: Introduction to x86 microprocessor, Addressing Modes, Instruction Set, Code Conversation, Directives, Control Operations, String Manipulation Operations. Programming in assembly Language. Interfacing Devices, 8255 PPI, 8259 PIC, 8237/8257 DMA Controller, 8279 Keyboard and display Controller, A/D converters, USB, DMA, Timing and delay, Stack and Subroutine, interrupts, Assembly Language programming, 22 References 1. Herbert Taub, Donald L. Schilling, Digital Integrated Electronics, McGraw -Hill, 2. Fredrick J. Hill, Gerald R. Peterson, Computer aided logical design with emphasis on VLSI, Wiley 3. Fredrick J. Hill, Gerald R. Peterson, Introduction to Switching Theory and Logical Design, Wiley 4. M. Morris Mano, Digital Logic and Computer Design, Person Education 5 Lance A. Leventhal, S. Cordes, Assembly language subroutines for the 8086, McGraw -Hill Book Co. 6 Randall Hyde, The Art of Assembly Language, 2nd Edition 7 The 80x86 Family: Design, Programming, and Interfacing, Pearson, John Uffenbeck. 21 Design and Analysis of Algorithms Prerequisite: Data Structures L T P C Total Hours: 42 3 0 0 3 Course Content Hrs Unit 1 Algorithm Analysis: Asymptotic notation, model of computation, time and space complexities, average and worst -case analysis, Master's Theorem, solving recurrence equations - interation method, substitution, recursion tree, master method. Amortised Analysis. Linear Search, Insertion Sort, Euclid's Algorithm for finding GCD (Lame’s Theorem): Correctness, Best -Case, Average -Case and the Worst -Case Running Time Analysis. Permutation Model for Average -Case Analysis of an Algorithm for Finding Maximum Element in an Array 8 Unit 2 Divide and Conquer : General recurrence and methods for obtaining bounds on given recurrence. Binary Search, Merge Sort, and Maximum Subarray Sum Problem. Quick -sort: Correctness, Running Time Analysis, Order statistics - finding median and Worst -case Linear Time Algorithm for Selection Problem. Max -Min problem, Strassen’s Algorithm for Matrix Multiplication, Karatsuba`s Algorithm for Large Integer Multiplic ation 8 Unit 3 Dynamic Programming Approach: Introduction to dynamic programming - principal of optimality, Optimal substructure. Matrix Chain Multiplication Problem, Optimal Binary Search Tree Problem, Longest Common Subsequence Problem, 0/1 Knapsack Problem. Greedy Approach: Elements of Greedy Strategy - Greedy choice property, optimal substructure. Example Problems - Activity Selection Problem, Fractional Knapsack Problem, Huffman codes, Travelling Salesman Problem. 9 Unit 4 Graph Algorithms: Graph Traversal Algorithms (BFS, DFS), Shortest path algorithms (Bellman -ford, Dijkstra’s, Transitive -Closure, Floyd -Warshall), minimum spanning tree algorithms Kruskal, Prim), Network -flow (ford -fulkerson) , applications of DFS: - bi-connectivity, topolog ical sort, strongly -connected components, Articulation point. 9 Unit 5 Backtracking: Introduction to Backtracking, Enumerating Independent Sets of a Graph, Graph Coloring Problem and N -Queen’s Problem. Complexity Classes: P, NP, NP -Hard and NP -Complete. NP-Complete Examples with Reductions: Satisfiability, Clique, Independent Set, Vertex Cover , Graph Coloring, Dominating Set, 8 References 1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI, 2009. 2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Second Edition, Universities Press, 2011. 3. Michael T. Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis and Internet Examples, Second Edition, Wiley -India, 2006. 22 4. Michael R. Garey and David S. Johnson, Computers and Intractability: A Guide the theory of NP -Incompleteness, W.H. Freeman & Co., 1979. 5. Herbert S. Wilf, Algorithms and Complexity, AK Peters Ltd., 2003. 6. Jon Kleinberg and Eva Tardos. 2005. Algorithm Design. Addison -Wesley Longman Publishing Co., Inc., USA. 23 Foundations of Learning Prerequisite: Some basic set theory (what is a set and elementary set operations), combinatorics (knowing different ways of counting, inclusion -exclusion principle) and calculus (knowing derivatives and integrals) L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit 1 Linear Algebra i. Scalars, Vectors, Matrices and Tensors ii. Multiplying Matrices and Vectors iii. Identity and Inverse Matrices iv. Linear Dependence and Span v. Norms vi. Special Kinds of Matrices and Vectors vii. Eigen decomposition viii. Singular Value Decomposition ix. The Moore -Penrose Pseudoinverse x. The Trace Operator xi. The Determinant xii. Principal Component Analysis 12 Unit 2 Probability and Information Theory i. Random Variables ii. Probability Distributions iii. Marginal Probability iv. Conditional Probability v. The Chain Rule of Conditional Probabilities vi. Independence and Conditional Independence vii. Expectation, Variance and Covariance viii. Common Probability

Distributions ix. Useful Properties of Common Functions x. Technical Details of Continuous Variables xi. Information Theory xii. Structured Probabilistic Models 12 Unit 3 Statistical inference: statistical decision theory, statistical assumptions, estimation theory. Methods of estimation: method of moments, method of minimum variance 9 Unit 4 Statistical hypothesis testing, null and alternate hypotheses. Simple and composite hypotheses, Type -I and Type -II errors, Z -tests for difference of means, chi -square test, tests for correlation and regression. 9 References 1. Linear Algebra, Gilbert Strang, MIT Cambridge Press 2. Foundations of Learning, Julie Fisher, Open University Press 3. Foundations of Learning, Laurie L. Hazard, Jean -Paul Nadeau, Pearson 4. Deep learning, Ian Goodfellow, MIT Cambridge Press 5. Probability and Statistics for Machine Learning, Anirban Das Gupta, Springer 24 Object Oriented Analysis and Design Prerequisite: : Computer Programming skills L T P C Total hours: 40 3 0 0 3 Course Content Hrs Part I Unit 1 Introduction to Object Oriented Programming fundamentals: Object Oriented Programming and Design, Review of abstraction Classes, Objects and Methods: Class, Object, Object reference, Constructor, Constructor Overloading 8 Unit 2 C++ Programming Basics: Fundamentals, variables and assignments, Input and Output, Data types and expressions, flow of control, subprograms, top -down design, predefined functions, user defined functions, procedural abstractions, local variables, overloading function names, operator overloading, parameter pa ssing, this pointer, destructors, copy constructor, overloading the assignment operator, virtual functions, function calling functions, friend functions, recursive functions, recursive member functions. Static member function. 6 Unit 3 C++ Object oriented concepts: Objects and classes, use of file for I/O, formatting output with stream functions, Character I/O, inheritance, structures for diverse data, structures as function arguments, initializing structures, defining classes and member functions, public and private members, constructors for initialization, standard C++ classes, derived classes, flow of control, use of Boolean expressions, multiway branches, use and design of loops. Friend function and friend class 8 Part II Unit 4 Introduction to OOD, Unified Process, UML diagrams, Use Case, Use case Modelling, Relating Use cases – include, extend and generalization – When to use Use-cases, Class Diagram, Elaboration -Domain Model, Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement, Finding conceptual class Hierarchies, Aggregation and Composition – Relationship between sequence diagrams and use cases, When to use Class Diagram 6 Unit 5 Dynamic Diagrams – UML interaction diagrams, System sequence diagram, Collaboration diagram, When to use Communication Diagrams, State machine diagram and Modelling –When to use State Diagrams, Activity diagram, When to use activity diagrams Implementatio n Diagrams -UML package diagram – When to use package diagrams, Component and Deployment Diagrams – When to use Component and Deployment diagrams 6 Unit 6 Design patterns: GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller Design Patterns – creational – factory method – structural – Bridge – Adapter – behavioural – Strategy – observer –Applying GoF design patterns – Mapping design to cod 6 References 1. Deitel and Deitel, C++ How to Program, Third Edition, Pearson Publication. 2. Robert Lafore, Object Oriented

Programming in C++, Fourth Edition, SAMS publications. 3. Craig Larman, ■Applying UML and Patterns: An Introduction to Object -Oriented Analysis and Design and Iterative Development■, Third Edition, Pearson Education, 2005. 4. Ali Bahrami – Object Oriented Systems Development – McGraw Hill International Edition – 1999 25 Technical Writing Prerequisite: :NiL L T P C Total hours: 1 0 0 1 Course Content Hrs Introduction to Documentation using Doxygen, Google Docs, Latex/ Overleaf. Drawing software: inkscape, xfig , open -office, and/or similar. Presentation using Beamer: Introduction to creating slides, adding frames, dividing the slide into multiple columns, adding different blocks, and similar. Graph plotting software (e.g., gnuplot). Version control tools - GIT /GitHub/SVN 7 Introduction: LaTeX, its installation, and different IDEs. The learner creates the first document using LaTeX, organizes content into sections using article and book class of LaTeX. Styling Pages: Reviewing different paper sizes, examines packages, formats the page by setting margins, customizing header and footer, changing the page orientation, dividing the document into multiple columns. Different types of error messages. Formatting Content: formatting text (styles, size, alignment), adding colors to text and entire page, and adding bullets and numbered items, the process of writing complex mathematics. Tables and Images: creating basic tables, adding simple and dashed borders, merging rows and columns, and handling situations where a table exceeds the size of a page. Add an image, explore different properties like rotate, scale, etc.. Referencing and Indexing: the learner learns to add cross -referencing (refer to sections, table, images), add bibliography (references), and create back index. 7 References 1. Latex - A document preparation system, 2/e, by Leslie Lamport, Addison -Wesley, 1994 2. https://www.doxygen.nl/ 26 Social Sciences and Professional Ethics Prerequisite: Nil L T P C Total hours: 56 3 1 0 4 Course objectives: • Augmenting the understanding of society, societal issues and problems • To provide the students an insight into the multifaceted economic and financial environment • Development of a positive character, empathetic human being, responsible citizen • Inculcating a positive work culture respecting professional ethics Course Content Hrs Unit 1 Introducing Sociology Meaning, scope and evolution of Sociology, Key theoretical trajectories . Society, community, Social Institutions, Social Groups, Socialisation and Culture, Norms and Values, Agency and structure 10 Unit 2 Social Change Social Change, development and progress; Globalisation, Industrialisation, urbanisation and modernisation; Social mobility and social stratification 8 Unit 3 Social Issues Science technology and society; Digital divide, Appropriate technology, Gender inequality; Substance abuse, Consumerism, Environmental degradation and climate crisis, Nation building 10 Unit 4 Socio -economic environment Overview of Socio -economic policy environment; PESTLE analysis. Economic growth & development; primary, secondary and tertiary sectors; structural changes & emerging sectors of the Indian economy. Design and strategy of economic reforms and liberalization: India’s growth post liberalization. 10 Unit 5 Finance and banking Banking and Financial Sector; Reforms & Challenges; Monetary & Fiscal Policies; meaning, importance & instruments. Global economic environment and opportunities. Intellectual property rights and R & D environment. 6 Unit 6 Ethics and values Professional Ethics: Need, importance and principles of Professional ethics, Ethics in relation with use of technology and technology development, diversity inclusion and equity; Social responsibility . Constitutional values: Preamble and DPSP, Rights and duties 12 References 1. Haralambos, Michael & Holborn, Martin. Sociology: Themes and Perspective, Harper Collins. Eighth edition. 2014. 2. Ritzer, George. Sociological Theories, McGraw -Hill; Fifth edition. 2011 3. Lillie, William. An introduction to Ethics Allied Publishers Pvt. Ltd.; 1st edition (1967) 4. Lama, Dalai. Ethics for the New Millennium by the. Riverhead Books; Reissue edition (2001) 5. Uma Kapila, Indian Economy Performance and Policies, Academic Foundation, New Delhi 6. Ahluwalia, I.J. & IMD Little, India's Economic Reform and Development, Oxford University Press . 27 Design and Analysis of Algorithms Lab Pre-requisite: C Programming, Data Structures L T P C 0 0 4 2 Course Content 1. Implementation of various sorting and searching algorithms (Revision) 2. Implement quick sort with three different positions of pivot element - first, last, random 3. Implement Tree traversal, and graph traversal (recursive algorithms) 4. Implement deterministic and randomized selection problem 5. Implement maximum subarray sum problem 6. Implement Karatsuba`s Algorithm for Large Integer Multiplication 7. Implement matrix chain multiplication, longest common sub -sequences, 0/1 knapsack 8. A program to obtain the topological ordering of vertices in a given digraph. 9. Implement travelling salesman problem. 10. Print all the nodes reachable from a given starting node in a digraph using BFS method. 11. Check whether a given graph is connected or not using DFS method. 12. Find minimum cost spanning tree of a given undirected path using a Prim's algorithm. 13. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm. References 1 Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI, 2009. 2 Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Second Edition, Universities Press, 2011. 3 Michael T. Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis and Internet Examples, Second Edition, Wiley -India, 2006. 28 Digital Circuits and Microprocessors Lab Prerequisite: Basics of Digital Logic L T P C 0 0 2 1 Course Content 1. Design and synthesis of pulse mode and clock mode circuits 2. Design and synthesis of clock mode circuits 3. Design and Simplification of incompletely specified sequential circuits 4. SPICE simulator based design and evaluation 5. X86 based Assembly language Programming a. Athematic and logical operations b. String manipulation c. Number Conversion d. Implementing a real -time clock. e. Writing a program to control and monitor external devices through parallel port communication. f. Developing a program to interface with a APC DAC. g. Creating a program to implement a basic graphical user interface (GUI) using assembly language. h. Implementing a program to perform image processing operations, such as image filtering or edge detection. i. Designing a program to control and monitor a robotic arm using assembly language. j. Developing a program to interface with an external memory device, such as EEPROM or flash memory. k. Writing a program to implement a basic text -based adventure game using assembly language. l. Developing a program to interface with a graphical LCD display using the 8086 microprocessor. m. Creating a program to perform digital signal processing (DSP) operations, such as filtering or Fourier transforms. References 1. Computer Aided

Logical Design with Emphasis on VLSI, 4th Edition, Frederick J. Hill, Gerald R. Peterson, by Wiley. 3. The 80x86 Family: Design, Programming, and Interfacing, 3rd Edition by John E. Uffenbeck, Pearson Education 29 Object Oriented Analysis and Design Lab Prerequisite: : Basic Computer Programming, Data Structures L T P C Total hours: 42 0 0 2 1 Course Content Hrs The laboratory course will be in two parts: Part I: Object oriented Programming (OOP). In this part, students will be given OOP assignments to cover the practical on: - Programs Using Functions - Simple Classes for understanding objects, member functions and Constructors - Classes with primitive data members - Classes with arrays as data members - Classes with pointers as data members – String Class - Classes with constant data members - Classes with static member functions - Compile time Polymorphism - Operator Overloading including Unary and Binary Operators - Function Overloading - Inheritance and - Runtime Polymorphism Part II: Object Oriented Methodology and Design In this part, students will be given experiments to design various UML diagrams such as USE case, Class Diagram, State Diagram, Activity Diagram, Sequence diagram etc., based on the given case study. 30 References 1. Deitel and Deitel, C++ How to Program, Third Edition, Pearson Publication. 2. Robert Lafore, Object Oriented Programming in C++, Fourth Edition, SAMS publications. 3 Craig Larman, ■Applying UML and Patterns: An Introduction to Object -Oriented Analysis and Design and Iterative Development■, Third Edition, Pearson Education, 2005. 4 Ali Bahrami – Object Oriented Systems Development – McGraw Hill International Edition – 1999 30 Technical Writing Lab Prerequisite: L T P C Total hours: 28 0 0 2 1 Course Content Hrs Unit 1 • Documentation using Google Docs and its usage for creating PPTs. • Introduction to Documentation using Doxygen and Graph plotting software (e.g., matplotlib in Python) • Using Drawing software (e.g. draw.io, open -office) • Documentation using Latex/ Overleaf o Presentation using Beamer: Introduction to creating slides, adding frames, dividing the slide into multiple columns, adding different blocks, etc. 8 Unit 2 Introduction: LaTeX and its installation. The learner creates the first document using LaTeX, organizes content into sections using article and book class of LaTeX. Styling Pages: Reviewing different paper sizes, examines packages, formats the page by setting margins, customizing header and footer, dividing the document into multiple columns. 8 Unit 3 Formatting Content: formatting text (styles, size, alignment), the process of writing complex mathematics. Tables and Images: creating basic tables, adding simple and dashed borders, merging rows and columns. 6 Referencing and Indexing: the learner learns to add cross -referencing, add bibliography (references). 6 References: 1. Latex - A document preparation system, 2/e, by Leslie Lamport, Addison -Wesley, 1994 2. https://www.doxygen.nl/ 3. Other online resources 31 Scheme and Syllabus of 4th Semester Fourth Semester S. No Code Subject L-T-P Credits Type 22CPT211 Computer Networks 3-0-0 3 PC 22CPT212 Computer Organization and Architecture 3-1-0 4 PC 22CPT215 Theory of Computation 3-1-0 4 PC 22CPT213 Database Information Systems 3-0-0 3 PC 22CPT214 Machine Learning 3-0-0 3 PC 22BMT201 Basics of Managements 3-0-0 3 MM 22CPP216 Computer Networks Lab 0-0-4 2 PC 22CPP217 Database Information Systems Lab 0-0-4 2 PC 22CPP218 Machine Learning Lab 0-0-2 1 PC 25 32 Computer Networks Prerequisite: Data communication. L T P C Total hours: 42 3 0 0 3 Course Content

Hrs Unit - I Introduction: Internet – nuts and bolts, network service, network protocols, network edge, network core, performance metrics - delay, throughput, etc. protocols and service models. 4 Unit - II End-to-End protocols and Applications -I: Application layer: principles of application layers, Domain Name System (DNS), HTTP, FTP, E -mail, www and etc. Pear to pear systems, video streaming, Socket programming. Flow control – window/credit schemes, rate control schemes, Congestion control Transport layer and TCP/IP. Introduction to ATM networks and Network Management And Interoperability. 8 Unit - III End-to-End protocols and Applications -II : Introduction to transport layer, multiplexing and de -multiplexing, connection oriented and connection less end to end protocols, principles reliable data transfer, and congestion control. 11 Unit - IV Data Plane : Introduction to network layer, layer 3 devices and inside, addressing – IPv4, IPv6, etc. NAT, Control Plane : Retransmission algorithms. Stability of queuing systems.. High speed switches scheduling, BroaPCast routing and spanning trees. Shortest path routing. Distributed routing algorithms, optimal routing, and traffic engineering. ICMP, SNMP,etc 11 Unit - V Future/Advanced Internet: Internet of Things (IoT) and applications, Software Defined Networks (SDN) : Control plane, data -plane, and issues, Information centric networks (ICN), Content distribution networks (CDN) and Future Internet.(5 Classes) 6 References 1. Data Networks: Bertsekas and Gallagher, PHI 2. Computer Networks: L. Peterson and Davie, Elsevier 3. Computer Networking A top down Approach: J.F.Kurose, Pearson 4. Computer Networks : Andrew S. Tanenbaum, Pearson 33 Computer Organization and Architecture Prerequisite: Ni l L T P C Total hours: 40 3 1 0 4 Course Content Hrs Unit 1 Organization of Computer Systems: CPU, Memory and I/O organization, Instruction encoding and addressing modes. Von -neumann versus Harvard Architecture, RISC and CISC architectures. Flynn Classification, Stack machines, subroutine calls, allocation and evaluation of data in stack machines. SIMD, SPMD and MIMD 8 Unit 2 CPU Organization: Addressing techniques, Instruction formats, Instruction set design, Instruction types: example for zero address, one address, two address and three address machines, Stack, accumulator and general purpose register organization. 8 Unit 3 Register Transfer Language: arithmetic, logic and shift micro operations and their hardware implementations as a simple ALU. Control Unit, Hardwired and Micro programmed control unit design. 8 Unit 4 Memory Organization: device characteristics, RAM organization, 1D and 2D organization, Virtual memory - Paging and Segmentation, High speed memories, Associative and Cache memory. Input -Output Design: IO interface, Bus structure, Modes of data transfer, Interrupts, Input Output Processor, Serial Communication Pipelining: Pipeline structure, Pipeline types - Instruction and Arithmetic pipelines. Interleaved memory organization, instruction prefetch, data buffers, pipeline performance measures. 8 Unit 5 Array processors: Routing mechanisms, Static v/s dynamic network. Multiprocessor systems, data flow concepts. Parallel processing languages. 8 References 1. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Pearson Education, Seventh Edition, 2006. 2. David A. Patterson and John L. Hennessy, “Computer Architecture -A Quantitative Approach”, Elsevier, a division of reed India Private Limited, Fifth edition, 2012 3. John P. Hayes, “Computer Architecture and Organization”, Tata McGraw Hill, Third Edition 4. Carl Hamacher, Computer Organization, 5th Edition, Mc Graw Hill Publishers, 2002. 34 Theory of Computation Prerequisite: N il L T P C Total hours: 40 3 1 0 4 Course Content Hrs Unit 1 Basic Foundation : Review Of SET Theory, Automata Theory, Alphabet, Power Of Alphabet, Kleen Closure, Positive Closure, String, Empty String, Concatenation, Language . Finite Automata (F A): Introduction, Deterministic Finite Automata (DFA) - Formal Definition, Simpler Notations (State Transition Diagram, Transition Table), Language of A DFA. Nondeterministic Finite Automata (NFA) - Definition, Language of an NFA, Equivalence Of Deterministic an d Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata w ith Epsilon Transitions, Eliminating Epsilon Transitions, Minimization Of Deterministic Finite Automata, FA with Output (Moore and Mealy Machines) and Inter Conversion. 8 Unit 2 REGULAR EXPRESSIONS (RE): Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions - Converting from DFA’s to Regular Expressions, Converting Regular Expressions to Automata, Minimization of Finite Automata, Applications of Regular Expressions. REGULAR GRAMMARS: Chomsky Classification of Languages, Regular Grammars and FA, FA for Regular Grammar, Regular Grammar for FA. Proving Languages to be Non -Regular -Pumping Lemma, Applications, Closure Properties of Regular Languages. 8 Unit 3 CONTEXT FREE GRAMMER (CFG): Derivation Trees, Sentential Forms, Rightmost and Leftmost Derivations of Strings. Ambiguity in CFG’s, Minimization of CFG’s, Normal Forms (CNF, GNF), Pumping Lemma for CFL’s 8 Unit 4 Pushdown Automata Theory : Push Down Automata, Deterministic and Nondeterministic PDA, PDA And Languages, Construction ; Acceptance of CFL, Acceptance by Final State and by Empty Stack and its Equivalence, Equivalence of CFG and PDA. Turing Machines (T M): Formal Definition and Behaviour, Languages of a TM, TM as Accepters, TM as a Computer of Integer Functions, TM with Storage in its State, TM as Subroutine, Minskey’s Theorem, Types of TMs, Multitrack, Mutitape, Nondeterministic TM, Encoding of TM, Computab ility and Acceptability. 8 Unit 5 Recursive And Recursively Enumerable Languages (REL): Properties of Recursive and Recursively Enumerable Languages . Undecibility And Undecidable Problems: Post's Correspondence Problem (PCP), Universal Turing Machine, The Halting Problem, Undecidable Problems about TMs. Context Sensitive Language and Linear Bounded Automata (LBA), Chomsky Hierarchy, Decidability 8 References 1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), Introduction to Automata Theory Languages and Computation, Pearson Education, India. 2. Cohen, Introduction to Computer Theory, Addison Wesley. 3. Martin, Introduction to Languages and Theory of Computation, TMH. 4. Papadimitriou, Introduction to Theory of Computing, Prentice Hall. 5 K. L. P Mishra, N. Chandrashekaran, Theory of Computer Science -Automata Languages and Computation, Prentice Hall of India, India. 35 Database Information Systems Prerequisite: :NiL L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit 1 Introduction to Database System Database approach and Information systems , Database System Architecture, current advances in database technology, Database Systems Development Life Cycle - Prototyping methodology three -schema architecture, three - tiered architecture Hierarchical model, Network model, Relational model, Object oriented model, Multidimensional model 6 Unit 2 Database Models: ER

-model notation, entity & entity type, relationship & relationship type, Degree, Cardinality & modality, Supertype/Subtype relationship Relational model concepts, Converting ER to Relational model 6 Unit 3 Introduction to SQL -DDL,DML and PCL, Advanced topics of SQL, PL/SQL language: Functions, Procedures & triggers, Views, Cursors etc. Formal query languages Relational Algebra and Relational Calculus Overview, Query processing and optimization 10 Unit 4 Relational schema, Functional dependencies, Inference axioms, Keys, closures, redundant FD's , Decompositions, Join Dependencies Normalization, normal forms:1NF, 2NF, 3NF, BCNF, 4NF, 5NF, Best Database Design criterion Transactions, concurrency control, Crash Recovery, Physical DB design, file organizations, Indexing Structures, File indexing, hashing 14 Unit 5 Client/Server database architecture Application Development, Database Security, Overview of Distributed database, Data Warehousing and Data mining, Data Analytics 4 References 1. Database System Concepts ,Silberschatz A, Korth H F, and Sudarshan S, , McGraw Hill,,6th Ed. 2. Modern Database Management systems , Hoffer J A, Prescott M B, and Topi H. Pearson Education Inc.,13th Edition 3. Fundamentals of Database Systems , Elmasri R, Navathe S B, Pearson Education, 7th Edition. . 4. Database Management System , Raghurama krishnan & Johannes Gehrke, McGraw -Hill 3rd edition 5 Commercial Application development using ORACLE Developer 2000 Forms 5.0 , Ivan Bayross, BPB Publications. 36 Machine Learning Prerequisite: Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential. L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 The learning problem – learning versus design, types of learning - supervised, unsupervised, reinforcement and other views of learning. 2 Unit 2 Training versus Testing: theory of generalization, interpreting the generalization bound. Generalization and over fitting: when does over fitting occur? Regularization, validation , cross validation. Bias -variance tradeoff. The Linear model: Linear classification, perceptron learning, linear regression, gradient descent, batch and stachastic gradient descent, convex functions, logistic regression, non linear transformation. 12 Unit 3 Generative vs discriminative models Supervised learning – Probability review, Bayes classifier, Naive Bayesian, MAP, MLE. K- nearest neighbor, measuring similarity using distance metrics, data normalization. Decision trees, constructing decision trees, ID3, C4.5. Random forest, Ensemble methods – bagging, boosting. Neural networks, going forward, biases, going backwards: back propagation of errors, MLP in practice, deriving back propagation network output and error, requirements of activation functions, learning rate, acceleration, decay, Loss functions - Sigmoid, Re lu. SVM (Linear), optimal separation, kernels. 16 Unit 4 Unsupervised learning – the general problem, hierarchical and partitional clustering, K -means clustering, density based clustering, DBSCAN, autoencoders 8 Unit 5 Assessing classification performance – accuracy, sensitivity, specificity, the area under the ROC curve, confusion matrices, FAR, TPR, TNR, FRR, precision and recall 4 References 1. A first course in Machine learning, Simon Rogers and mark Girolami, CRC Press 2. Learning from Data, Yaser S Abu -Mostafa, AML books 3. Machine learning, Marsland, CRC press 4. An Introduction to Machine Learning, Kubat Miroslav, Springer 37 Basics of Management Department: Department of Management Studies L T P C Prerequisite: None 3 0 0 3 Course Learning Objectives

By the end of this course student will be able to: 1. Demonstrate the roles, skills and functions of managers. 2. Develop the understanding and cognizance of the importance of management principles. 3. Make effective application of acquired knowledge to diagnose and solve organizational problems and develop optimal managerial decisions. 4. Understand seven Ps of marketing and digital marketing strategies 5. Get to know about key people management processes. 6. Understand the decisions and processes in operations management. 7. Gain knowledge of financial systems, institutions, regulators and instruments. 8. Diagnose and communicate the complexities associated with management of various issues in the organizations and integrate the learning in handling these complexities Course Content • General Management Processes and Principles : - Concept, Functions and Principles of Management, Roles and skills of Managers; • Functions of Management: Planning, Decision Making; Organizing: Organizational Design & Organizational Structures; Leading, Motivation, Communication and Controlling; • Introduction to Human Resource and Marketing Management: Trends and Practices in People Management; Marketing Management Process and decisions, Marketing Mix; • Introduction to Finance and Operations Management: Overview of Financial Systems, Financial Institutions, Markets and Instruments; Decisions & processes in Operations Management. References 1. Robbins, Stephen P. and Coulter, Mary (2019) 'Management', 14th edition, Prentice Hall of India 2. Dessler, G. & Varkkey, B. (2018). Human Resource Management, 15e, Pearson. 3. Laasch , O. (2021). Principles of Management -Practicing Ethics, Responsibility, Sustainablity, 2nd Edition, Sage Publications. 4. Hill, Charles W L and McShane, Steven L. (2017) Principles of Management, Special Indian Edition, McGraw Hill Education 5. Khan, M. Y. and Jain P. K. (Latest edition). Financial Management, Text, Problems & Cases. Tata McGraw Hill Company, New Delhi. 6. Philip Kotler. (Latest edition). Marketing Management: Analysis, Planning, Implementation & Control. Prentice Hall of India. 7. Koontz, Harold and Weihrich, Heinz & Ramachandra Aryasri A. (2016). Principles of Management, Latest edition, McGraw Hill Education 38 Computer Networks Lab Prerequisite: : The programming lab in C++, which means you need to be very comfortable with C++ and using standard debugging tools. L T P C Total hours: 48 0 0 4 2 Course Content Hrs The laboratory experiments conducted on various tools Lab 1 -3: Introduction networking (wireshark,, TCP dump, CISCO packet tracer) Lab 3 -4: Introduction to socket programming Lab 5 -9: Experiments on NS2 and NS3 Lab 10 -12 : Experiments Mininet 48 References 1. Data Networks: Bertsekas and Gallagher, PHI 2. Computer Networks: L. Peterson and Davie, Elsevier 3. Computer Networking A top down Approach: J.F.Kurose, Pearson 4. Computer Networks : Andrew S. Tanenbaum, Pearson 39 Database Information Systems Lab Prerequisite: :Ni l L T P C Total hours: 48 0 0 4 2 Course Content Hrs I Design exercises and various Tools of designing the ER diagram and its mapping to relational model 8 II Programming exercises on SQL –Detailed DDL commands and queries to create databses. 8 III Programming exercises on SQL –Detailed DML commands 10 IV Programming exercises on SQL –Detailed PCL commands 6 V Programming Exercise on advanced topics of SQL, PL/SQL language : Functions, Procedures, triggers, Views, Cursors etc. 8 VI There will be as semester Mini -Group Project on theme of Database

Information system 8 References 1. Database System Concepts ,Silberschatz A, Korth H F, and Sudarshan S, , McGraw Hill,,6th Ed. 2. Modern Database Management systems, Hoffer J A, Prescott M B, and Topi H.,Pearson Education Inc.,13th Edition 3. Fundamentals of Database Systems, Elmasri R, Navathe S B, Pearson Education, 7th Edition. . 4. Database Management System, Raghuramakrishnan & Johannes Gehrke, McGraw -Hill 3rd edition 5 Commercial Application development using ORACLE Developer 2000 Forms 5.0, Ivan Bayross, BPB Publications. 40 Machine Learning Lab Prerequisite: Python Programming L T P C Total hours: 42 0 0 2 1 Course Content Hrs 1 Perceptron Learning Algorithm: 1. Generate a linearly separable data (random) set of size 20. Plot the examples {(x n , yn)} as well as the target function f on a plane. Be sure to mark the examples from different classes differently, and add labels to the axes of the plot. 2. Run the perceptron learning algorithm on the data set above. Report the number of updates that the algorithm takes before converging. Plot the examples {(x n , yn)}, the target function f , and the final hypothesis g in the same figure. Comment on whether f is close to g. Repeat everything in (2) with another randomly generated data set of size 100. Compare your results with (2) 3 2 Linear Regression: Write a python script that can find w0 and w1 for an arbitrary dataset of number of hours studied versus rank of a students as {(x n, yn)} pairs. Find the linear model, y = w T x, that minimizes the squared loss. Derive the optimal w for the total training loss:s MSE/RSS L = Σ(yn – wT xn)2 . Using the model predict the rank for the number of hours studied. Load the data stored in the file syntheticdata.mat. Fit a 4th order polynomial function f (x; w) = w 0 + w 1 x + w 2 x 2 + w 3 x 3 + w 4 x 4 to this data. What do you notice about w2 and w4?) Fit a function f (x; w) = w 0 + w 1 x + w2 sin((x–a)'/ b, assuming a and b are fixed in some sensible range. Show a least square fit using this model. What do you notice about w1 and w2. Comment about generalization and overfitting. 3 3 Logistic Regression: Handwritten Digits Data: You should download the two data files with handwritten digits data: training data (ZipDigits.train) and test data (ZipDigits.test). Each row is a data example. The first entry is the digit, and the next 256 are grayscale values b etween –1 and 1. The 256 pixels correspond to a 16 × 16 image. For this problem, we will only use the 1 and 4 digits, so remove the other digits from your training and test examples. Please submit your Python code implementing the logis tic regression for classification using gradient descent. Familiarize yourself with the data by giving a plot of two of the digit images. Develop two features to measure properties of the image that would be useful in distinguishing between 1 and 4. You ma y use symmetry and average intensity (as discussed in class). As in the text, give a 2 -D scatter plot of your features: for each data example, plot the two features with a red redx if it is a 4 and a blue blue if it is Classifying Handwritten Digits: 1 vs. 4. Implement logistic regression for classification using gradient descent to find the best separator you can using the training data only (use your 2 features from the above question as the inputs). The output is +1 if the example is a 1 and –1 for a 4. Give separate plots of the training and test data, together with the separators. Compute E in on your training data and E test , the test error on the test data after 1000 iterations. Now repeat the above using a 3rd order polynomial transform. As your fi nal deliverable to a customer, would you use the linear model with or without the 3rd order polynomial transform? Explain. Regularization: Logistic regression can also be augmented with the l 2 -norm regularization: min E(w) + λ||W || 22 , where E(w) is the logistic loss. Please change your gradient descent algorithm accordingly and use cross -validation to determine the best regularization parameter. Plot the training and testing performance curves.Indicate in the plot the best regularization parameter you obtained (using cross validation). 6 41 4 Neural Networks: In this problem you will implement forward and backward propagation methods for a multi -layer neural network with K hidden layers. Assume that K is a user input less than 10. Implement the networks separately with the following activation functions: Sigmoid: Derive the gradient of the activation function. Confirm with numerical differentiation. Tanh: Derive the gradient of the activation function. Confirm with numerical differentiation. Assume that the last layer has a linear activation function and the loss function is l(y, ■) = ||y – ■|| 22 . Submit your code (along with any instructions necessary to # run it), the forward pass outputs at each layer and the gradients of the parameters (W ij k , b ki). The input, output and the parameters of the network can be found in the MAT file associated with this problem. In this problem you will train a mu lti-layer neural network to recognize handwritten digits. Use the multi -layer neural network (with ReLU activation) that you implemented in the previous homework. Use 32 nodes in each layer and initialize the weights randomly. The data is also provided to you in a MAT file. • Report the training and validation accuracy as a function of iterations (with 5 hidden layers). Report the convergence speed of the training procedure (with 5 hidden layers) for the Stochastic Gradient Descent optimization algorithm. • Determine the number of hidden layers required via cross -validation. Report the training and validation accuracy for cross -validation. • Finally, report the best test error that you can achieve. 6 5 Evaluation Metrics: Consider a theoretical biometric matcher that generates distance scores in the range [–∞,∞]. Assume that the genuine and impostor score distributions due to this matcher can be approximately modeled as N(30, 10) and N(60, 15), respectively. Here, N(μ, σ2) denotes normal distribution with mean, μ, and variance, σ2 Suppose the following decision rule is employed: s is classified as a genuine score if s ≤ η; else it is classified as an impostor score. Here, η ∈ [0, 100]. • Plot the genuine and impostor distributions in a single graph. The distributions should be contained in the range [0, 100]. • If η = 50, what is the FMR (i.e., FAR) and FNMR (i.e., FRR) of the biometric matcher? • Given s is classified as a genuine score if s ≤ η; else it is classified as an impostor score. If η = 75, what is the FMR (i.e., FAR) and FNMR (i.e., FRR) of the biometric matcher? • Plot the DET curve of this matcher. • Plot the ROC curve and AUC of this matcher. 4 6 SVM: Classify the digits data as given for exercise 4 using a Support Vector Machine. Compute the values of W and an offset b, also draw the hyperplane. 8 7 Decision Trees and Random Forest: Generate three tables: Table one with attributes: Id, Exercise, Family history, Heart Attack Risk. Table two with attributes: Id, Smoker, Obese, Heart Attack Risk, Table three: Id, Obese, Falimy history and Heart Attack Risk. Generate s100 samples randoml y for the three tables. List three bootstrap samples, using these bootstrap samples create decision trees that will be in the random forest model using entropy based information gain as the feature selection criteria. Assuming the random forest uses majori ty voting, what prediction will it return for the query: EXERCISE =

rarely, SMOKER = false, OBESE = true, FAMILY = yes. 6 8 Clustering: A bank wants to detect fradulent credit card transactions. Using random function generate data for lots of transactions (each transaction is an amount of money, a shop, and the time and date) and some information about which credit cards were stolen, and the transactions that were perfor med on the stolen card. Generate random data files for the above description of atleast 200 transactions. Implement Agglomerative, Hierarchichal and Density based clustering techniques to cluster people's transactions together to identify patterns, so that stolen cards can be detected as changes in pattern. How well do you think this will work? There is much more data of transactions when cards are not stolen, compared to stolen transactions. How does it affect the learning, and what can you do about it. 6 References 1. A first course in Machine learning, Simon Rogers and mark Girolami, CRC Press 2. Learning from Data, Yaser S Abu -Mostafa, AML books 3. Machine learning, Marsland, CRC press 4. An Introduction to Machine Learning, Kubat Miroslav, Springer 42 Scheme and Syllabus of 5th Semester Fifth Semester S. No Code Subject L-T-P Credits Type 22CPT301 Compiler Design 3-0-0 3 PC 22CPT302 Cryptography 3-0-0 3 PC 22CPT303 Operating System 3-0-0 3 PC 22CPT304 Software Engineering 3-0-0 3 PC 22CPT305 Emerging Technologies for CS 3-0-0 3 PC 22CPTxxx Program Elective -1 3-0-0 3 PE 22CPP306 Compiler Design Lab 0-0-2 1 PC 22CPP307 Cryptography Lab 0-0-2 1 PC 22CPP308 Operating System Lab 0-0-2 1 PC 21 Honors CSTxxx Advance Data Structures and Algorithms 3 CSTxxx Honors Elective -1* 3 6 Minor CSE 22CPT104 Data Structures 3 PC 22CPT303 Operating System 3 PC 6 43 Compiler Design Prerequisite: : Theory of Computation L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Language Translators: Compilers and Interpreters, Hybrid Compiler, Structure of a Compiler, Self Compiler and Cross Compiler. Lexical Analysis: Design and implementation of Lexical Analyzers, Finite automata and Regular expressions, Lex tool – the Lexical Analyzer Generator. 8 Unit 2 Syntax Analysis: Context Free Grammars, Derivation and Parse trees, Ambiguity of grammars. Bottom -up and Top -down Parsing - Shift Reduce Parser, Operator Precedence Parser, First and Follow functions, Left recursion, LL Parsers, Canonical collection of items, LR parsers, Conflict Resolution in LR parsers. 14 Unit 3 Syntax -Directed Translation: Syntax -directed definitions and translation schemes, Attributes and Translation Rules, Implementation of S -attributed and L-attributed definitions. Intermediate Code Generation: Intermediate codes, Three address codes, Transla tion of Expressions and Type Checking. 8 Unit 4 Code Optimization and Code Generation : Basic blocks, Flow graphs, DAG, Global data flow analysis, ud -chaining, Available expressions, Loop optimization, Compilation of Expression and Control structures. Error Detection and Recovery. 12 References 1. Aho, Lam, Sethi and Ullman: Compilers – Principles, Techniques and Tools, Pearson Education 2. Tremblay and Sorenson: The Theory and Practice of Compiler Writing, BS Publications. 3. Allen Holub : Compiler Design in C, Prentice Hall India. 44 Cryptography Prerequisite: Nil L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit 1 Introduction to Number Theory: Divisibility theory in integers. Extended Euclid's algorithm. Modular Arithmetic – exponentiation and inversion. Fermat's Little Theorem, Euler's Theorem. Solution to congruence's, Chinese Remainder Theorem.

Review of abstract algebra – Study of Ring Zn, multiplicative group Zn* and finite field Zp – Gauss Theorem (cyclicity of Zp*) - Quadratic Reciprocity. Primality Testing – Fermat test, Carmichael numbers, SolovayStrassen Test, Miller Rabin Test – analysis 8 Unit 2 Conventional Encryption , Classical Techniques - substitution and transposition ciphers, study of basic cryptanalysis possible on classical ciphers, Modern Techniques - block and stream ciphers and RC4 8 Unit 3 Shannon's principles of diffusion and confusion, Design Principles of Block cipher: SPN and Fiestel Structure, The Data Encryption Standard (DES) , AES 8 Unit 4 Asymmetric cryptography: Public Key Encryption, Diffie – Hellman Key Exchange algorithm, RSA algorithm and its limitations 8 Unit 5 Cryptographic hash functions, secure hash algorithm, Message authentication, digital signature, RSA digital signature 8 References 1. W. Stallings,"Cryptography and Network Security Principles and practice", 5/e, Pearson Education Asia, 2013 2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 2nd edition, Tata McGraw Hill, 2013 3. N. Koblitz, Number Theory and Cryptography, Springer, 2001 4. J. Katz and Y. Lindell, Introduction to Modern Cryptography, Third edition CRC press, 2020 45 Operating Syste m L T P C Total Hours : 42 3 0 0 3 Prerequisite: Computer Organization and Architecture, Data structures and algorithms, Problem solving using C Course Content Hrs Unit 1 Introduction: What is an operating system, Types of operating systems and differences among them, OS as a virtual machine; User and Operating -System Interface, System Calls, System Services, Linkers and Loaders, Booting, OS as a resource manager, Interrupts and traps, System calls, Limited direct execution, user versus kernel mode. CPU Scheduling: Process, Process v/s program, context switch, Process state diagram, CPU scheduling – FCFS, SJF, SRTF, Priority, Pre -emptive priority, Round Robin, MLFQ, Lottery, CFS, Multi -Processor Scheduling, Real -Time CPU Scheduling, Thread v/s process, Process and T hread APIs 10 Unit 2 Synchronization: Inter -process communication and Processes: IPC in Shared -Memory Systems and Message -Passing Systems, Race condition, mutual exclusion, The Critical -Section Problem (CSP), Algorithmic solutions to CSP – Dekker's, Peterson's, Lamport Bakery Solution; Hardware Support for Synchronization – Test and Set, Comp are and Swap; OS support for synchronization - Mutex Locks, Semaphores, Monitors; Condition Variables; Classic Problems of Synchronization – Producer Consumer, Sleeping Barber; Dining Philosopher's Problem, Deadlock – Prevention, avoidance, detection and r ecovery, Safe state, Banker's algorithm. Livelock. 10 Unit 3 Memory Management: working set model, hardware support; Contiguous allocation - partitioned memory allocation – fixed and variable partitioning, memory management with bit maps – swapping – relocation - protection and sharing. Non contiguous allocation – Paging – principles , page allocation, segmentation. Virtual memory concepts, address translation, management of virtual memory, page replacement policies, protection and sharing, Thrashing; Caching principles and quantitative estimation of cache behavior 8 Unit 4 I/O Management: Overview of Mass -Storage Structure, HDD Scheduling, NVM Scheduling, Error Detection and Correction, Storage Device Management, Swap -Space Management, SSD (Solid State Disks); I/O Systems -Overview; I/O Hardware; Kernel I/O Subsystem, Transforming I/O Requ ests to Hardware Operations File management: File Concept, Access Methods, Directory Structure, Protection, File-System Interface, Shared files. File -System Implementation: Structure and Operations; Directory Implementation; Allocation Methods; Free -Space Management; Case study: EXT, NTFS, HFS 8 Unit 5 Security and Protection: Program Threats – stack overflow, return to libc, RoP, heap spraying, integer overflow, format string attacks; System and Network Threats; User Authentication; Principles of Protection - Protection Rings, Domains; Access Matrix, Implementation of the Acce ss Matrix – Access Control Lists, capabilities; Revocation of Access Rights, Role -Based Access Control, Mandatory Access Control, Capability - Based Systems 6 References 1. Remzi H. Arpaci -Dusseau and Andrea C. Arpaci -Dusseau, Operating Systems:Three Easy Pieces [online http://pages.cs.wisc.edu/~remzi/OSTEP/] 46 2. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts . 9th edition. Wiley. 3. Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation . Prentice -Hall. 4. Maurice J Bach, Design of Unix Operating System . AT&T; Bell Labs. 5. Andrew Tanenbaum, Modern Operating Systems , Prentice Hall. 6. William Stallings, Operating Systems: Internals and Design Principles , 9th Edition, Pearson. 7. Crowley: Operating System A Design Approach , TMH. 47 Software Engineering Prerequisite: :Nil L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction to Software Engineering : The evolving Role of Software Engineering, The Changing Nature of Software, Legacy software, Software Evolution and Software Myths. Industrial Engineering Tools for Software Engineering. 8 Unit 2 Process Models : Software Process Models: The Waterfall Model, The Incremental Model, the RAD model, Evolution Process Model: Prototyping, The Spiral model, Concurrent Development Model. Agile Process Models: Extreme Programming (XP) 6 Unit 3 Software Project Management: Management Activities, Project Planning, Project scheduling, Risk management. Requirements Engineering. Feasibility study, requirement analysis, cost benefit analysis, planning systems, analysis tools and techniques. 6 Unit 4 System Design: design fundamentals, modular design, data and procedural design, object oriented design and UML. System Development : Code documentation, program design paradigms. 6 Unit 5 Software Testing : Test Strategies for Conventional Software, Test Strategies for Object – Oriented Software, Verification and Validation Testing, System Testing, Debugging. Black -Box and White -Box Testing, Basis Path Testing, Control Structure Testing, Regression Testing, Mutation Testing, Dataflow Testing. 8 Unit 6 Software Maintenance : Maintenance Characteristics, Maintainability, Maintenance Tasks and side effects 8 References 1. Pressman Roger S, Software Engineering A Practitioner’s Approach, TATA McGraw -Hill Publications, 6th Edition, 2005, ISBN No. 007 -301933X 2. Ian Sommerville, Software Engineering, Pearson Education, 7th Edition, 2008, ISBN: 978 -81-7758 -530-8. 3. Ghezzi C. Jazayeri M and Mandrioli: Fundamentals of Software Engg. , PHI. 4. Rajib Mall, Fundamentals of software engineering. PHI Learning Pvt. Ltd.. 5. Unified Modeling Language Reference manual”, Grady Booch, James Rambaugh, Ivar Jacobson, Pearson India, ISBN – 9788177581614 R5. 48 Emerging Technologies for CS Prerequisite: Operating system, computer network, etc. L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit - I Introduction: emerging areas in CS, Internet of things (IoT) : introductions to IoT, sensors and its features, architectures and challenges, Applications – smart city, smart grid, Industrial IoT, etc. 8 Unit - II Computing and Applications: introduction to Cloud computing, various cloud architectures and its applications, mobile edge computing, MEC architectures, design principles and applications, MEC integration with disruptive technologies. 8 Unit - III Blockchain: Introduction to bockchain, principles and technologies, cryptocurrencies, smart contracts, Major applications and issues. Drones – introduction, drone design principles, smarm optimization, Theory of drones, applications, etc. 8 Unit - IV Decentralized learning: Introduction to decentralized learnings, types of learnings, aggregation and communication challenges, privacy and security. 3D printing : introduction to 3D printing and it's applications Quantum technologies : introduction, requirements, challenges, Q -bit principles, quantum computing, quantum cryptography, etc. 8 Unit - V Future/Advanced trends: introduction to future social applications, augmented reality (AR), Virtual reality (VR), mixed reality (MR), extended reality (XR) and metaverse, design principles, major challenges and applications. 5G communication and its use cases, 5G and beyond techn ologies. 8 References 1. The course materials are mainly from the lecturing slides. Research papers from top conferences like SIGCOMM, MOBICOM, NSDI, MobiSys etc. 49 Compiler Design Lab Prerequisite: : Theory of Computation L T P C 0 0 2 2 Course Content 1. Design and implement a lexical analyzer for a given language. 2. Design and implement a lexical analyzer using the Lex/Flex tool. 3. Implement an Operator precedence parser for a given operator grammar. 4. Implement First and Follow functions. 5. Develop an LL(1) parser for a given input grammar. 6. Develop an LR(1) parser for a given input grammar. 7. Intermediate Code generation for a given source code. 8. Control Flow graph generation from a given intermediate code. 9. DAG construction and performing local optimization. 10. Implementation of Constant Folding, Redundant -subexpression elimination, and other optimizations. References 1. Aho, Lam, Sethi and Ullman: Compilers – Principles, Techniques and Tools, Pearson Education 2. Tremblay and Sorenson: The Theory and Practice of Compiler Writing, BS Publications. 3. Allen Holub : Compiler Design in C, Prentice Hall India. 4. John R. Levine, Tony Mason, Doug Brown : Lex & Yacc, O'Reilly. 50 Cryptography Lab Prerequisite: :Ni l L T P C Total hours: 40 0 0 2 2 Course Content Hrs Unit 1 a. Euclidean and Extended Euclidean algorithm for finding the Greatest Common Divisor of two large integers. Computing the Multiplicative inverses in Zn. b. Repeated square and multiply algorithm for modular exponentiation in Zn. c. Determining the order of a group element. Finding a generator of a cyclic group. d. Chinese remainder theorem. e. Computation of Legendre symbol and Jacobi symbol f. Modular polynomial arithmetic g. RSA public key algorithm h. ElGamal Cryptosystem i. Rabin cryptosystem j. Diffie -Hellman Key exchange protocol. Unit 2 a. Fermat's factorization method b. Congruence of squares. Finding a congruence of squares modulo n to factor n. c. Construction of Finite Field of characteristic 2. d. Computations in elliptic curve over a finite field. Unit 3 a. Sieve of Eratosthenes b. Fermat primality test c. Solovay -Strassen probabilistic primality test d. Miller -Rabin probabilistic primality test References 1. Menezes, P.C. van Oorschot, S.A. Vanstone: Handbook of Applied Cryptography: CRC Press, 1996 2. Abhijit Das and C.E.VeniMadhavan, Public -key Cryptography: Theory and Practice, Pearson, 2009. 3. Darrel Hankerson, Alfred

Menezes, Scott Vanstone,Guide to Elliptic Curve Cryptography, Springer - Verlag, 2004 Instructions: C/C++ Programming Language under Linux Operating System gmp-man-6.1.2.pdf (Refer GMP library manual) Code should be well modularised and documented, Code should be well modularised and documented 51 Operating System Lab L T P C Number of Weeks: 14 0 0 2 2 Pre-requisite: C Programming, Linux basics, Python Course Content 1) Write a C/Python program to simulate CPU scheduling. Following CPU scheduling mechanisms need to be implemented: a) SJFS, FCFS b) Priority (pre -emptive & non -pre-emptive) c) Round Robin d) MLFQ e) Lottery 2) Given a list of process IDs, write a program to develop a tree depicting ancestor/parent/child relationship. This shall be a dynamic scenario, and the tree should be updated every second (as new child processes may be created and some may be killed or term inated normally/abnormally). 3) Given two processes P1 and P2 (created as parent/child process through fork/ two threads within same process or two independent processes through two different programs) both of which increment a shared variable, implement Dekker's & Peterson's solutions. 4) Implementation of Lamport -Bakery solution for (N>= 5) processes. Each process shall increment a shared counter by one. 5) Modify solution to producer -consumer problem so that it works wherein producer produces one item but consumer consumes two items. If buffer has only one item, consumer relinquishes critical section and waits till there are two or more items. The solution s hould be a) threads based b) independent process based 6) Write a program to check if there is a deadlock in the resource -allocation graph. If not, how can the process be allocated resources with no deadlock ever occurring. 7) Implement Sleeping Barber and dining Philosophers problem using semaphores. 8) Write a program in C that reads a file from the file system and displays its contents on the screen. Implement error handling and permission checking. 9) Write a program in C that implements a simple memory allocation algorithm such as first-fit or best -fit, and tests its performance using a benchmark program. 10) You are given a file named "input.txt" that contains parameters related to a disk in the first six lines - number of cylinders (track), number of sectors, bytes per sector, RPM, average seek time, initial head position. These parameters are in different l ines of the same file. Track 0 is the outermost one. The seventh line of the file should contain a sequence of requests for track (cylinder) numbers. Write a program to output a) Average Rotational delay b) Total Seek Time to service all the requests for ● SSTF (Shortest Seek time first) ● LOOK 11) Create a virtual machine using Virtual Box or VMware, install an operating system on it, and configure it to run a web server. Test the web server using a web browser and network analysis tools 12) Implement buffer overflow attack using stack smashing. 13) Write a shell script that performs the following tasks: a) File manipulation: Create, delete, copy, and move files and directories. 52 b) Text processing: Search for specific patterns in files and perform text transformations. c) System monitoring: Retrieve system information like CPU usage, memory utilization, and disk space. d) Automation: Automate a repetitive task on your Linux system using a shell script. 14) Implement a program in Linux that demonstrates the following process management concepts: a) Process creation: Create child processes using the fork() system call. b) Process termination: Terminate processes using the exit() system call. c) Process synchronization: Synchronize processes using semaphores, mutexes, or other synchronization mechanisms. d) Signal handling: Handle signals like SIGINT or SIGTERM in your program. 15) Develop a program that interacts with the Linux file system. Your program should enable users to: a) Create files and directories. b) Navigate through directories and display their contents. c) Copy or move files and directories. d) Change file permissions and ownership. 16) Write a simple Linux device driver that interacts with a custom hardware device or simulates a virtual device. Your device driver should: a) Implement read and write operations to interact with the device. b) Handle interrupts or other device -specific functionalities. c) Test the device driver by accessing the device and performing read/write operations. References 1. Remzi H. Arpaci -Dusseau and Andrea C. Arpaci -Dusseau, Operating Systems:Three Easy Pieces [online http://pages.cs.wisc.edu/~remzi/OSTEP/] 2. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts . 9th edition. Wiley. 3. Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation . Prentice - Hall. 4. Maurice J Bach, Design of Unix Operating System . AT&T; Bell Labs. 5. Andrew Tanenbaum, Modern Operating Systems , Prentice Hall. 6. William Stallings, Operating Systems: Internals and Design Principles , 9th Edition, Pearson. 7. Crowley: Operating System A Design Approach , TMH. 53 Advanced Data Structures and Algorithms (Honors) Prerequisite: Data Structures, Design and Analysis of Algorithms L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis, Recurrence equations. 8 Unit 2 Advanced Data Structures: B -Trees, Binomial Heaps, Fibonacci Heaps, AVL trees, Red - black trees, B -trees, Splay trees, Interval trees; Disjoint set – union and path compression, Amortized analysis Greedy Algorithms: shortest distance, minimum spanning tree, interval scheduling, interval partitioning; Divide and Conquer: sorting, integer and polynomial multiplication. 10 Unit 3 Dynamic programming: Longest common subsequence. Chain of matrix multiplication, sequence alignment, Bellman Ford Convex hull and Voronoi diagrams, line segments, Optimal polygon triangulation; Primality testing, Integer factorization. 10 Unit 4 Graph algorithms: Matching and Flows; Parallel algorithms: Basic techniques for sorting, searching, merging. Intractability: Independent Set, Vertex Cover, Randomized algorithms, Probabilistic algorithms. 8 Unit 5 Approximate Algorithms: Vertex -cover, set -covering problems, Travelling Salesman problem. Complexity classes - NP-Hard and NP -complete Problems - Cook's theorem NP completeness reductions, undecidability 6 References: 1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India. 2. Aho A.V , J.D Ulman: Design and analysis of Algorithms, Addison Wesley 3. Brassard : Fundamental of Algorithmics, PHI. 4. Sara Baase: Computer Algorithms: Introduction to Design and Analysis, Pearson Education. 5. Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms and Complexity, PHI 6. Motwani and Raghavan: Randomized Algorithms, Cambridge University Press 54 Scheme and Syllabus of 6th Semester Sixth Semester S. No Code Subject L-T-P Credits Type 22CPT309 Artificial Intelligence 3-0-0 3 PC 22CPT310 Computer and Network Security 3-0-0 3 PC 22CPT311 Digital Image Processing 3-0-0 3 PC 22CPT312 Parallel and Distributed Computing 3-0-0 3 PC 22EET313 Smart Grid 3-0-0 3 PLEAS 22CPTxxx Program

Elective -2 3-0-0 3 PE 22CPP313 Computer and Network Security Lab 0-0-2 1 PC 22CPP314 Digital Image Processing Lab 0-0-2 1 PC 22CPP315 Parallel and Distributed Computing Lab 0-0-2 1 PC 21 Honors CSTxxx Honors Elective -1* 3 CSTxxx Honors Elective -2* 3 6 Minor CSE 22CPT211 Computer Networks 3 PC 22CPT213 Database Information Systems 3 PC 6 55 Artificial Intelligence Prerequisite: Ni l L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Overview of AI, Problems, Shift in focus of AI towards providing smarter solutions, Change in application domains of AI, State -of-the-art technologies in AI. Problem space and searching techniques, Types of production system, Control strategies, Heuristic search Techniques. Defining AI problems as a State Space Search: example, Production Systems, Types of production systems, Search and Control Strategies, Problem Characteristics. 6 Unit 2 Heuristic search techniques - Generate -and-test, Hill Climbing, Best First Search, A* , Problem Reduction, AO*, Constraint Satisfaction with inferencing, backtracking and local search, Mean -Ends Analysis. Knowledge representation, Representation, mappings, approaches and issues. 8 Unit 3 Propositional Logic and theorem proving, First order Predicate logic: syntax and semantics, Propositional v/s First Order Predicate Logic, Satisfiabilit problems, model finding, Inference algorithms: Backward and forward chaining, Resolution (proof by contradiction). Representing Simple facts in Logic, Representing Instances and Isa relationships, Computable Functions and Predicates, Using First Order Logic, Inferencing process and resolution, Unification algorithm. Knowledge Representation : Ontologies, objects, events, PEAS, Forward v/s backward reasoning, Matching and control knowledge, Levels of knowledge representation, entailment, implication, contradiction, contingency, model checking, Modus ponens inference r ule, CNF clauses, Horn clauses. SAT Solvers: DPLL Weak Structures: Semantic Nets, Frames, Strong Structures: Conceptual Dependencies, Scripts. Expert Systems and applications : Representing and using domain knowledge, Expert system shells, Knowledge Acqu isition. 10 Unit 4 Game Playing : Minimax Search Procedures, Adding alpha -beta cutoffs , State -of-the- Art Game Programs and modern examples, Watson and how it solved Jeopardy. Information Retrieval - Google's page rank algorithm, Introduction to natural language processing. 8 Unit 5 Uncertain knowledge and reasoning Quantifying uncertainity, Probabilistic reasoning,, Graphical Models, Bayesian networks, Bayesian inference, forward and backward inference, inference by enumeration, and variable elimination algorithm, Probabilistic reasoning overtime, Inference in temp oral models. Sampling: prior sampling, rejection sampling, likelihood weighting. Hidden markov models, the forward algorithm, the HMM Viterbi algorithm. Concepts in Machine learning: Introduction , Foundations of AI v/s ML, When to use ML and when not to use, Framework for AI/ML application to a problem, Taxonomy of Computational Intelligence, Classification under Machine Learning. 10 References 1. Artificial Intelligence: A Modern Approach by Russel and Norvig, Third Edition, Pearson, 2015. 2. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc -Graw Hill. 3. Introduction to AI & Expert System: Dan W. Patterson, PHI. 56 Computer and Network Security Prerequisite: : Cryptography, Computer networks, etc. L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit - I Introduction: Introduction (a) Security(b) Malware(c) OWASP top ten and other major security issues in the world(d) CVE and other information (e) Introduce various types of security areas 5 Unit - II Software and OS Security: OS Security: Common Bugs, Buffer Overflow, Runtime Defenses against memory safety vulnerabilities, program verification and other vulnerabilities, Principles in OS Security; Mechanisms for confining bad code, Mechanisms for confining bad code: isolation, sandboxing, SFI and V irtualization, Trusted Computing 8 Unit - III Web Security: Secure web site design (SQL injection, XSS, etc.), Browser Security, 7 Unit - IV Network Security: TCP/IP, DDoS Attacks, Network worms and botnets: attacks and defenses, DNS and BGP security, Network defense tools – Firewall and Intrusion Detection . 11 Unit - V Future/Advanced Security: Introduction - The Security in Existing wireless Networks, Upcoming wireless networks and challenges, Thwarting and malicious behavior – Naming and addressing, security association and secure neighbor discovery, secure routing in multichip wireless network s and privacy protection. Mobile OS Security and Privacy: Android, IOS security challenges, processor security, privacy, anonymity and censorship and other security issues according to the current situations and future requirements 9 References 1. Security in Computing (3rd edition) 2. Cryptography and Networks 7 edition 3. The course materials are mainly from the lecturing slides I?ve made and research papers from top conferences like NDSS, USENIX, SIGCOMM, MOBICOM, NSDI, MobiSys etc. 57 Digital Image Processing Prerequisite: Fundamental knowledge on signals and systems, basics of linear algebra and calculus, and programming skills L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction to Digital Image Processing: Digital Image Representation, Fundamental Steps in DIP, Elements of Visual Perception, Image Sensing and Acquisition, Image Model, Sampling, Quantization, Basic Relationship Between the Pixels 6 Unit 2 Image Transforms: Discrete Fourier Transform (DFT), Properties of 2D DFT, Fast Fourier Transform, Inverse FFT, Discrete Cosine Transform and KL Transform, Discrete wavelet Transform, Convolution and Correlation 8 Unit 3 Image Enhancement: Spatial Domain - Basic Gray Level Transformations, Histogram processing, Smoothing and Sharpening Spatial Filters Frequency Domain - Smoothing and Sharpening frequency domain filters, Homomorphic filtering 8 Unit 4 Image Restoration: Overview of Degradation models, Unconstrained and constrained restorations, Inverse Filtering, Wiener Filter 6 Unit 5 Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding, region oriented segmentation Image Compression: Need for data compression, image compression models, loss -less and lossy compression 8 Unit 6 Representation and Description: Representation schemes, boundary descriptors, regional descriptors. Morphology: Dilation, erosion, opening, closing, Hit -or-Miss Transform, some basic morphological algorithms 6 References 1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson , 3rd Edition, 2008 2. Castleman. Digital Image Processing. Prentice Hall. 3. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson , 2002 58 Parallel and Distributed Computing Prerequisite: Programming in C, Data Structures, Operating Systems, Computer Architecture and Organization L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit 1 Parallel Computing, Sequential programs, Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity on Performance, Scalability of Parallel Systems, Parallel Programming Platforms, Implicit Parallelism, SIMD & MIMD systems, Clusters , Single -Core and Multi -Core Processors, Physical Organization of Parallel Platforms, Cache Coherence, Posix -Threads, problem -Solving using P -threads. 8 Unit 2 Programming Using the Message -Passing Paradigm - MPI Principles of Message Passing Programming; Building blocks (Sending and Receiving Operations); Communication Library calls; Collective communication and Computation library calls, Programming Shared Address Space Platforms – OpenMP, Directive Parallel Programming; The OpenMP programmin g Model (Concurrent Tasks, Synchronization Constructs, Data Handling); Open libraries; OpenMP - Environment Variables; 10 Unit 3 Parallel Programs, Matrix Computations, Matrix -Vector Multiplication, Matrix - Matrix Multiplication, Solving system of Linear Equations; Parallel Implementation of Sparse Matrix Computations with Vector; Sorting algorithms, Issues in Sorting on Parallel Computers , Bubble Sort and its Variants, Quicksort; Parallelizing Quicksort; Sequential and Parallel Implementation of all -pairs of Shortest Paths Algorithms; Sequential & Parallel Search Algorithms; Depth -First Search Algorithms; Best -First Search Algorithms 8 Unit 4 Programming on Multi -Core Systems with GPU accelerators, An Overview of Brief History of GPUs; An Overview of GPU Programming; An Overview of GPU Memory Hierarchy Features; An Overview of CUDA enabled NVIDIA GPUs, Introduction to CUDA C, Parallel Programming using OpenACC, CUDA APIs, CUDA Libra ries for Numerical and Non -Numerical Computations; The OpenCL – Heterogeneous Programming; OpenCL Libraries, The OpenCL Memory Model, Execution Model; Platform and Devices; An Overview of OpenCL API; 6 Unit 5 An Overview of MapReduce, An Overview of MapReduce Programming, An Overview of Hadoop Architecture /Execution (Master/slave, Namenode/Datanode); Hadoop Distributed File System (HDFS), An Overview of Hadoop Components, Hadoop – Control Flow and Data Flow; A n overview of Hive (Distributed Data Warehouse); Hbase (Distributed Column based database, PIG –(Data Flow Language) , Introduction to Spark, Spark RDD, Machine Learning Using Spark. 8 References 1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Second Edition Pearson Education – 2007 2. Peter Pacheco, An Introduction to Parallel Programming, Morgan Kaufman Publishers, Elsevier (2011) 3. Jason Sanders, Edward Kandrot, CUDA By Example – An Introduction to General -Purpose GPU Programming, Addison Wesley (2011) 4. Rohit Chnadra, Leonardo Dagum, Dave Kohr, Dror Maydan, Jeff McDonald, Ramesh Menon, Parallel Programming in OpenMP, Academic Press (2001) 59 5. Benedict R Gaster, Lee Howes, David R Kaeli Perhaad Mistry Dana Schaa, (2011), Heterogeneous Computing with OpenCL McGraw -Hill, Inc. Newyork 6. Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw -Hill International Ed (2003) 7. Aru C Murthy, Vinod Kumar Vavilapalli, Doug Eadline, Joseph Niemiec, and Jeff Markham, Apache Hadoop YARN Moving beyond MapReduce and Batch Processing with Apache Hadoop 2, Addison Wesley, 2014 60 Smart Grid Prerequisite : Data communication, computer networks, data science, etc. L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit - I Introduction to Power systems and Smart grid : power systems: Load and Generation, Power Flow Analysis, Economic Dispatch and Unit Commitment Problems, Smart Gird: Definition, Applications, Government and Industry, Standardization 4 Unit - II

Renewable Generation: Carbon Footprint, Renewable Resources: Wind and Solar, Microgrid Architecture, Tackling Intermittency, Stochastic Models and Forecasting 8 Unit - III Smart Grid Communications: Two-way Digital Communications Paradigm, Network Architectures, IP -based Systems, Power Line Communications, Advanced Metering Infrastructure Wide Area Measurement: Sensor Networks, Phasor Measurement Units, Communications Infrastructure, Fault Detection and Self -Healing Systems, Applications and Challenge 11 Unit - IV Renewable Generation: Carbon Footprint, Renewable Resources: Wind and Solar, Microgrid Architecture, Tackling Intermittency, Stochastic Models and Forecasting Intelligent Demand Response : Definition, Applications, and State -of-the Art, Pricing and Energy Consumption Scheduling, Controllable Load Models, Dynamics, and Challenges, Electric Vehicles and Vehicle -to-Grid Systems, Demand Side Ancillary Services 11 Unit - V Data science for economics and market operations: Energy and Reserve Markets, Market Power, Detection of market power using data science methods, Analysis of pricing patterns and market behaviour and Assessment of market concentration and its impact on competition and consumer welfare , Generation Firms - Optimization of scheduling and dispatch of generation units and Predictive maintenance using machine learning algorithms, improved operational efficiency through data -driven models. , Locational Marginal Pric es - Prediction of local marginal prices using data science techniques, Analysis of historical data to identify correlations and patterns, Accurate price forecasting and risk management strategies. Financial Transmission Rights - Estimation of financial value of transmission rights, Optimization of allocation and trading of transmission rights, Predictive models for assessing financial risks and returns. Security and Privacy: Cyber Security Challenges in Smart Grid, Load Altering Attacks, False Data Injecti on Attacks, Defence Mechanisms, Privacy Challenges 6 References 1. This course does not have any official textbook. The main source of learning for the students is the set of handouts provided by the instructor. The students will also need to read several recent papers in the field of smart grid, e.g., in the IEEE Transactions on Smart Grid, the IEEE Innovative Smart Grid Technologies Conference, and the IEEE Conference on Smart Grid Communications. 2. The course materials are mainly from the lecturing slides made and research papers from top conferences like SIGCOMM, MOBICOM, NSDI, MobiSys etc. 61 Computer and Network Security Lab Prerequisite: : The programming lab in C++, which means you need to be very comfortable with C++ and using standard debugging tools. L T P C Total hours: 28 0 0 2 2 Course Content Hrs The laboratory experiments conducted on various tools Lab 1 -3: Experiments on Network traffic scanning tools – Wireshark, Nmap, Nessus, etc tools Lab 3 -4: Experiments on control hijacking attacks, and OS security Lab 5 -9: Experiments on Network security (OpenSSL, OpenVAS, Snort, Metasploit, Firebug, etc.) Lab 10 -12 : Experiments on Web security (DVWA, snort, etc) 28 References 1. Security in Computing (3rd edition) 2. Cryptography and Networks 7 edition 3. The course materials are mainly from the lecturing slides I've made and research papers from top conferences like NDSS, USENIX, SIGCOMM, MOBICOM, NSDI, MobiSys etc. 62 Digital Image Processing Lab Prerequisite: Fundamental knowledge on image processing and programming skills L T P C 0 0 2 1 Course Content 1. Familiarization with various image processing tools 2. Basic operations on images 3. Basic grey -level transformations 4. Image Negative 5. Logarithmic transformation 6. Power -law transformation 7. Perform the following over a given image 8. Grey level slicing 9. Zooming (Nearest neighbour interpolation, bilinear interpolation) 10. Bit-plane slicing 11. Histogram equalization and specification 12. Implementation of different image transforms (DFT, PCT, DWT, etc.) 13. Spatial filtering in presence of various noise 14. Filtering in frequency domain 15. Implementation of image deblurring techniques 16. Image segmentation (edge detection, line detection, point detection) 17. Implementation of region based image segmentation 18. Implementation of different morphological operations 19. Analysis of images using color models 20. Mini project References 1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson , 3rd Edition, 2008 3. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson , 2002 63 Parallel and Distributed Computing Lab Prerequisite : C Programming, DSA L T P C 0 0 2 1 Course Content 1. Implementation of pthreads, problem -solving using pThreads. 2. Problem -solving using openMP 3. Matrix multiplication using task. 4. Problem -solving using MPI, Sending and Receiving Operations 5. Parallel Programs, Matrix Computations, Matrix -Vector Multiplication, Matrix -Matrix Multiplication using MPI. 6. Parallel Implementation of Sparse Matrix Computations with Vector; Sorting Algorithms , Issues in Sorting on Parallel Computers; Bubble Sort and its Variants using GPU Resources. 7. Quicksort; Parallelizing Quicksort; Sequential and Parallel Implementation of all -pairs of Shortest Paths Algorithms; Sequential & Parallel Search Algorithms. 8. Depth -First Search Algorithms; Best -First Search Algorithms. Control Flow graph generation from a given intermediate code. 9. Implementation of MapReduce programs for large scale data handling. 10. Programming on Multi -Core Systems with GPU accelerators. References 1. Aru C Murthy, Vinod Kumar Vavilapalli, Doug Eadline, Joseph Niemiec, and Jeff Markham, Apache Hadoop YARN Moving beyond MapReduce and Batch Processing with Apache Hadoop 2, Addison Wesley, 2014 2. Benedict R Gaster, Lee Howes, David R Kaeli Perhaad Mistry Dana Schaa, (2011), Heterogeneous Computing with OpenCL McGraw -Hill, Inc. Newyork 3. Jason Sanders, Edward Kandrot, CUDA By Example – An Introduction to General -Purpose GPU Programming, Addison Wesley (2011) . 64 Pool 1: Electives: 3 -0-0 (Credits 3, Semesters 5/6 /7) 1. 5G and Beyond 2. Advanced Algorithms 3. Blockchain Technologies 4. Cyber Physical Systems 5. Deep Learning 6. Evolving Architectures 7. Malware Analysis 8. Artificial Neural Networks 9. Nature Inspired Algorithm 10. Parallelizing Compilers 11. VLSI Algorithms 12. Wireless Security 13. Wireless Networks 65 5G and Beyond Prerequisite: : Data communication, computer networks, etc. L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit - I Introduction to mobile networks : Mobile Networks (wireless communication), Need of Generations, Evolution of generation, Challenges of generations, 4G Network and architecture, From 4G to 5G, Network Architecture of 5G/6G, Challenges of 5G. 4 Unit - II 5G apps: 5G apps (pull from user demands) - app overview and 5G objectives, 5G apps in the automotive sector and D2D technologies, IoT applications and technologies: Internet of Things in 5G Era, 3GPP Standards for the Internet -of-Things, Other 5G apps and technologies : Media and Entertainment Sector, eHealth sector 8 Unit - III 5G Technologies: Overview and radio - 5G (core network): Network slicing, C - RAN, NFV, SDN, 5G technologies (mobile edge computing, management and orchestration, discussion). 11 Unit - IV Overview of Active Research: 6G, vision and thoughts towards 6G, network intelligence for 5G and beyond 11 Unit - V Security for 5G and beyond : Overview of security for 5G and beyond, enhanced system level security design, blockchain for 5G and beyond. 6 References 1. Erik Dahlman, Stefan Parkvall, and Johan Sköld: 5G NR: The Next Generation Wireless Access Technology. Academic Press, 2018, ISBN: 9780128143230. 2. The course materials are mainly from the lecturing slides I ha ve made and research papers from top conferences like SIGCOMM, MOBICOM, NSDI, MobiSys etc. 66 Advanced Algorithms Total Hours L T P C 42 3 0 0 3 Prerequisite: Data Structures, Design and Analysis of Algorithms, C programming Course Content Hrs Unit 1 Review of Data Structures - Height balanced trees, AVL, Red-black trees, splay trees, Binomial and Fibonacci heaps, treaps, suffix tree, Range minimum query, Aho- Corasick automata, Hash tables, Tries, van Emde boes tree. 8 Unit 2 String Algorithms: Exact String Matching: Rabin -Karp, KMP, Boyer Moore; Inexact string matching: Edit distance, Levenshtein distance computing algorithm. Computational Geometry: Convex Hull. Line-segment Intersection. Sweep Lines. Voronoi Diagrams. Range Trees. Optimal polygon triangulation. 8 Unit 3 Linear Programming: Formulation of Problems as Linear Programs. Duality. Simplex, Interior Point, and Ellipsoid Algorithms. Online Algorithms: Ski Rental. River Search Problem. Paging. The k-Server Problem. List Ordering and Move -to-Front. Parallel Algorithms: PRAM. Pointer Jumping and Parallel Prefix. Bitonic sorting, Odd-even sorting, Maximal Independent Set. 10 Unit 4 Approximation Algorithms: Greedy Approximation Algorithms. Dynamic Programming and Weakly Polynomial -Time Algorithms. Linear Programming Relaxations. Randomized Rounding. Vertex Cover, Wiring, and TSP. Fixed - Parameter Algorithms - Parameterized Complexity. Kernelization. Vertex Cover. Probabilistic algorithms: Primality testing, Integer factorization, Randomized algorithms: Monte Carlo – mincut, Las Vegas – quicksort 8 Unit 5 Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions – SAT, 3SAT, vertex cover, Independent Set, Hamiltonian cycle, travelling salesman. 8 References 1. Cormen, Leiserson, Rivest: Introduction To Algorithms, Prentice Hall Of India. 2. Aho A.V , J.D Ulman: Design And Analysis Of Algorithms , Addison Wesley 3. Jon Kleinberg And Éva Tardos: Algorithm Design, Pearson. 4. Motwani And Raghavan : Randomized Algorithms , Cambridge University Press 5. Vaizirani: Approximation Algorithms , Springer Verlag 6. Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms And Complexity , Phi. 67 Blockchain Technologies Prerequisite: : Nil L T P C Total hours: 35 3 0 0 3 Course Content Hrs Unit 1 Introduction to blockchain - Distributed Ledger Technology, Decentralization, Problems in Traditional Money transfer system, Digital Crypto currency, Bitcoin nuts and bolts, Generic elements of Blockchain, Bitcoin Network and Architecture, Block and transac tions in a Blockchain, Advantages over Traditional Databases, Mining Mechanism, Types of Blockchain: Public, Private, Consortium,Hybrid 6 Unit 2 Cryptography: Elliptic Curve Cryptography, Hash Functions, Merkle Tree, Merkle Patricia Trie, Digital Signature, Wallets and Keys, User Addresses and Privacy CRYPTO CURRENCY History, Distributed ledger, Creation of Coins, Double spending, 3 Unit 3 Mechanics of Bitcoin,

Bitcoin protocols, Transaction in Bitcoin Network, AltCoins, Ethereum ,Transactions in Ethereum, EVM, Accounts, Transactions, Gas, Fees, Smart Contracts, Wallets managing and protecting crypto assets, Types of Wallets, different ways of storing Bitcoin keys, security measures, Tokenizing, Risk and challenges, 8 Unit 4 Bitcoin Mining and consensus –definition, working of Consensus Mechanism, Byzantine Generals Problem, Nakamoto consensus,Properties of consensus mechanism , incentives in consensus,Types of Consensus Algorithms, Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Proof of Importance (PoI), Proof of Capacity (PoC) ,The Proof of Elapsed Time (PoET), Hybrid Proof of Activity (PoA), Proof of Authority (PoA), Proof of Burn (PoB) Byzantine Fault Tolerance (BFT), and other flavours of consensus mechanisms , Pros and Cons of Consensus Mechanisms, :, sybil resistance, Security analysis of various Consensus Mechanisms 9 Unit 5 Ethereum Syntax &, Structure ,Decentralized Apps (dApp), EVM, and the Ethereum blockchain, Eth 2.0, Sharding Chains ,Smart Contract, , MetaMask, Blockchain -based IoT Applications, Hyperledger, Components of Ethereum Ecosystem Smart contract on ethereum, Setting up Ethereum Node using Geth Client, Smart Contracts and DApps, Programming in solidity Truffle, Ganache CLI, Metamask, Remix, Solidity, Writing and Deploying Smart Contracts in Solidity, Connection to Web3.js Library, Vulnerabilities in Smart Contracts, Attacks, Prevention of Attacks, Decentralized Autonomous Organization (DAO), Building an Initial Coin Offering (ICO). Privacy and Scaling the blockchain, blockchain interoperability, future of blockchains 6 Unit 6 Use Cases and applications in Cryptocurrency and Other Sectors like Finance, Voting System, and Healthcare, Networks , Bitcoin: A Peer -to-Peer Electronic Cash System, Supply Chain Management (SCM) etc 3 References 1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfede, “Bitcoin and Cryptocurrency Technologies”, Princeton University Press, 2016. 2. Lantz, Lorne, and Daniel Cawrey, “Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications” O’Reilly Media, 3. Imran Bashir, Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained, Packt Publishing Ltd, March 2018 68 Cyber -Physical Systems Prerequisite: : Data communication, computer networks, etc. L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit - I Introduction to CPS : Characteristics of Cyber -Physical Systems (CPS), Cyber - Physical Systems (CPS) in the real world, Basic principles of design and validation of, 4 Unit - II CPS Hardware: Industry 4.0, AutoSAR , IIOT implications, Building Automation, Medical CPS -CPS physical systems modeling and formalisms: CPS - Platform components - CPS HW platforms - Processors, Sensors, Actuators, 8 Unit - III CPS Network and systems: , CPS Network - WirelessHart, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks Principles of Dynmical Systems - Dynamical Systems and Stability, Controller Design Techniques and Performance under Packet drop and Noise, 11 Unit - IV CPS Implementations and Intelligence: CPS implementation issues - From features to automotive software components, Mapping software components to ECUs, CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, and build ing real - time networks for CPS, CPS Intelligent CPS 11 Unit - V Applications and Security for CPS : Safe

Reinforcement Learning, Robot motion control, Autonomous Vehicle control, Gaussian Process Learning, Smart Grid Demand Response, Building Automation, Secure Deployment of CPS, Secure Task mapping and Partitioning, State estimation for attack detection, Automotive Case study : Vehicle ABS hacking Power Distribution Case study : Attacks on Smart Grids 6 References 1. “Introduction to Embedded Systems – A Cyber –Physical Systems Approach “ - E. A. Lee, Sanjit Seshia 2. “Principles of Cyber -Physical Systems” - Rajeev Alur 3. The course materials are mainly from the lecturing slides I?ve made and research papers from top conferences like SIGCOMM, MOBICOM, NSDI, MobiSys etc. 69 Deep Learning Prerequisite: : Probability, Statistics, Algebra, Basic Computer Programming, Data Structures L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Course Overview: Introduction to Deep Learning and its Applications. Introduction to Statistical Learning: Multi -Layer Perceptron, Back Propagation, Linear Regression, Loss Functions and Optimization: Optimization, stochastic gradient descent, dropout, batch normalization, etc. 8 Unit 2 Convolutional Neural Networks: Convolution, pooling, Activation Functions, Back propagation of CNN, Weights as templates, Translation invariance, Training with shared parameters. CNN Architecture Design and Discussion: AlexNet, VGG, GoogLeNet, ResNet, Capsule Net, etc. Visualization and Understanding: Visualizing intermediate features and outputs, Saliency maps, Visualizing neurons, Cam -Grad, etc. 8 Unit 3 Sequential Modelling: Recurrent and Recursive Nets, RNN, LSTM, GRU, Image captioning, visual question answering, etc. 6 Unit 4 Generative Models: Encoder, Decoders, Variational Autoencoders, Generative Adversarial Networks like pix2pix, CycleGAN, etc. Transformers based Models:. 8 Unit 5 Deep Learning Applications: Object Detection: RCNN, Fast RCNN, Faster RCNN, YOLO and variants, Retina Net, etc., Adversarial Attacks on CNN Deep learning for NLP 8 Unit 6 Deep learning Libraries and Frameworks: Keras, TensorFlow, PyTorch, AutoML, etc 4 References 1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, “Deep Learning,” MIT Press. 2. Michael A. Nielsen, “Neural Networks and Deep Learning,” Determination Press, 2015. 70 Evolving Architectures Prerequisite: Operating Systems, Computer Networks, DBMS, Algorithms L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Special, emerging and advanced topics in different areas of Computer Science and Engineering will be covered under this course. • Understand Taxonomy of new Architectures • Understand the Building Blocks of each architecture. • Install the Open -Source Tools • Study the State of the Art • Listen to an Expert (Academia / Industry) • Discuss Survey / Research Papers (Last 5 -7 years) • Case Studies of Tool or Simulator • Build some components for a Simple Model as assignment. 8 Unit 2 8 Unit 3 8 Unit 4 9 Unit 5 9 References 1. Research Papers from Journals and Conferences 2. Technical and Research Reports from Consortiums / Committees 3. Red Books, White Papers, Request For Comments (RFCs) 4. Manuals, Guides, Blogs 71 Malware Analysis Total Hours L T P C 42 3 0 0 3 Prerequisite: Fundamentals of Cryptography, Operating Systems, Computer Organization and Architecture, Data structures and algorithms, Programming Course Content Hrs Unit 1 Introduction: Introduction to malware, OS security concepts, malware threats, evolution of malware, malware types - viruses, worms, rootkits, trojans, bots, spyware, adwares, logic bombs, malware analysis, static malware analysis, dynamic malware analysis. 8 Unit 2 Advanced Static Analysis: x86 Architecture, Analyzing Windows programs, Portable executable file format, disassembling malicious executable programs. Anti-static analysis techniques - obfuscation, packing, metamorphism, polymorphism. 8 Unit 3 Advanced Dynamic Analysis: Debugging malware - ollydbg, windbg, setting virtual environments - sandboxes, emulators, hypervisors, virtual machines, live malware analysis, dead malware analysis, analyzing traces of malware - system - calls, api -calls, registries, network activities. An ti-dynamic analysis techniques - anti-vm, runtime -evasion techniques. 9 Unit 4 Malware Functionality: Downloaders, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching - Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC Injection. 8 Unit 5 Malware Detection Techniques: Signature -based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature. Non-signature based techniques: similarity -based techniques, machine -learning methods, invariant -inferences. 9 References 1. Thabet, A., Kleymenov, A.: Mastering Malware Analysis: A Malware Analyst's Practical Guide to Combating Malicious Software, APT, Cybercrime, and IoT Attacks. 2. Bruce Dang, Alexandre Gazet, and Elias Bachaalany: Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation 3. Peter Szor : The Art of Computer Virus Research and Defense, Addison Wesley Professional. 4. Eric Filiol: Computer Viruses: from theory to applications , Springer. 5. Michael Sikorski and Andrew Honig: Practical Malware Analysis: The Hands -On Guide to Dissecting Malicious Software, No Starch Press 6. Christopher Elisan: Advanced Malware Analysis, McGraw -Hill Osborne Media. 7. Michael Hale Ligh, Andrew Case: The Art of Memory Forensics: Detecting Malware, Wiley. 8. Published articles from reputed Journals and Conferences. 72 Artificial Neural Networks Prerequisite: : L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Overview of Biological Neurons, Structure of biological neurons relevant to Artificial Neural Networks(ANNs), Fundamental Concepts of Artificial Neural Networks Models of ANNs; Feedforward & feedback networks; learning rules; Hebbian learning rule, percept ion learning rule, delta learning rule, Widrow -Hoff learning rule, correction learning rule, Winner –lake all elarning rule, etc. 8 Unit 2 Single layer Perception Classifier: Classification model, Features & Decision regions; training & classification using discrete perceptron, algorithm, single layer continuous perceptron networks for linearly seperable classifications. 9 Unit 3 Multi -layer Feed forward Networks: Linearly non -seperable pattern classification, Delta learning rule for multi -perceptron layer, Generalized delta learning rule, Error back -propagation training, learning factors, Examples. 10 Unit 4 Single layer feedback Networks: Basic Concepts, Hopfield networks, Training & Examples., Associative memories: Linear Association, Basic Concepts of recurrent Auto associative memory: rentrieval algorithm, storage algorithm; By directional associative memo ry, Architecture, Association encoding & decoding, Stability. 9 Unit 5 Self organizing networks: Unsupervised learning of clusters, winner -take-all learning, recall mode, Initialisation of weights, seperability limitations, Learning Vector Quantization (LVQ). Applications of Artificial Neural Network in various domains 6 References 1. S. Haykin, “Neural Networks and Learning Machine”s , 3rd Edition , Prentice -Hall , 2008 , ISBN No. 0131471392 2. Jacek M. Zurada, “Introduction to Artificial Neural Systems , Jaico Publishing House; First edition. 3. B Yegnanarayana , “Artificial neural networks”, 1st ed., Prentice Hall of India P Ltd, 2005. 73 Nature Inspired Algorithms Prerequisite: Programming in C L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit 1 Introduction to Algorithms, Optimization, and Search for optimality, computational intelligence, Nature Inspired solutions and characteristic, Nature inspired Meta -heuristics and its brief history. 8 Unit 2 Analysis of Optimization Algorithms, Nature Inspired Algorithms, parameter Tuning and control Constrained and unconstrained optimizations, Random Walks and Optimizations, evolutionary strategies and Evolutionary Algorithms (EA), Simulated Annealing (SA) Algorithm and its behaviour, Genetic Algorithms(GA) - genetic operator, parameters, fitness functions, genetic programming and convergence analysis, GA variants 10 Unit 3 Swarm Intelligence optimization, Particle Swarm Optimization(PSO) Algorithm, Ant Colony Optimization (ACO) Algorithms, Artificial Bee Colony ACO) optimization algorithms, Cuckoo Search (CS) Algorithms, Intelligent Water Drop Algorithm (IWD), Bat Algorithms (BA), Firefly Algorithms(FA) 8 Unit 4 Applications of nature -inspired algorithm, machine learning using nature inspired algorithm, data clustering using NIA. 6 Unit 5 Parallel processing of NIA using Hadoop, Parallel data clustering using NIA. Multi -objective optimization and applications. 8 74 Parallelizing Compiler s Prerequisite: Compiler Design L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction – Compilation for parallel machines and automatic detection of parallelism, structure of a parallelizing compiler. 8 Unit 2 Dependence Theory and Practice - Types of dependences, data and control dependencies, dependence analysis, direction vectors, loop carried and loop independent dependences, tests for data dependence and their applicability, construction of data dependence and control dependence graphs. 18 Unit 3 Parallel Code Generation - Automatic extraction of parallelism, representation of iteration spaces of nested loops, loop based transformations such as loop distribution, loop coalescing, loop interchange and cycle shrinking transformation. 8 Unit 4 Interprocedural Analysis and Optimization - aliasing information, summary data flow analysis, interprocedural constant propagation, interprocedural data dependence analysis and parallelization of call statements. 8 References 1. Randy Allen, Ken Kennedy: Optimizing compilers for modern architectures. Morgan Kaufmann. 2. Steven Muchnick : Advanced Compiler Design & Implementation, Morgan Kaufmann. 3. Hector, Ullman, Widom : Database System Implementation, Pearson. 75 VLSI Algorithms Prerequisite: Compiler Design L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction of VLSI Technology, VLSI design cycle, design styles, basic Layout rules and circuit abstraction, introduction to standard Cell, Gate array, FPGA 8 Unit 2 Overview of basic graph algorithms, Graph algorithms for physical Design Partitioning: Classification of partitioning algorithms, Karnighan -Lin Algorithm, FM Algorithm, Ratio cut algorithm 18 Unit 3 Floor -planning: Rectangular dual graph approach of floor -planning, hierarchical tree based approach, Integer programming based floor planning. Placement: placement by simulated annealing and force directed method 8 Unit 4 Routing: classification of routing algorithms, Global routing: Maze routing algorithms, line probe algorithms, Steiner tree based algorithms, Detailed, Single layer and two layer routing algorithms, routing in FPGAs 8 References 1. Naveed Shervawani, " Algorithms for VLSI physical Design Automation " III Ed Springer 2. Sarrafzadeh and Wong " An introduction to VLSI Physical design " MGH 3. Sze: VLSI Technology 4 Weste and Eshranghan, " Introduction toVLSI Design". Pearson Edu. 5 Sadiq M. Sait, Habib Youssef, "VLSI Physical Design Automation: Theory and Practice", World Scientific Publishing Company; 6 Cormen Leiserson, Rivest, " Introduction to Algorithms", Pearson Edu. 76 Wireless Security Total Hours L T P C 42 3 0 0 3 Prerequisite: Fundamentals of Computer Networks, Wireless Networks, Cryptography Course Content Hrs Unit 1 Introduction to Wireless Security, Overview of wireless networks, Wireless network architecture, Wireless network security goals and objectives, 6 Unit 2 Wireless Network Vulnerabilities and Threats, Wireless network security threats, Active and passive attacks, Wireless network vulnerabilities, Common attacks on wireless networks 8 Unit 3 Wireless Security Protocols: Wired Equivalent Privacy (WEP), Wi -Fi Protected Access (WPA), Wi -Fi Protected Access II (WPA2) 802.11i 10 Unit 4 Wireless Authentication and Encryption protocols: Password -based authentication, Certificate -based authentication, Secure Wireless Network Design, Secure wireless network design principles, Secure network configuration 10 Unit 5 Placement of access points and antennas, Site survey and signal analysis, Wireless Security Standards and Policies, Wireless network security standards, Wireless security policies and guidelines regulatory compliance, Wireless Security Management and Monitoring, Wireless network managem ent, Wireless network monitoring and auditing, Incident response 8 References 1. ""Hacking Exposed Wireless: Wireless Security Secrets & Solutions" by Johnny Cache, Vincent Liu, and Billy Rios (2nd Edition, 2010) 2. "802.11 Wireless Networks: Security and Analysis" by Alan Holt and Chi -Yu Huang (1st Edition, 2010) 3. ""Wireless Network Security: A Beginner's Guide" by Tyler Wrightson (1st Edition, 2011) 4. ""Wireshark for Security Professionals: Using Wireshark and the Metasploit Framework" by Jessey Bullock and Jeff T. Parker (1st Edition, 2017) 5. "Wireless Network Security: A Practical Approach to Securing Your Wi -Fi Network". 77 Wireless Networks Prerequisite: : Computer Networks L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit 1 Introduction to Wireless Networking ,History of wireless networks, Difference between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Wireless Network Architecture, Benefits of Wireless Networks, Wireless Networking Applications Radio propagation models, Narrowband digital modulation and Coding under wireless fading environments. 8 Unit 2 Medium Access and Resource allocation Techniques: Basics of CDMA and OFDM, Randomized medium access - Unslotted and Slotted Aloha, IEEE 802.11 CSMA protocol, channel allocation in (TDMA/FDMA/CDMA) -based wireless networks under the protocol model. Wireless LANs: Technology,IEEE 802.11 Wireless LAN Standard, Radio based Wireless LANs, Wi -Fi, Wimax 8 Unit 3 Routing Layer: Introduction, Routing protocols - Routing, Dynamic source routing, Destination sequence distance vector, Overview ad -hoc routing protocols , Application - RFID, Bluetooth, Zigbee, NFC 8 Unit 4 TCP enhancements for wireless protocols - Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility - Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP - TCP over 3G wireless networks. 8 Unit 5 Emerging industry standards such as 4G Cellular – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, 5G, IEEE 802.11p, Cognitive Radio 8 References 1. William Stallings , Wireless Communications and Networks, Pearson Education, 2009 2. Jon W. Mark and W. Zhuang , Wireless Communications and Networking, Pearson Ed, 2009 3. Upena Dalal, Wireless Communication and Networks, Oxford publications, 2015 78 Pool 2: Electives: (3 -0-0 (Theory) + 0 -0-2 (Practical)) (Credits 4, Semesters 7/8) 1 Advanced Computer Networks 2 Advanced Computer Networks Lab 3 Advanced Database Systems 4 Advanced Database Systems Lab 5 Biometrics 6 Biometrics Lab 7 Computer Vision 8 Computer Vision Lab 9 Data Analytics 10 Data Analytics Lab 11 Data Mining 12 Data Mining Lab 13 Decentralized Learning 14 Decentralized Learning Lab 15 Embedded System Design 16 Embedded System Design Lab 17 Full Stack Development 18 Full Stack Development Lab 19 Information Retrieval 20 Information Retrieval Lab 21 Internet of Things (IoT) 22 Internet of Things (IoT) Lab 23 IoT based Robotics 24 IoT based Robotics Lab 25 Natural Language Processing 26 Natural Language Processing Lab 27 Program Analysis 28 Program Analysis Lab 29 Social Network Analysis 30 Social Network Analysis Lab 31 Software Testing 32 Software Testing Lab 33 Topics in Computing 34 Topics in Computing Lab 35 Topics in Operating System 36 Topics in Operating System Lab 79 Advanced Computer Networks Prerequisite: : Data communication, computer networks, etc. L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit - I Software Defined Network -1: Logically -Centralized Control, SDN Software Stack, Data -Plane Verification, Forwarding Table Verification, Debugging - Diagnosis, Measurement – Overview, APIs. 8 Unit - II Software Defined Networks - II: Resource Management, Device Heterogeneity, Scalability: Data -Plane, Control -lane Extending Data -Plane: OpenFlow++, SDN Applications: Data -center & Cloud & Wide -Area -Networks. 8 Unit - III Advances in Wireless Networks: Wireless networking: Bluetooth, 802.11 standards, Information theory, bandwidth, multiple access, Wireless Terahertz Networks, 5G and 6G communication, Intelligent Transportation Systems. 8 Unit - IV Emerging networking technologies -I: Host configuration and service discovery principles, Future routing architectures, IPv6 deployment scenarios and challenges, IPv6 transition/integration, Advanced IP multicast, including IPv6 multicast and SSM. 8 Unit - V Emerging networking technologies - II : Data centre networks , Delay -tolerant networking Future home network, architectures, IP network management and monitoring, Social Networks 8 References 1. Software Defined Networking by Thomas D Nadeau and Ken Gray. 2. Hagen S, (2006). IPv6 Essentials. 3. The course materials are mainly from the lecturing slides made and research papers from top conferences like SIGCOMM, MOBICOM, NSDI, MobiSys etc. 80 Advanced Computer Networks Lab Prerequisite: : The programming lab in C++, which means you need to be very comfortable with C++ and using standard debugging tools. L T P C Total hours: 36 0 0 2 2 Course Content Hrs The laboratory experiments conducted on various tools Lab 1 -3: Experiments on SDN using mininet, NS,etc Lab 3 -4: Experiments on Internet of things using NS3, Netsim, etc Lab 5 -9: Experiments on Wireless networks using NS3, Netsim, etc Lab 10 -12 : Experiments on 5G and beyond using NS3, Netsim, etc 36 References 1.

Software Defined Networking by Thomas D Nadeau and Ken Gray. 2. Hagen S, (2006). IPv6 Essentials. 3. The course materials are mainly from the lecturing slides and research papers from top conferences like SIGCOMM, MOBICOM, NSDI, MobiSys etc. 81 Advanced Database Systems Prerequisite: : Database Information Systems L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Query Processing and Optimization – Implementation of Database operations, External Sorting, Size Estimations, Equivalence Rules, Heuristic -based Optimization, Materialized Views, Incremental View Maintenance. 14 Unit 2 Transaction Processing and Implementation - Concurrency Control Protocols, Two-phase Lock Protocol and its variants, Deadlock Prevention and Detection schemes and implementation, Timestamp -based Ordering Protocol, Log -based Recovery Management. 12 Unit 3 Modern Database Systems - Database System Architectures, Distributed Database Systems, Parallel Databases, Times in Databases, Multimedia Databases. 8 Unit 4 Distributed Databases - Data Storage, Global Catalog, Distributed Transaction Processing, Two -Phase Commit Protocol, Distributed Query Processing. 8 References 1. Silberschatz , Korth, Sudarshan : Database System Concepts, McGrall Hill. 2. Elmasri and Navathe : Fundamentals of Database Systems, 3rd Edition, Addison Wesley. 3. Hector, Ullman, Widom : Database System Implementation, Pearson. 4. Ceri and Pelagatti : Distributed Databases – Principles and Systems, McGraw Hill. 82 Advanced Database Systems Lab Prerequisite: : Database Information Systems L T P C 0 0 2 1 Course Content 1. Programming exercises on Query Processing and Implementation of Database operations. 2. Programming exercises on Query Optimization – Cost-based and Heuristic -based Optimization. 3. Programming exercises on Transaction Processing. 4. Programming exercises on Concurrency Control Protocols. 5. Programming exercises on Log -based Recovery Management. 6. Programming exercises on Distributed Transaction Processing, and Distributed Query Processing. References 1. Silberschatz ,Korth , Sudarshan : Database System Concepts, McGrall Hill. 2. Elmasri and Navathe: Fundamentals of Database Systems, 3rd Edition, Addison Wesley. 3. Hector, Ullman, Widom: Database System Implementation, Pearson. 4. Ceri and Pelagatti: Distributed Databases – Principles and Systems, McGraw Hill. 83 Biometrics Prerequisite: : A basic knowledge of statistics, linear algebra, and programming is expected. L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction: Person recognition, Biometric systems, Biometric functionalities, biometrics system errors, the design cycle of biometric systems 6 Unit 2 Fingerprint recognition: friction ridge patterns, finger print acquisition, feature extraction and matching, palm prints 8 Unit 3 Face recognition: image acquisitions, face detection, feature extraction and matching, handling pose, illumination and expression variations 8 Unit 4 Iris recognition: image acquisition, Iris segmentation, Iris normalization, Iris encoding and matching, Iris quality assessment techniques 6 Unit 5 Additional Biometric Traits: Ear, Gait, Hand geometry, Soft biometrics Multimiometrics: sources of multiple evidence, fusion levels: sensor, feature, score, rank and decision level fusion 8 Unit 6 Security of biometric systems: adversary attacks, attacks at user interface, attacks on biometric processing, attacks on template database 6 References 1. Introduction to Biometrics, Anil K Jain Arun Ross, Springer 2. The Science of Biometrics, Ravindra Das, Springer 3. Practical

Biometrics, Julian Ashbourn, Springer 4. Introduction to Biometrics, Anil K Jain Arun Ross, Springer 84 Biometrics Lab Prerequisite: A basic knowledge of statistics, linear algebra, and programming is expected. L T P C 0 0 2 1 Course Content Familiarization with image processing toolbox, implementation of fingerprint recognition algorithms and systems, feature extraction and matching algorithms, design of face recognition systems, face detection, implementation of iris recognition systems, design of multimodal biometric system using fingerprint, face, speech, etc., fusion strategies, design of biometric system using other biometric traits (ear, gait, Hand geometry, etc.), Security of biometric systems, Mini project References 1. Introduction to Biometrics, Anil K Jain Arun Ross, Springer 2. The Science of Biometrics, Ravindra Das, Springer 3. Practical Biometrics, Julian Ashbourn, Springer 85 Computer Vision Prerequisite: Fundamental knowledge on image processing and machine learning, basics of linear algebra and calculus, and programming skills L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction to Computer Vision: Applications of Computer Vision, Basic concepts of Digital Image Formation, Capture and Representation, Pixel Relationships, Linear Filtering, Correlation, Convolution, Image in Frequency Domain, Fourier Transform 8 Unit 2 Visual Features and Representation: Edge, Corner Detection, SIFT, SURF, HoG, LBP, GLCM, etc. Feature Matching, Bag -of-words, VLAD, RANSAC, Hough Transform, Image Pyramids, 2D Transformations 12 Unit 3 Machine Learning for Computer Vision: Basic stages in Machine Learning, Image classification, Object Detection, Semantic Segmentation Overview of Machine Learning Algorithms: Neural Networks, Support Vector Machine (SVM), Dimensionality Reduction Techniques 6 Unit 4 Convolutional Neural Networks (CNNs): Introduction to CNNs, Evolution of CNN Architectures, Visualization and Understanding CNN CNNs for Different Computer Vision Tasks: Recognition, Detection, Segmentation, and Activity Recognition 8 Unit 5 Deep Generative Models in Vision: GANs, VAEs, etc. Modern Approaches: Attention Models in Vision, Vision Transformer (ViT) 8 References 1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010 2. Simon Prince, Computer Vision: Models, Learning, and Inference, 2012 3. Bishop, Christopher M, Pattern Recognition and Machine Learning, Springer, 2006 4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 2016 86 Computer Vision Lab Prerequisite: Fundamental knowledge on image processing, machine learning, and programming skills L T P C Total hours: 28 0 0 2 2 Course Content Hrs Unit 1 1. Familiarization with various computer vision tools 2. Basic operations on images and videos 3. Linear filtering and convolution 4. Implementation of different image transforms 8 Unit 2 1. Implementation of various feature descriptors (SIFT, SURF, HoG, LBP, GLCM, etc.) Edge Detection , Line Detection and Corner Detection 2. Edge detection , line detection and corner detection 3. Implementation of feature matching algorithms 10 Unit 3 1. Multi -layer Perceptrons, Backpropagation and its applications 2. Implementation of CNN architectures for various tasks such as classification, segmentation, object detection, etc., and transfer learning 3. Implementation of GAN and ViT models 4. Mini project 10 References: 1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010 2. Bishop, Christopher M, Pattern Recognition and Machine Learning, Springer, 2006 3. Ian Goodfellow, Yoshua

Bengio, Aaron Courville, Deep Learning, 2016 87 Data Analytics Prerequisite: Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential. L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Data Understanding and Preparation Introduction, Reading data from various sources, Data visualization, Distributions and summary statistics, Relationships among variables, Extent of Missing Data. Segmentation, Outlier detection, Automated Data Preparation , Combining data files, Aggregate Data, Duplicate Removal, Sampling DATA, Data Caching, Partitioning data, Missing Values Data : Gather, extract, analyse, and manipulate data to draw conclusions or insights. With algorithms and coding with dataset availabl e 10 Unit 2 Introduction to Data Mining: Classification - Naïve Bayes, Clustering - K means , Model development & techniques Data Partitioning, Model selection, Model Development Techniques, 10 Unit 3 Neural networks, Decision trees, Logistic regression, Discriminant analysis, Support vector machine, Bayesian Networks, Linear Regression, Logistic Regression, Association rules.. 10 Unit 4 Model Evaluation and Deployment Introduction, Model Validation, Rule Induction Using CHAID, Automating Models for Categorical and Continuous targets, Comparing and Combining Models, Evaluation Charts for Model Comparison, Meta Level Modelling, Deploying Model, Assessing Model Performance, Updating a Model. Visualisation 10 References 1. Daniel T. Larose and Chantal D. Larose, Discovering Knowledge in Data: An Introduction to Data Mining, 2nd Edition, Wiley, 2014. ISBN: 978 -0-470-90874 -7 2. Recommended Reading: Foster Provost and Tom Fawcett, Data Science for Business: What You Need to Know About Data Mining and Data -Analytic Thinking, O'Reilly, 2013. ISBN: 978 -1- 449-36132 -7

88 Data Analytics Lab Prerequisite: Python programming basics L T P C Total hours: 28 0 0 2 2 Course Content Hrs Unit 1 Visualization: a. Find the data distributions using box and scatter plot. b. Find the outliers using plot. c. Plot the histogram, bar chart and pie chart on sample data 4 Unit 2 Descriptive statistics in R a. Write an R script to find basic descriptive statistics using summary b. Write an R script to find subset of dataset by using subset Reading and writing different types of datasets a. Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk location. b. Reading Excel data sheet in R. c. Reading XML dataset in R. 6 Unit 3 Descriptive statistics in R a. Write an R script to find basic descriptive statistics using summary b. Write an R script to find subset of dataset by using subset Apply multiple regressions, if data have a continuous independent variable. Apply on above dataset. 6 Unit 4 a. Install relevant package for classification. b. Choose classifier for classification problem. c. Evaluate the performance of classifier. 6 Unit 5 Installing Hadoop, PIG, Hive, Visualizing Big data sets, Applying Parallel machine learning models to handle large scale data. 6 References: 1. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly Media, 2017. 2. Joshua N. Milligan, Learning Tableau: Create effective data visualizations, build interactive visual analytics and transform your organization, Packt Publishing Limited, 2020. 3. Nathan Marz, James Warren: Big Data: Principles and best practices of scalable realtime data systems, 2020. 89 Data Mining Prerequisite: : L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Overview of the Data Mining and

Knowledge Discovery from Databases Process, Data Warehousing and OLAP, Data Preprocessing: Summary Data Structures, imensionality Reduction 6 Unit 2 Association Rule Mining: Frequent Item set Mining Methods, Rule Generation, Interestingness Measures 6 Unit 3 Classification: Decision Trees, Instance Based, Support Vector Machines, Computational Learning Theory, Associative Classification 10 Unit 4 Clustering: Partitional, Hierarchical, Density Based, Grid Based, Advanced Methods 7 Unit 5 Sequence Mining Complex Data Mining 6 Unit 6 Web Mining: Information Retrieval, Link Analysis, Search Engines, Usage Analysis Data Mining Applications 7 References 1. 1. J. Han and M. Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann/Elsevier India, 3rd edition, 2011. 2. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Morgan Kaufmann, 2005, ISBN: 0 -12-088407 -0. 90 Data Mining Lab Prerequisite: L T P C Total hours: 28 0 0 2 2 Course Content Hrs Unit 1 Implementation of Data Pre -processing 4 Unit 2 Implementation of Association Rule Mining 4 Unit 3 Implementation of Decision Trees and Support Vector Machines 6 Unit 4 Implementation of Various Clustering Algorithms 8 Unit 5 Implementation of Sequence Mining Algorithms 2 Unit 6 Implementation of Web Mining Algorithms 4 References 1. 1. J. Han and M. Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann/Elsevier India, 3rd edition, 2011. 2. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Morgan Kaufmann, 2005, ISBN: 0 -12-088407 -0. 91 Decentralized Learning Prerequisite: Machine learning, deep learning, etc. L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit - I Challenges in Big Data and Traditional AI: Understanding nature of Big Data, Data privacy as a bottleneck, Impact of training Data and model bias, Model drift and performance degradation, FL as the main solution for a data problems. 4 Unit - II Introduction to Federated Learning: Understanding the current state of ML, Distributed Learning, Understanding of FL, FL system considerations, FL system architecture, Understanding of FL system flow: from initialization to continuous operations, Basics of secure aggregation, Different desi gns of FL (HFL, VFL, FTL, RFL). 8 Unit - III Systems and Frameworks : Statistical and Systems Heterogeneity, Statistical and Systems Heterogeneity, Variations of federated aggregations, Local Training and Scalability of Federated Learning Systems, Straggler Management, Systems Bias in Federated Learning, Frameworks of FL (F ATE, Flower, Tensorflow Federated(TFF), OpenFL, PySyft) 11 Unit - IV Privacy and Security: Data Leakage in Federated Learning, Differential Privacy within Federated Systems, Approach for protecting against Data Leakage, Private Parameter aggregation for Federated Learning, Security and Robustness to Federated Learning, Dealing with Byzantine threats to neural network. 11 Unit - V Decentralized learning for communication systems and blockchain for DL 6 References 1. Federated Learning with Python: Design and Implement a Federated Learning System and Develop Applications Using Existing Frameworks, George Jeno, Kiyoshi Nakayama, Packt Publishing, Limited, 2022. 2. Federated Learning: A Comprehensive Overview of Methods and Applications, Heiko Ludwig, Nathalie Baracaldo, Springer Nature, 2022. 3. The course materials are mainly from the lecturing slides I?ve made and research papers from top conferences like NDISS, USNIX, SIGCOMM, MOBICOM, NSDI, MobiSys etc. 92

Decentralized learning Lab Prerequisite: : The programming lab in python and ML tools L T P C Total hours: 36 0 0 2 2 Course Content Hrs The laboratory experiments conducted on various tools Lab 1 -3: Develop and FL setup using IOT devices and a sever setup to design FL average or other. Lab 3 -4: Collaborative Learning experiments using FL Lab 5 -9: Experiments on Data Model poisoning Lab 10 -12 : Projects on Decentralized learning 36 References 1. Federated Learning with Python: Design and Implement a Federated Learning System and Develop Applications Using Existing Frameworks, George Jeno, Kiyoshi Nakayama, Packt Publishing, Limited, 2022. 2. Federated Learning: A Comprehensive Overview of Methods and Applications, Heiko Ludwig, Nathalie Baracaldo, Springer Nature, 2022. 3. The course materials are mainly from the lecturing slides I?ve made and research papers from top conferences like NDISS, USNIX, SIGCOMM, MOBICOM, NSDI, MobiSys etc. 93 Embedded System Design Prerequisite: Compiler Design L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction to embedded systems., design representations, level of abstractions, design methodologies. Models and architectures, Taxonomy of models and architectures 8 Unit 2 Brief descriptions of specification languages, Specification requirement for embedded systems, Spec Chart and Spec Chart Description. Design challenges & issues, hardware and software design, co -design of software and hardware, ASIC 18 Unit 3 Design quality estimation: Quality matrix, software and hardware estimation. 8 Unit 4 Microcontroller 8051: Architecture, programming , interfacing and use cases, Instruction addressing modes, Interrupts, Counters and timers. Introduction to the ARM processors. 8 References 1. Embedded Systems: Real -Time Operating Systems for Arm Cortex -M Microcontrollers" by Jonathan Valvano 2. Embedded Systems: Design and Applications with the 68HC12 and HCS12" by Steven Barrett and Daniel Pack 3. Embedded Systems: A Contemporary Design Tool" by James K. Peckol

94 Embedded System Design Lab Prerequisite: Digital Logic Design L T P C Total hours: 28 0 0 2 2 Course Content Hrs Unit 1 Proteus Introduction: Introduce students to the basic circuit simulations and simulator user interface of Proteus. LED Blinking: Design a simple embedded system using a microcontroller to blink set of LEDs at the specific patterns. Vary the blinking pattern and observe the LEDs behaviour . LCD Display: Write programs in the C programming language to initialize the 16x2 LCD and display the message. The messages to displayed are defined in the code. 8 Unit 2 Keypad Interfacing: Design the hex keypad using push button then displayed the pressed key on the LCD. Next use the predefined he keypad module to implement simple calculator. Seven Segment Display: design the seven segment display using LEDs. Use predefined seven segment module and interface it with hex keypad to display the pressed digit on the display. Digital Counter: Design four digit increment and decrement digital counter using a microcontroller and display the count on a 7 -segment display. 10 Unit 3 Elevator Movement: Design the program to simulate the movement of elevator and display the floor numbers when keys are pressed inside the elevators or it moves. Quiz Buzzer: Design a quiz buzzer system that will act as the central controller for the quiz system, managing participant buzzers and increment the counter for the team who press the buzzer button first. Date & Time: D esign an

embedded system to display the current date and time on an LCD (Liquid Crystal Display) using a Real -Time Clock (RTC) module. 10 References: 1. Embedded Systems: Real -Time Operating Systems for Arm Cortex -M Microcontrollers" by Jonathan Valvano 2. Embedded Systems: A Contemporary Design Tool" by James K. Peckol 95 Full Stack Development Prerequisite: L T P C Total Hours : 42 3 0 0 3 Course Content Hrs Unit 1 Introduction to Full Stack Development: Overview of full stack development, roles and responsibilities of a full stack developer, Understanding the client -server architecture. Front -End Development Fundamentals: Introduction to HTML5, CSS3, JavaScript, jQuery, Bootstrap. Building web pages with styling, programming concepts, and syntax. DOM manipulation and event handling. Introduction to responsive design and mobile -first development. 10 Unit 2 Front -End Frameworks: Introduction to popular front -end frameworks (e.g., React, Angular, Vue.js). Building dynamic and interactive web applications using a framework of choice Components, state management, and routing in front -end frameworks. Working with APIs to fetch and update data Handling, form input and validation. 10 Unit 3 Back -End Development Fundamentals: Introduction to server -side programming languages (e.g., PHP, Node.js, Python), Working with HTTP protocols and RESTful APIs, Handling data persistence with databases (SQL or NoSQL - MongoDB, Cassandra), Creating server -side routes and handling requests, Im plementing user authentication and authorization. 8 Unit 4 Back -End Frameworks and APIs: Building server -side applications using a framework (e.g., Express, Django), Implementing APIs for data retrieval and manipulation, Database integration and querying, Securing APIs and implementing access control. Full Stack Frameworks: MEAN Stack (MongoDB, Express.js, Angular, Node.js), MERN Stack (MongoDB, Express.js, React, Node.js), LAMP Stack (Linux, Apache, MySQL, PHP). 8 Unit 5 Deployment and DevOps: Introduction to cloud platforms and hosting providers, Deploying web applications to cloud platforms, Continuous integration and deployment (CI/CD), Version control systems (e.g., Git) and collaboration tools. 6 References 1. "Full Stack JavaScript Development with MEAN" by Adam Bretz, Colin J. Ihrig, and Patrick Mulder (Publisher: Manning Publications, 2016) 2. "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node" by Vasan Subramanian (Publisher: Apress, 2019) 3. "Full Stack Development for Beginners: Learn React, Node.js, MongoDB, and TypeScript" by Jonas Fehre (Publisher: Packt Publishing, 2021) 4. "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics" by Jennifer Niederst Robbins (Publisher: O'Reilly Media, 2018) 96 5. "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage" by Kristina Chodorow (Publisher: O'Reilly Media, 2013) 6. "JavaScript and jQuery: Interactive Front -End Web Development" by Jon Duckett (Publisher: Wiley, 2014) 7. "PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide" by Larry Ullman (Publisher: Peachpit Press, 2017) 8. "Bootstrap 4 Quick Start: A Beginner's Guide to Building Responsive Layouts with Bootstrap 4" by Jacob Lett (Publisher: Packt Publishing, 2018) 97 Full Stack Development Lab Prerequisite: . L T P C Hrs: 28 0 0 2 2 Course Content Hrs Unit 1 Creation of basic web pages/applications using HTML and CSS. Write JavaScript code to create interactive elements on a webpage, such as buttons, forms, and event handling. Use server -side languages like Node.js, Python (with Flask/Django), or Ruby (with Ruby on Rails) to create a basic web application. Integrate a database (e.g., MySQL, PostgreSQL, MongoDB) with your web application to store and retrieve data. Implement user registration and login functionality using authentication techniques such as JWT (JSON Web Tokens) or OAuth. Create a RESTful API that allows users to perform CRUD (Create, Read, Update, Delete) operations on resources. 10 Unit 2 Use popular front -end frameworks like React, Angular, or Vue.js to build more dynamic and interactive web applications. Build a single -page application that communicates with the backend through APIs and updates the UI without full page reloads. Implement state management in your front -end application using tools like Redux or Vuex. Ensure your web application looks and functions well on different devices and screen sizes. Write unit tests for your code and debug common issues in both the front -end and back -end. 10 Unit 3 Deployment and Hosting: Deploy your full -stack application to a cloud platform (e.g., AWS, Azure, Heroku) and make it publicly accessible. Version Control: Use Git for version control to manage changes to your codebase effectively. Real-time Features: Integrate real -time communication features using technologies like WebSockets or WebRTC. Security Considerations: Implement security best practices to protect your application from common web vulnerabilities (e.g., Cross -Site Scripting, SQL Injection). 8 References 1. "Full Stack JavaScript Development with MEAN" by Adam Bretz, Colin J. Ihrig, and Patrick Mulder (Publisher: Manning Publications, 2016) 2. "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node" by Vasan Subramanian (Publisher: Apress, 2019) 3. "Full Stack Development for Beginners: Learn React, Node.js, MongoDB, and TypeScript" by Jonas Fehre (Publisher: Packt Publishing, 2021) 4. "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics" by Jennifer Niederst Robbins (Publisher: O'Reilly Media, 2018) 98 5. "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage" by Kristina Chodorow (Publisher: O'Reilly Media, 2013) 6. "JavaScript and jQuery: Interactive Front -End Web Development" by Jon Duckett (Publisher: Wiley, 2014) 7. "PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide" by Larry Ullman (Publisher: Peachpit Press, 2017) 8. "Bootstrap 4 Quick Start: A Beginner's Guide to Building Responsive Layouts with Bootstrap 4" by Jacob Lett (Publisher: Packt Publishing, 2018) 99 Information Retrieval Prerequisite: nil L T P C Total hours: 40 3 0 0 3 Course Content Hrs Unit 1 Introduction: Goals and history of IR. The impact of the web on IR. Basic IR Models: Boolean and vector -space retrieval models; ranked retrieval; text -similarity metrics; TF -IDF (term frequency/inverse document frequency) weighting; cosine similarity. Basic Tokenizing, Indexing, and Implementation of Vector -Space Retrieval: Simple tokenizing, stop-word removal, and stemming; inverted indices; efficient processing with sparse vectors; 8 Unit 2 Performance metrics: recall, precision, F -measure, and NPCG; Evaluations on benchmark text collections. Query Operations: Relevance feedback; Query expansion. Text Representation: Word statistics; Zipf's law; Porter stemmer; morphology; index term selection; using thesauri. 8 Unit 3 Web Search: Search engines; spidering; meta -crawlers; directed spidering; link analysis , HITS, hubs and authorities, Google PageRank); Text Categorization: Categorization algorithms: Rocchio, nearest neighbor 8 Unit 4 Text

Classification :Language -Model Based Retrieval : Using naive Bayes text classification for ad hoc retrieval. Improved smoothing for document retrieval. Text Clustering: Clustering algorithms: agglomerative clustering; k -means; expectation maximization (EM). Applications to web search and information organization. Recommender Systems: Read this paper by Herlocker et al. Collaborative filtering and content -based recommendation of documents and products. 8 Unit 5 Recommender Systems: Collaborative filtering and content -based recommendation of documents and products. Ethical Issues in IR: Privacy, Fairness, Fake news and disinformation, Filter bubble, Viewpoint diversity, fostering extremism, Internet addiction. Information Extraction and Integration: Extracting data from text; semantic web; collecting and integrating specialized information on the web. Question Answering: Semantic parsing. Question Answering from structured data and text. Deep Learning for IR: Word embeddings. Neural language models. 8 References 1. Modern Information Retrieval, Ricardo Baeza -Yates and Berthier Ribeiro -Neto, Addison - Wesley, 2000. http://people.ischool.berkeley.edu/~hearst/irbook/ 2. Information Retrieval: Implementing and Evaluating Search Engines by S. Buttcher, C. Clarke and G. Cormack, MIT Press, 2010. 3. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by B. Liu, Springer, Second Edition, 2011. 4. Cross -Language Information Retrieval by By Jian -Yun Nie Morgan & Claypool Publisher series 2010 5. Multimedia Information Retrieval by Stefan M. Rüger Morgan & Claypool Publisher series 2010. 6 Ricci, F.; Rokach, L.; Shapira, B.; Kantor, P.B. (Eds.), Recommender Systems Handbook. 1st Edition., 2011, 845 p. 20 illus., HarPCover, ISBN: 978 -0-387-85819 -7, Relevant Research Papers 100 Information Retrieval Lab L T P C Total hours: 28 0 0 2 2 Course Content Hrs Assignment 1 Pre-processing of a Text Document: Stop word removal, Stemmer, Lemmatizer, Cosine -Similarity Measure using TF -IDF 4 Assignment 2 Document similarity using Boolean Model / Extended Boolean Model / Vector Space Model 4 Assignment 3 Inverted Index and postings 2 Assignment 4 Simple web crawler 2 Assignment 5 Terrier search engine 4 Assignment 6 Parse XML text, generate Web graph and compute topic specific page rank - Page Rank Algorithm 4 Assignment 7 Mining Flipkart review and perform sentiment analysis based on both review and ratings. 4 Assignment 8 Perform movie recommendation system by scrapping real -time movie rating from imdb website. 4 References: 1. https://www.analyticsvidhya.com/blog/2021/09/essential -text-pre-processing -techniques -for-nlp/ https://www.kaggle.com/code/sudalairajkumar/getting -started -with-text-preprocessing 2. https://minoli110.medium.com/use -of-vector -space -model -vsm-to-calculate -the-similarity - between -2-text-documents -3dfb31138fc2 https://github.com/manan -paneri -99/Vector -Space -based -Document -Retrieval -system https://www.geeksforgeeks.org/document -retrieval -using -boolean -model -and-vector -space -model/ 3. https://medium.com/@fro_g/writing -a-simple -inverted -index -in-python -3c8bcb52169a https://towardsdatascience.com/using -inverted -index -for-efficient -document -similarity - computation -a8d3fb8f0c12 4. https://towardsdatascience.com/web -scraping -with-scrapy -8071fd627051 https://towardsdatascience.com/https -towardsdatascience -com-5-tips-to-create -a-more -reliable - web-crawler -3efb6878f8db 5.

http://terrier.org/docs/v2.2.1/index.html https://github.com/terrier -org/terrier -core 6. https://www.geeksforgeeks.org/xml -parsing -python/ https://towardsdatascience.com/pagerank -3c568a7d2332 7. https://www.analyticsvidhya.com/blog/2022/09/sentiment -analysis -on-flipkart -dataset/ https://machinelearningprojects.net/flipkart -reviews -extraction -and-sentiment -analysis/ 8. https://www.geeksforgeeks.org/scrape -imdb -movie -rating -and-details -using -python/ https://janineb.medium.com/movie -recommendation -system -d6aa8583cdb 101 Internet of Things Prerequisite: Nil L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction: Internet of Things and Connected Products, IoT paradigm, Smart objects, Goal orientation, Convergence of technologies; Business Aspects of the Internet of Things. IoT Architectures and Protocols: Importance, Communication models in IoT, Layer s in IoT architecture, Role of protocols in IoT communication. 6 Unit 2 Wireless Technologies for IoT: Wi -Fi and 802.15.x family - features, range, power consumption; Zigbee: Network topology, mesh networking, Zigbee stack, LoRaWAN, SigFox, Cellular technologies for IoT (2G, 3G, 4G, NB -IoT, 5G). Latest developments in communic ation technologies. 8 Unit 3 IoT Network Topologies: Overview (star, mesh, hybrid, etc.), selection based on advantages and limitations. Network Protocols: overview of IoT network protocols. IPv6 and its significance in IoT addressing, 6LoWPAN - IPv6 over Low-power Wireless Personal Area Networks, Header Compression. RPL - overview and operation, Case studies of network protocols in IoT deployments. 10 Unit 4 IoT Application Protocols: Introduction (MQTT, CoAP, HTTP, etc.), Comparison of IoT protocols (features, performance, scalability), MQTT - Concepts, message structure, QoS levels, CoAP - Principles, RESTful architecture, resource discovery, HTTP in IoT - Web services, REST APIs, JSON/XML data formats. Data: OMA Lightweight M2M (LwM2M) protocol, OPC Unified Architecture (OPC UA), BACnet, Modbus. Data Protocols and Formats: IoT data formats (JSON, XML, CBOR, Protocol Buffers) . IoT Standards and Interoperability 10 Unit 5 IoT Security Protocols: Security challenges and threats in IoT, Secure communication protocols for IoT (DTLS, TLS, IPsec), Authentication and access control in IoT, Security protocols for device management and firmware updates, Privacy protection and data encryption in IoT. 4 Unit 6 Emerging Trends: Blockchain, 5G and its impact, IoT and edge -cloud integration, latest advancements in IoT architectures and protocols. 4 References 1. The Internet of Things: Key Applications and Protocols, David Boswarthick, OlivierHersent, and Omar Elloumi, Wiley. 2. Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley. 3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, and Florian Michahelles, Springer. 4. Latest research articles. 102 Internet of Things Lab Prerequisite: L T P C Total hours: 28 0 0 2 1 Course Content Hrs Unit 1 Setting up communication using XBEE and BLE. Data Exchange and interfacing Sensors 8 Unit 2 Programming on Cooja and CoAP Setting up CoAP on programmable boards. 10 Unit 3 Using CoAP to set up communication. Implementation of homogeneous and heterogeneous networks. Data processing on application layer. 10 References: 1. Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley. 2. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, and Florian

Michahelles, Springer. 3. Latest research articles. 103 IoT based Robotics Prerequisite: Nil L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction to IoT and Robotics: Overview of IoT and Robotics; Historical development of IoT and Robotics; Applications of IoT and Robotics; Types of IoT devices; Types of Robotics; 6 Unit 2 Introduction to the Internet of Things. Protocols and Architectures. IoT Hardware: IoT devices and sensors; IoT networks and communication protocols; IoT gateways and controllers; IoT platforms and services 10 Unit 3 IoT Software: Introduction to IoT protocols; IoT data management and analytics; IoT security and privacy; IoT programming and development; 8 Unit 4 Robotics Fundamentals: Robotics history and evolution; Robotics components and structure. Robotics Hardware: Types of robots and their applications; Robotics sensors and actuators; Robotics control systems; Robotics power systems. Robotics Software: Robotics programming and development; Robotics motion planning and control; Robotics perception and vision; Robotics intelligence and autonomy. 10 Unit 5 Robotics Applications: Industrial Robotics; Service Robotics; Medical Robotics 4 Unit 6 IoT and Robotics Integration: Use cases and examples; Challenges and opportunities; Future trends and directions 4 References 1. The Internet of Things: Key Applications and Protocols, David Boswarthick, Olivier Hersent, and Omar Elloumi, Wiley 2. Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley 3. Learn Robotics Programming, Danny Staple, Packt Publishing, 2nd ed. 4. Robotics Simplified, Jisu Elsa Jacob and Manjunath N, BPB Publications. 104 IoT based Robotics Lab Prerequisite: L T P C Total hours: 28 0 0 2 1 Course Content Hrs Unit 1 Setting up communication using XBEE and BLE. Data Exchange and interfacing Sensors 8 Unit 2 Interfacing with Actuators. Programming Motion and automation. Controller based interfacing. 10 Unit 3 Visual interfacing and controlling motion. Analysis of robotic arm and conveyor belts. 10 References: 1. Learn Robotics Programming, Danny Staple, Packt Publishing, 2nd ed. 2. Robotics Simplified, Jisu Elsa Jacob and Manjunath N, BPB Publications. 105 Natural Language Processing Prerequisite: L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is DifficultParts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory : Entropy, perplexity, The relation to language, Cross Entropy, Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Fini te State transducer. 6 Unit 2 Language Modelling, Words: Collocations - Frequency -Mean and Variance –Hypothesis testing:The t test, Hypothesis testing of differences, Pearson’s chi -square test, Likelihood ratios. Statistical Inference: n –gram Models over Sparse Data: Bins: Forming Equivalence Classes - N gram model – Statistical Estimators - Combining Estimators 6 Unit 3 Word Sense Disambiguation, Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, An informationtheoretic approach, Dictionary - Based Disambiguation: Disambiguation based on sense, Thesaurusbased disambiguation, Disambiguation ba sed on translations in a second -language corpus. 6 Unit 4 Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging 6 Unit 5 Parsing, The Probability of a String, Problems with the Inside -Outside Algorithm, Parsing for disambiguation, Treebanks, Parsing models vs. language models, Phrase structure grammars and dependency, Lexicalized models using derivational histories, Dependency -based models. 8 Unit 5 Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information ex traction, Text mining, Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Social network analysis, Text Summarization. 10 References 1. D. Jurafsky, J.H. Martin, Speech and Language Processing, 3rd Online Edition (available at https://web.stanford.edu/~jurafsky/slp3/). 2. J. Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019. 106 Natural Language Processing Lab Prerequisite: L T P C Total hours: 28 0 0 2 2 Course Content Hrs Unit 1 Implementation of Pre -processing of Text (Tokenization, Stop word Removal, Stemming and Lemmatization etc.) and Morphological Analysis 6 Unit 2 Implementation of N -gram Models 4 Unit 3 Implementation of Word Sense Disambiguation 2 Unit 4 Implementation of POS Tagging and Named Entity Recognition 6 Unit 5 Implementation of CKY Parsing and Mini Project 10 References 1. D. Jurafsky, J.H. Martin, Speech and Language Processing, 3rd Online Edition (available at https://web.stanford.edu/~jurafsky/slp3/). 2. J. Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019. 107 Program Analysis Prerequisite: Operating system, Computer Architecture and organization L T P C Total Hours: 42 3 0 0 3 Course Content Hrs Unit 1 Structure of a program, data flow and control flow, basic blocks, forward and backward flow analysis; Program Analysis Tools: debuggers, disassemblers, decompilers, emulators, virtualized environments 8 Unit 2 Dataflow Analyses and Transformations; Control Dependence Graph, Inter -procedural analysis, Program Analysis via Graph Reachability 8 Unit 3 Program Analysis Techniques: Static analysis, Dynamic analysis, Instrumentation, Hybrid analysis, Automatic Generation of High -Coverage Tests for Complex Systems Programs, Input fuzzing, 8 Unit 4 Control -flow analysis; Abstract interpretation; Symbolic execution and program testing, Mixing type checking and symbolic execution; Model checking 8 Unit 5 Case Study: C, JAVA, .apk, .elf for program analysis 10 References 1. Nielson, Nielson, and Hankin: Principles of Program Analysis, Springer. 2. Ravi Sethi, Alfred V. Aho, Monica S. Lam, D. Jeffrey Ulman: Compilers : Principles, Techniques, & Tools, 2nd Edition, Pearson 3. Muchnick: Advanced Compiler Design and Implementation, Morgan Kaufmann. 4. Published articles from reputed Journals and Conferences. 5. "Program Analysis and Compilation: Theory and Practice" by Thomas Reps, Mooly Sagiv, and J. Lim. (Year: 1997, Publisher: MIT Press) 6. "Program Analysis for Software Tools and Engineering" by Thomas Reps. (Year: 2007, Publisher: Springer) 7. "Data Flow Analysis: Theory and Practice" by Uday P. Khedker. (Year: 2015, Publisher: CRC Press) 8. "Formal Methods for Software Verification" by Grigore Rosu and Klaus Havelund. (Year: 2018, Publisher: CRC Press) 108 Program Analysis Lab

Prerequisite: L T P C Total hours: 28 0 0 2 1 Course Content Hrs. Unit 1 1) Analyze the program to identify any potential code optimization opportunities. a) Write a program that contains multiple nested conditional statements (if, else if, else). b) Use Egypt tool to create a flow graph of this program. Visualize the graph using Graphviz and SVG. 2) Design and implement a control flow analysis for detecting potential null pointer dereferences in each C/C++ codebase using the "Clang Static Analyzer" tool. a) Choose a C/C++ codebase (your project or open -source project) with multiple occurrences of pointer usages and potential null pointer dereferences. Use the "Clang Static Analyzer" to perform control flow analysis on the selected codebase. b) Identify expressions or code paths where the "Clang Static Analyzer" detects potential null pointer dereferences. c) Note the location of potential null pointer dereferences identified by the tool. 3) Implement dynamic program analysis techniques to look for the pointers and array during runtime. a) Generate a program flow during runtime using dynamic binary analysis tool. b) Note the location of pointers and array identified by the tool. 4) Implement program analysis using emulators. a) Write a simple C program that simulates a basic calculator. b) Choose a suitable emulator tool (e.g., QEMU, Bochs, VirtualBox, etc.) and install it on your machine. c) Compile the C program for the target architecture compatible with the emulator environment. d) Run the program within the emulator environment. e) Use the emulator's debugging and monitoring features to analyse the program's execution. f) Find out the entry point of the program. g) Trace the flow of the program execution, including function calls and return statements, using the emulator's tracing features. 5) Perform backward flow analysis using cflow to identify reaching definitions for each variable. Determine which assignments may influence the value of a variable at a particular point in the program. a) Write a C program that includes assignments to variables and multiple points where variables are used and modified. b) Execute the C program with cflow to perform backward flow analysis. c) Observe the output generated by cflow, which represents the reaching definitions for each variable at different points in the program. d) Identify and list the assignments that may influence the value of a variable at a particular point in the program. 6) Implement binary structure analysis on a compiled executable. a) Choose a compiled binary your project or open -source binary. b) Select the tool for examining ELF file. c) Use the selected tool to analyse the binary and identify the number of registers used by the program. d) Determine the entry point of the binary using the selected tool. The entry point is where the program's execution begins. e) Examine the various sections of the binary (code section, data section, symbol table). 8 109 7) Implement a C program that takes input from users or external sources. Use fuzz testing tools to generate random or invalid inputs and analyse how the program handles such inputs. a) Write the C code for the program that takes input from users or external sources. b) Choose a fuzz testing tool (e.g., American Fuzzy Lop (AFL), libFuzzer) and install it on your system. c) Modify the C program to accept input from the fuzz testing tool rather than traditional user input. d) Execute the fuzz testing tool with the modified C program as the target. e) Monitor the C program's behavior during the fuzz testing process. Identify any crashes, exceptions, or unexpected outputs. f) Examine the logs or reports generated by the fuzz testing tool after the testing process 8) Write a C program with several functions and use cflow to generate the function call graph. Identify the functions that have the most dependencies (incoming and outgoing calls) and assess their importance in the program. Consider how reducing dependenci es could improve code maintainability. a) Write a C program with several functions that demonstrate function call interactions. b) Use cflow to generate the function call graph for the C program. c) Visualize the call graph to analyse the relationships between functions. d) Find out the high control dependencies in the program. References: 1. Nielson, Nielson, and Hankin: Principles of Program Analysis, Springer. 2. Ravi Sethi, Alfred V. Aho, Monica S. Lam, D. Jeffrey Ulman: Compilers : Principles, Techniques, & Tools, 2nd Edition, Pearson 3. Muchnick: Advanced Compiler Design and Implementation, Morgan Kaufmann. 4. Published articles from reputed Journals and Conferences. 5. "Program Analysis and Compilation: Theory and Practice" by Thomas Reps, Mooly Sagiv, and J. Lim. (Year: 1997, Publisher: MIT Press) 6. "Program Analysis for Software Tools and Engineering" by Thomas Reps. (Year: 2007, Publisher: Springer) 7. "Data Flow Analysis: Theory and Practice" by Uday P. Khedker. (Year: 2015, Publisher: CRC Press) 8. "Formal Methods for Software Verification" by Grigore Rosu and Klaus Havelund. (Year: 2018, Publisher: CRC Press) 110 Social Network Analysis Prerequisite: Data Structures and Algorithms L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Basics of Graph Theory: Basic definitions of graphs and multigraphs; adjacency matrices, independent sets and cliques, vertex colouring, chromatic number, matching, vertex cover, edge cover, independent set, cut -set, spanning trees. 8 Unit 2 Network Models: Properties of Real -World Networks: Degree Distribution, Clustering Coe■cient, Average Path Length. Random Graphs, Small -World Model, Preferential Attachment Model, Modeling of Real -World Networks using Random Graphs, Small -World Model and Preferential Attachment Model 8 Unit 3 Network Centrality: Degree Centrality, Eigenvector Centrality, PageRank, Centrality, Closeness Centrality. 4 Unit 4 Basics of Deep Learning: Basic terminologies, Artificial Neural Networks (ANN) and their limitations, Convolution Neural Networks (CNNs), Limitations of CNNs on graph data 6 Unit 5 Deep Learning on Graphs: Theory of Graph Neural Networks (GNNs) (Graph Convolution Network (GCN), Graph Attention Network (GAT) and GraphSAGE), Semi supervised Node classification using GNNs, Real life applications of GNNs (including Google Maps, Pinterest) 8 Unit 6 Applications of Graph Neural Networks for Network Analysis: Node classification, Link Prediction, Recommendations, Community Detection, MRI analysis, NLP related applications. 8 References 1. Social media mining: an introduction, Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. Cambridge University Press, 2014. 2. Networks, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg, Cambridge University Press. 3. Networks: An introduction by Mark Newman, Oxford university press, 2018. 4. Graph Representation Learning by William L. Hamilton, 2020. 111 Social Network Analysis Lab Prerequisite: Data Structures and Algorithms L T P C Total hours: 28 0 0 2 1 Course Content Hrs Unit 1 Graph Representation and Analysis: • Constructing adjacency matrices for given graphs and multigraphs. • Identifying independent sets and cliques in a network. • Investigating the chromatic number and vertex coloring of a graph. • Finding matching, vertex cover, and edge cover in various graphs. • Analyzing cut -sets and spanning trees in a network. 4 Unit

2 Real-World Network Properties: • Analyzing degree distributions in real -world networks. • Calculating clustering coefficients and average path lengths of networks. • Generating random graphs using different algorithms (e.g., Erd■s -Rényi model). • Simulating small -world networks and comparing them with real -world networks. • Building networks based on preferential attachment and studying their properties. 4 Unit 3 Network Centrality Analysis: • Calculating degree centrality for nodes in a given network. • Implementing eigenvector centrality and PageRank algorithms. • Comparing different centrality measures and their outcomes. • Identifying influential nodes in social networks using centrality measures. • Analyzing closeness centrality and its impact on information flow. 4 Unit 4 Deep Learning Basics: • Implementing a simple artificial neural network (ANN) for classification. • Implementing convolutional neural networks (CNNs) for some real life application(s). 4 Unit 5 Graph Neural Network Implementation: • Implementing a basic Graph Convolution Network (GCN) from scratch. • Building a Graph Attention Network (GAT) and understanding its attention mechanism. • Developing a GraphSAGE model for node representation learning. • Comparing the performance of GNNs with traditional methods for node classification. 6 Unit 6 Real-Life Applications of GNNs: • Performing node classification using GNNs on benchmark datasets. • Predicting missing links in a given network using link prediction techniques. • Building a recommendation system based on GNN embeddings. • Detecting communities in social networks using GNN -based algorithms. 6 112 • Exploring how GNNs can be applied to analyze networks in MRI data and NLP tasks. References 1. Social media mining: an introduction, Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. Cambridge University Press, 2014. 2. Networks, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg, Cambridge University Press. 3. Networks: An introduction by Mark Newman, Oxford university press, 2018. 4. Graph Representation Learning by William L. Hamilton, 2020. 113 Software Testing Prerequisite: Software Engineering L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Introduction : Software Testing, Importance of testing, Roles and Responsibilities, Testing Principles, Attributes of Good Test, V -Model, Test Case Generation, SDLC Vs STLC . 8 Unit 2 Types of Testing: Unit Testing, Integration Testing, System Testing, Regression Testing, Acceptance Testing, Functional/Non Functional Testing, Static and Dynamic Testing Categorization of testing methods : Manual Testing, Automation Testing and Automated Testing Vs. Manual Testing, Testing Tools. 6 Unit 3 Non Functional Testing: Performance Testing, Load Testing, Security Testing, Scalability Testing, Compatibility Testing, Stress Testing, Installation Testing. 6 Unit 4 Software Testing Methodologies: Validation & Verification, White Box Testing, Black Box Testing, Grey Box Testing. White/Glass Box Testing: Statement Coverage Testing, Branch Coverage Testing, Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing, Mutation testing, Data Flow Testing. Black Box Testing: Boundary Value Analysis, Equivalence Class Partition, State Based Testing, Cause Effective Graph, Decision Table. 6 Unit 5 Software Testing Life Cycle: Requirements Analysis, Test Planning, Objective, Scope of Testing, Schedule, Approach, Roles & Responsibilities, Assumptions, Risks & Mitigations, Entry & Exit Criteria, Test Automation, Deliverables. 8 Unit 6 Test Cases Design : Write Test

cases, Review Test cases, Test Cases Template, Types of Test Cases, Difference between Test Scenarios and Test Cases, Test Oracle, Test Environment setup, Understand the SRS, Hardware and software requirements, Test Data. 8 References 1. A.P. Mathur, " Foundations of Software Testing", Pearson publications. 2. Naresh Chauhan , “Software Testing Principles and Practices ” Oxford University Press, New Delhi. 3. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education. 114 Software Testing Lab Prerequisite: Software Engineering L T P C Total hours: 28 0 0 2 1 Course Content Hrs Unit 1 Study of Software Testing Automation Tools: Unit Testing (e.g. JUnit, CPPunit), Test Case Generation and Test Coverage. 8 Unit 2 Functional Testing using Automated Tools (e.g. selenium), Coverage Analysis, Test Sequence Generation and Validation. 10 Unit 3 Performance Testing using Automated Tools (e.g JMeter), Load Testing, Acceptance Testing, Mutation Testing, Defect Management. 10 References: 1. Book -1 : Foundations of Software Testing, by Aditya P. Mathur (Pearson) 2. Book -2: Software Testing: Principles and Practices, by Srinivasan Desikan and Gopalaswamy Ramesh (Pearson) 3. Book -3: Software Testing, by Yogesh Singh (Cambridge) 115 Topics in Computing Prerequisite: Operating Systems, Computer Networks, DBMS, Algorithms L T P C Total hours: 42 3 0 0 3 Course Content Hrs Unit 1 Cloud Computing: Virtualization and Containerization, Cloud Computing, Docker, Hypervisors 7 Unit 2 High Performance Computing: Big Data and Analytics, Data Science 7 Unit 3 Modern Networking: Internet of Things, Mobile Edge Computing, SDN and NFV 7 Unit 4 Distributed Ledger Technology: Blockchain, Bitcoin, Ethereum, Mining, Proof of Work, Proof of Stake, Wallets, Atomic Swap 7 Unit 5 Security Computing: Darknets, Deep and Dark Web, The Onion Routing 7 Unit 6 Quantum Computing: 7 References 1. William Stalling, “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud”, Addison - Wesley Professional, ISBN: 9780134175478 2. Kai Hwang, Jack Dongarra, Geoffrey C. Fox, “Distributed and Cloud Computing: From Parallel Processing to the Internet of Things” · 2013, Elsevier Science, ISBN: 9780128002049 3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies” Princeton University Press ISBN: 9781400884155 4. Documentation from torproject.org 116 Topics in Computing Lab Prerequisite: L T P C Total hours: 28 0 0 2 1 Course Content Hrs Assignment 1 Virtualization 2 Assignment 2 Virtual Machine Introspection 2 Assignment 3 Cloud Software Setup (OpenStack) 4 Assignment 4 Hadoop Ecosystem Setup 4 Assignment 5 Software Defined Network Setup 4 Assignment 6 Internet of Things: Environmental Setup 4 Assignment 7 Blockchain Implementation 4 Assignment 8 Quantum Computing Handson 4 References: 1. https://help.ubuntu.com/community/Xen https://help.ubuntu.com/community/KVM/Installation http://www.ubuntu.com/download/desktop http://www.centos.org/download/ 2. https://code.google.com/archive/p/insight -vmi/ 3. http://docs.openstack.org/icehouse/install -guide/install/yum/content/ 4. https://hadoopecosystemtable.github.io/ https://hadoop.apache.org/ 5. http://networkstatic.net/how -to-build -an-sdn-lab-without -needing -openflow -hardware/ http://networkstatic.net/openflow -openvswitch

-and-kvm-sdn-lab-installation -app/ 6. http://www.nimbits.com/howto_install.jsp https://thingspeak.com/ https://www.paraimpu.com/ https://www.contiki -ng.org/ 7. https://www.javatpoint.com/blockchain -java https://www.javatpoint.com/building -a-blockchain -using -python 8. https://qiskit.org/documentation/index.html 117 Topics in Operating Systems Total Hours L T P C 42 3 0 0 3 Prerequisite: Fundamentals of Operating Systems and Computer Organization and Architecture Course Content Hrs Unit 1 Review of Operating System, Virtual Machines: Overview, Types of VMs and Their Implementations, Virtualization and Operating -System Components; Hypervisors 8 Unit 2 Design issues of Distributed OS, Distributed v/s network operating system. process management, inter -process communication, scheduling, deadlocks Communication: Client Server, RPC; Distributed Concurrency, Transactions. Design and implementation of distributed file systems, DFS Naming and Transparency, Remote File Access distributed shared memory 10 Unit 3 Embedded Operating System: ARM architecture, interrupts and exceptions; Process management, process synchronization, Threads, Memory management - paging, I/O buffer management, File systems 10 Unit 4 Real time Operating System: Scheduling, design principles, Uniprocessor real -time OS, Multi -processor real -time OS 8 Unit 5 Mobile Operating System: Android as a case study 6 References 1. "Operating System Internals and Design Principles" by William Stallings (9th Edition, 2021) 2. "Modern Operating Systems" by Andrew S. Tanenbaum and Herbert Bos (4th Edition, 2014) 3. "Operating System Concepts" by Abraham Silberschatz, Greg Gagne, and Peter B. Galvin (10th Edition, 2018) 4. "The Design and Implementation of the FreeBSD Operating System" by Marshall Kirk McKusick, George V. Neville -Neil, and Robert N.M. Watson (2nd Edition, 2015) 5. Published articles from reputed Journals and Conferences. 118 Topics in Operating Systems Lab Total Hours L T P C 28 0 0 2 2 Prerequisite: Fundamentals of Operating Systems and Computer Organization and Architecture Course Content Hrs Unit 1 - Install different operating systems (e.g., Windows, Linux distributions) on virtual machines to understand the installation process and gain familiarity with various OS environments. - Set up virtual networks with multiple VMs to learn about IP addressing, subnetting, DHCP, and DNS configurations. - Create vulnerable VMs and practice ethical hacking or penetration testing techniques to identify and fix security vulnerabilities. -Experiment with Docker to create, deploy, and manage containers for various applications and services. -Create VM clusters to simulate high availability and load -balancing scenarios for critical services. -Practice deploying virtual machines on cloud platforms like AWS, Azure, or Google Cloud to understand cloud infrastructure. -Explore container orchestration tools like Kubernetes and deploy multi -container applications on virtual machines. -Experiment with nested virtualization, where you run virtual machines inside virtual machines. 12 Unit 2 -Create a cluster of computers using a distributed OS like Linux -based ones (e.g., CentOS, Ubuntu) or specialized distributions like Beowulf. Learn how to configure the network and set up intercommunication between cluster nodes. -Implement load -balancing algorithms to distribute computational tasks evenly across nodes in the cluster, improving system performance. -Set up and experiment with distributed file systems like Hadoop Distributed File System (HDFS) or GlusterFS to understand data storage and retrieval across the cluster. - Run parallel processing tasks across the cluster using tools like Apache Spark or MPI (Message Passing Interface) to solve computationally intensive problems. - Research and test various distributed algorithms, such as leader election, consensus protocols (e.g., Paxos, Raft), and distributed data structures (e.g., distributed hash tables). 10 Unit 3 -Write a simple C program on your host computer that prints "Hello, Embedded World!" (or any other basic functionality) to the console. -Use the ARM cross -compiler toolchain to cross -compile the C program for the ARM architecture. This will generate an ARM executable binary. -Create multiple tasks with different priorities and execution times using RTOS APIs. 6 References 1. "Operating System Internals and Design Principles" by William Stallings (9th Edition, 2021) 2. "Modern Operating Systems" by Andrew S. Tanenbaum and Herbert Bos (4th Edition, 2014) 3. "Operating System Concepts" by Abraham Silberschatz, Greg Gagne, and Peter B. Galvin (10th Edition, 2018) 119 4. "The Design and Implementation of the FreeBSD Operating System" by Marshall Kirk McKusick, George V. Neville -Neil, and Robert N.M. Watson (2nd Edition, 2015) 5. Published articles from reputed Journals and Conferences. 120 Pool 3: Honors Electives: 3 -0-0 (Credits 3) Honors Electives Credit L T P 1. Advances in Compiler Design 3 3 0 0 2. Android Programming 3 3 0 0 3. Big Data Analytics 3 3 0 0 4. Cloud Security 3 3 0 0 5. Cyber Security 3 3 0 0 6. Data Compression 3 3 0 0 7. Data Visualization 3 3 0 0 8. Digital Forensic 3 3 0 0 9. Distributed Systems 3 3 0 0 10. E-commerce 3 3 0 0 11. Embedded System Security 3 3 0 0 12. Hardware Software Codesign 3 3 0 0 13. Image Analysis 3 3 0 0 14. Intrusion Detection 3 3 0 0 15. Neural Network 3 3 0 0 16. Network on Chip 3 3 0 0 17. Network Performance Modeling 3 3 0 0 18. Parallel Processing & Algorithms 3 3 0 0 19. Parallelizing Compiler 3 3 0 0 20. Pattern Recognition 3 3 0 0 21. Public Key Infrastructure and Trust Management 3 3 0 0 22. Quantum Computing 3 3 0 0 23. Quantum Cryptography 3 3 0 0 24. Real Time Systems 3 3 0 0 25. Robotics and Control 3 3 0 0 26. Security Analysis of Protocols 3 3 0 0 27. Selected Topics in Cryptography 3 3 0 0 28. Social Media Mining 3 3 0 0 29. Software Project Management 3 3 0 0 30. System on Chip 3 3 0 0 31. Wireless Sensor Networks 3 3 0 0 121 Advances in Compiler Design Prerequisite: Basic course in Compiler Design L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Modern Compiler Design – Structure of Compilers for Modern Programming Languages, Cross Compiler, Just -In-Time (JIT) and Adaptive Compilation 8 Unit 2 Runtime System Architectures. Parser Development - LR Parsers and LR Grammars – Design and Implementation. 10 Unit 3 Parser and Ambiguity, Conflict Resolution, Lex and Yacc Tools. Optimizing Compiler - Control -flow Analysis, Control -flow Graphs, Basic Blocks. 10 Unit 4 Data -flow Analysis Methods, Dependence Analysis, Global Optimizations, Loop Optimizations. 8 Unit 5 Peephole Optimization and Optimal Code Generation, Data Dependence Analysis in Loops, Loop Scheduling. 6 References: 1. Aho, Lam, Sethi and Ullman: Compilers – Principles, Techniques and Tools, Pearson Education 2. 3. 4. 2. Steven Muchnick : Advanced Compiler Design & Implementation, Morgan Kaufmann 3. Holub: Compiler Design in C, Prentice Hall India. 4. Keith Cooper and Linda Torczon : Engineering a Compiler, Morgan Kaufmann. 122 Android Programming Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Basics: Review of Java Programming, Setting up and configuring Android

Studio setup, Android Emulator Hello Android example, AndroidManifest.xml, R.java file, Activity, Fragment, 10 Unit 2 Layout Manager - Relative Layout, Linear Layout, Table Layout, Grid Layout. Activity, Intent & Fragment: Activity Lifecycle, Activity Example, Intent – implicit and explicit, Intent filters, Fragment Lifecycle, Fragment Example 8 Unit 3 UI Widgets – buttons (toggle, switch, image), check box; Android Menu: Option Menu, Context Menu, Popup Menu; View. 8 Unit 4 Android Service: lifecycle, example, Data Storage, Shared Preference, SQLite, Content Provider, Android Notification Adding functionality: Multimedia API, Speech API, telephony API. 10 Unit 5 Location API Sensors: Sensor API, Working with WiFi, Working with Camera, Motion Sensor, Position Sensor; Android Graphics App development project. 6 References: 1. Official Android Website 123 Big Data Analytics Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Overview of Database Management Systems, Introduction to Big Data, Introduction to distributed file system, Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics. 8 Unit 2 Apache Hadoop & Hadoop Eco -System, Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data Serialization. Hadoop Architecture. 10 Unit 3 Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, Name -Node, Secondary Name -Node, and Data -Node, Hadoop MapReduce paradigm, Map and Reduce tasks, Job. 10 Unit 4 Task trackers - Cluster Setup, SSH & Hadoop Configuration – HDFS Administering, Monitoring & Maintenance. Pig, Pig Latin Language, Hive Introduction, Hive queries. Spark Introduction. Cassandra CQL 8 Unit 5 Query language and CQL data model: Key space, Table definition, Column, and Data Types. Mongo DB Cluster analysis, K -means algorithm, Naïve Bayes, Parallel k - means using Hadoop, parallel particle swarm algorithm using MapReduce, case studies on big data mi ning. Parallel swarm Intelligence. 6 References: 1. Dan Sulliva ,NoSQL for Mere Mortals 1st Edition., Pearson Publishers, 2014 2. Pramod J. Sadalage , Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition, Pearson Publishers,ISBN -13: 978 -0321826626, 2017. 3. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies (The MIT Press) 4. John D. Kelleher, Brendan Tierney, Data Science (MIT Press Essential Knowledge series). 124 Cloud Security Prerequisite: Computer Networks, Operating System L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction of Cloud Computing: Taxonomy and related technologies, Essential Characteristics, Service and Deployment Models 8 Unit 2 Virtualization: Types of Virtualization and Hypervisors, Virtualization at Storage, Compute and Network, Hypervisors (Types and Case studies), Virtual Machine Provisioning, Virtual Machine Migration. 10 Unit 3 Architectures:Standards, Orchestration, Provisioning, Portability, Interoperability, Federated Cloud, Security: CIA Triad, Vulnerabilities in Cloud, Threats to Infrastructure, Data and Access Control 10 Unit 4 Identity Management; Multi Tenancy Issues; Attack taxonomy; Intrusion Detection, VM Specific attacks, VM Introspection, Management; Trusted Cloud Initiative of Cloud Security Alliance (CSA). 8 Unit 5 Forensics: NIST Forensics Reference Architecture, Forensic Science Challenges, Architectural Issues, Evidence Collection and Analysis, Anti -Forensics, Incident Response, Standards and Framework 6 References: 1. K. Hwang, G. C. Fox, and J. Dongarra, Distributed and Cloud Computing, 1st ed.: Morgan Kaufmann, 2011 2. R. Buyya, J. Broberg, and A. M. Goscinski, Cloud Computing: Principles and Paradigms: Wiley -Blackwell, 2011 3. S. Dinkar and G. Manjunath, Moving to the Cloud: Developing Apps in the New World of Cloud Computing Syngress Media, U.S., 2012. 4. W. Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, 1st ed.: Addison -Wesley Professional, 2015. 5. T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture: Prentice Hall/PearsonPTR, 2014 6. R. L. Krutz and R. D. Vines, Cloud Security - A Comprehensive Guide to Secure Cloud Computing, Wiley Publishing, 2010 7. T. Mather, S. Kumaraswamy, and S. Latif, Cloud Security and Privacy - An Enterprise Perspective on Risks and Compliance, O Reilley Publishers, 2009. 8. V. (J. R.) Winkler, G. Speake, P. Foxhoven, Securing the Cloud: Cloud Computer Security Techniques and Tactics, Syngress, 2011. 125 Cyber Security Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats, Need for a Comprehensive Cyber Security Policy. Cyber Security Safeguards (Overview): Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Thre at Management. 8 Unit 2 Network Security & Web Security: Security Issues in TCP/IP, which includes TCP, DNS, Routing (basic problems of security in TCP/IP, IPsec, BGP Security, DNS Cache poisoning, etc), Network Defense tools such as Firewalls, Filtering, DNSSec, NSec3, Distribut ed Firewalls. 10 Unit 3 Web Application Security: Cross -Site Scripting Attacks, Cross -Site Request Forgery, SQL Injection Attacks Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Ant iMalware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation 10 Unit 4 Cyber Forensics: Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting diskbased analysis, Investigating Information -hiding, Scrutinizing E -mail, Validating Email header information, Tracing Internet access, Tracing memory in real -time. 8 Unit 5 Security in Mobile Platforms: Android vs. ioS security model, threat models, information tracking, rootkits, Threats in mobile applications, analyzer for mobile apps to discover security vulnerabilities, Viruses, Spywares, and keyloggers and malware detect ion. Cyberspace and the Law 6 References: 1. Latest research papers, journals and articles 2. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and SunitBelapure. 3. Cybersecurity Essentials By Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short · 2018 4. Cybersecurity: Attack and Defense Strategies: Infrastructure Security with Red Team and Blue Team TacticsBook by ErdalOzkaya and Yuri Diogenes 126 Data Compression Prerequisite: Object Oriented Analysis and Design L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction: Compression techniques, lossless compression, lossy compression, measures of performance, modeling and coding. 8 Unit 2 Mathematical preliminaries - Overview, introduction to information theory, models, physical models, probability models, Markov models. 10 Unit 3 Basic Coding Schemes: Statistical Methods - Shannon -Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding. Arithmetic Coding (Encoding, Decoding, Adaptive Coding). Dictionary Methods - LZ77, LZ78, LZW Algorithms. Case study of lossless compression sta ndards. 10 Unit 4 Lossless Compression standards: zip, gzip, bzip, unix compress, GIF, JBIG. Image and Video Compression: Discrete Cosine Transform, JPEG. Wavelet Methods - Discrete Wavelet Transform, JPEG 2000 8 Unit 5 Motion Compensation, Temporal and Spatial Prediction. MPEG and H.264. Audio Compression: Digital Audio, WAVE, FLAC, MPEG -1/2 Audio Layers. 6 References: 1. Khalid Sayood. 2012. Introduction to Data Compression (4th ed.). Elsevier 2. David Salomon, Giovanni Motta. 2010. Handbook of Data Compression. Springer, London 127 Data Visualization Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Modern Visualisation tools and techniques, Create multiple versions of digital visualizations using various software packages. 8 Unit 2 Identify appropriate data visualization techniques given particular requirements imposed by the data. 10 Unit 3 Apply appropriate design principles in the creation of presentations and visualizations; Analyse, critique, and revise data visualizations 8 Unit 4 Information overload and issues in decision making Design of visual encoding schemes to improve comprehension of data and their use in decision making 6 Unit 5 Use of Tableau - Data visualization tool for data analysts, scientists, statisticians, etc. to visualize the data and get a clear opinion based on the data analysis, Comparing classifiers - ROC curves, McNemar’s test, other statistical tests. 10 References: 1. A first course Sosulski, K. (2018). Data Visualization Made Simple: Insights into Becoming Visual. New York: Routledge 2. The Visual Display of Quantitative Information (2nd Edition). E. Tufte. Graphics Press, 2001. 128 Digital Forensics Prerequisite: Operating Systems, Computer Networks & Security L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 File System Forensics: Duplicating hard disks for "dead analysis”, reading hidden data on a disk's Host Protected Area (HPA), Direct versus BIOS access, dead versus live acquisition 8 Unit 2 Disk partitions - DOS, Apple, and GPT partitions, BSD disk labels, Sun Volume; multiple disk volumes - RAID and disk spanning. 10 Unit 3 Analyzing FAT, NTFS, Ext2, Ext3, UFS1, and UFS2 file systems, Finding evidence: File metadata, recovery of deleted files, Using The Sleuth Kit (TSK), Autopsy Forensic Browser, and related open source tools 10 Unit 4 Web Forensics: network -based evidence in Windows and Unix environments, Reconstructing Web browsing, email activity, Tracing domain name ownership and the source of e -mails 8 Unit 5 System Forensics: Windows Registry changes, Duplicating and analyzing the contents of PDAs and flash memory devices Electronic document, computer image verification and authentication. 6 References: 1. Brian Carrier. File System Forensic Analysis, Addison Wesley 2. Chris Prosise, Kevin Mandia. Incident Response and Computer Forensics, McGraw Hill. Course Technology. 3. Linda Volonino, Reynaldo Anzaldua, and Jana Godwin. Computer Forensics: Principles and Practices, Prentice Hall. 4. Keith J. Jones, Richard Bejtlich, and Curtis W. Rose. Real Digital Forensics: Computer Security and Incident Response, Addison Wesley. 5. Vacca, John R., Computer Forensics Computer Crime

Scene Investigation, Charles River Media. 6. Nelson, Phillips, Enfinger, Steuart. Guide to computer Forensics and Investigation 129 Distributed Systems Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction to Distributed Systems, OS and Advanced OS, various distributed systems, Trends in Distributed System and challenges, Networking: network protocols, point -to-point communication. Introduction – Clocks, events and process states – Synchronizing physical clocksLogical time and logical clocks – Global states,Limitations, Lamport's logical clock, vector clock, causal ordering, global state, Cuts. Distributed Mutual Exclusion: Lamport, Recart -agrawala, and Maekawa's algorithms; Suzuki -kasami broadca st algorithm, and Raymond's tree based algorithm , Elections algorithms 8 Unit 2 Transactions and Concurrency Control – Transactions -Nested transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic Commit Distributed transactions: two phase commit, three -phase commit, ACID/BASE models Techniques of Inter proce ss Communication: the API for internet protocols – External data representation and Multicast communication, Sun RPC: programming and implementation, Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation And Objects: Remote Inv ocation – Introduction – Request -reply protocols – Remote procedure call – Remote method invocation. Case study: Java RMI – Group communication – Publish -subscribe systems – Message queues – Shared memory approaches – Distributed objects. 10 Unit 3 Case study: Enterprise Java Beans -from objects to components. Distributed Deadlock Detection: Resource Vs. Communication deadlock, Replication, Strategies to handle deadlock, Ho -Ramamoorthy, Path -Pushing, Edge -Chasing, Diffusion Computation - based algorith ms. Agreement Protocols: System model, Classification of agreement problems, Solutions to Byzantine Agreement (BA) problems.Distributed Scheduling: Issues in Load Distribution, Components of a load distribution algorithm, Load Distribution Algorithms, V -system, Sprite, and Condor. 10 Unit 4 Network file systems: design, NFS, AFS (scale), DFS & CIFS (cache control), CODA (redundancy) Google File System (GFS), Hadoop Distributed File System (HDFS)Distributed Shared Memory: Algorithms for implementing DSMs, Memory Coherence, and Coherence Protoc ols, IVY Process Management: Process Migration: Features, Mechanism – Threads: Models, Issues, Implementation. 8 Unit 5 Resource Management: IntroductionFeatures of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach Recovery: Classification of failures, Synchronous and Asynchronous Check pointing and Recovery. Fault Tolerance: Commit Protocols, Voting Protocols, Failure Resilient Processes. Protection and Security: Access Mat rix Model, Implementation of access matrix, Unix, and Amoeba. Case study -Distributed systems. 6 References: 1. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems Principles and Paradigm," 2nd Edition, Pearson 2. George Coulouris, Jean Dollinmore, Tim Kindberg, Gordon Blair "Distributed SystemsConcepts and Design," 5th Edition, Pearson 130 3. M. Singhal& N. Shivaratri, "Advanced Concepts in Operating Systems: Distributed, Database and Multiprocessor Operating Systems", Tata McGraw Hill, 2015 4. John Bloomer, "Power Programming with RPC," O'Reilly & Associates, Inc 5. Advanced Programming in the Unix Environment by W. Richard Stevens, Addison -Wesley. 6.

Liu M.L., “Distributed Computing, Principles and Applications”, Pearson Education 7. Distributed Systems - An Algorithmic approach by Sukumar Ghosh. 131 E-Commerce Prerequisite: knowledge of Digital Market, Basics of Computer Network and security L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction: Definition of Electronic Commerce, technology and prospects, incentives for engaging in electronic commerce, needs of E -Commerce, E -Commerce Infrastructure, advantages and disadvantages, Impact of E -commerce on business, E - Commerce Models. 8 Unit 2 Network Infrastructure for E - Commerce. Internet and Intranet based E -commerce: Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication. Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile Information device 10 Unit 3 Web Security: Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls. Encryption: Encryption techniques, Symmetric Encryption: Keys and data encryption standard, Triple encryption, Secret key encryption. 10 Unit 4 Asymmetric encryption: public and private pair key encryption, Digital Signatures, Virtual Private Network. Customer Service Expectations of the E -commerce Experience. 6 Unit 5 Electronic Payments: Overview, The SET protocol, Payment: Smart card, credit card, magnetic strip card, E -Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E - Commerce Law, Forms of Agreement, Govt. policies and Agenda 8 References: 1. Turban, “Electronic Commerce 2004: A Managerial Perspective”, Pearson Education 2. Pete Lohsin , John Vacca “Electronic Commerce”, New Age International 3. Bajaj and Nag, “E -Commerce the cutting edge of Business”, TMH 6 4. Laudon, “E-Commerce: Business, Technology, Society”, Pearson Education 132 Embedded System Security Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Security Flaws and Attacks in Embedded systems: Code injection, Invasive and Non invasive physical and logical attacks 8 Unit 2 Defenses Against Code Injection Attacks: Methods using Address Obfuscation and Software Encryption, Anomaly Detection. 10 Unit 3 Safe Languages, Code Analyzers Compiler, Library, and Operating System Support for embedded systems 10 Unit 4 Security, Control Flow Checking, IP Protection: Encryption of IP Cores, additive and Constraint -Based watermarking. 8 Unit 5 Implementation of DES 3DES, AES, RC4, MD5, RSA algorithms 6 References: 1. Security in Embedded Hardware 133 Hardware Software Codesign Prerequisite: Logic System Design/ Digital Logic Design L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Codesign overview, device Modeling and methodologies of system design 8 Unit 2 Hardware software partitioning and scheduling, Co simulation. 10 Unit 3 Synthesis and verifications, Architecture, Interface and reconfiguration. 10 Unit 4 System on chip, Application specific processors (DSP) 8 Unit 5 Codesign tools and case studies 6 References: 1. A Practical Introduction to Hardware/Software Codesign, Patrick Schaumont,Springer, 2009, ISBN 978 -1-4419 -5999 -7 2. Specification and Design of Embedded Systems Daniel D. Gajski, Frank Vahid, S. Narayan, & J. Gong, Prentice Hall, 1994 3. Hardware / Software Co -Design: Principles and Practice,JStaunstrup and Wayne Wolf, Prentice Hall, 1994 134 Image Analysis Prerequisite: None L T P C Total hours:

42 3 0 0 3 Course Content Hrs. Unit 1 Image Preliminaries & Image Processing: Overview, Computer imaging systems, Human visual system, image model, etc. Geometric transformations: Translation, rotation, scaling and shearing. 8 Unit 2 Frequency transformation: Discrete Fourier transform (DFT), fast Fourier transform (FFT), shorttime Fourier transform (STFT), Multi -resolution Expansions: Wavelet Transforms in 1 -D and 2 - D. The Fast Wavelet Transform Wavelet Packets Transform 10 Unit 3 Feature Extraction and Dimension Reduction Color, Texture, Shape and structure Features in spatial and frequency domains, Corner Detection, Hough Transform, Principal Component Analysis, Linear Discriminant Analysis, Feature Reduction in Input and Feature Spaces. Image Segmentation. Gray -level thresholding, Supervised vs. Unsupervised thresholding, Binarization using Otsu’s method, Locally adaptive thresholding. 10 Unit 4 Color -based segmentation, Region oriented segmentation, Use of motion in segmentation, Spatial techniques, Frequency domain techniques. Features Based Image Matching:Scale Space Image Processing. 8 Unit 5 Different Feature descriptors: Key Point Detection, SIFT descriptor SURF descriptor Bag of Visual Words approach, Geometric consistency check, Vocabulary tree Panoramic Imaging, Template Matching, Mono Panorama, Stereo Panorama. 6 References: 1. J G Proakis and D G Manolakis, "Digital Signal Processing," Pearson, Fourth edition 2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Prentice Hall, 3rd Edition, 2007. 3. Bishop, Pattern Recognition and Machine Learning 4. Duda, Pattern Classification. 135 Intrusion Detection Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction - Intrusion Detection System (IDS), Intrusion Prevention System (IPS). 8 Unit 2 Unauthorized access – buffer overflow, packet fragmentation, out -of-spec packets Review of Network protocol – TCP/IP, Intrusion detection through tcpdump 10 Unit 3 IDS and IPS – Architecture and internals. Malicious and non -malicious traffic, IP headers, TCP, UDP and ICMP protocols and header formats. 10 Unit 4 Header information to detect intrusion, logs and their analysis. 6 Unit 5 IDS through reaction and response Intrusion analysis – data correlation, tools, SNORT - A case study 8 References: 1. Matt Fearnow, Stephen Northcutt, Karen Frederick, and Mark Cooper. Intrusion Signatures and Analysis, SAMS. 2. Carl Endorf, Gene Schultz, Jim Mellander, Intrusion Detection and Prevention, McGraw Hill 3. Paul E. Proctor. The Practical Intrusion Detection Handbook, Prentice Hall. 4. Stephen Northcutt and Judy Novak. Network Intrusion Detection, SAMS. 136 Neural Networks Prerequisite: Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential. L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction to Neural Architecture, McCulloch -Pitts networks, Learning Rules, Perceptrons. 8 Unit 2 Regression and least mean square algorithm, Multilayer perceptrons. 8 Unit 3 Back propagation: generalized delta rule, limitations, modifications – momentum, variable learning rate, conjugate gradient, Radial -basis function networks. 10 Unit 4 Support vector Machines, Unsupervised learning and self -organization, Boltzmann machines and deep networks, Convolutional networks. 10 Unit 5 Recurrent networks, Associative Memories, Adaptive Resonance Theory, Applications of Neural Networks. 6 References: 1. Simon Haykin: Neural Networks: A Comprehensive Foundation, Pearson 137 Network on Chip Prerequisite: Computer

Architecture, Logic System Design L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 The Concept of route packet not wires for On -Chip Interconnection Networks, Topology and design architecture of Network -on-Chip, Area and power trade off NoC protocols. 8 Unit 2 Routing and Flow Control mechanism, Verification of Communications in Networks - on-Chips. Application Mapping on Network -on-Chip. 10 Unit 3 Resource Allocation for QoS On -Chip Communication, routing techniques in different 2D/ 3D NoC topology, performance evaluation in terms of throughput, latency, gitter. 10 Unit 4 Signal Integrity and Reliability of Network -on-Chip, Testing of Network -on- Chip Architectures, Test and Fault Tolerance for NoC Infrastructures. 8 Unit 5 Reconfigurable Network -on-Chip Design, Security in NoCs. Energy and Power estimation techniques Network -on-Chips. 6 References: 1. Giovanni De Micheli, Luca Benini, DavideBertozzi, Networks on Chips:Technology and Tools, Morgan Kaufmann, 2006. 2. Fayez Gebali, HaythamElmiligi, Mohamed Watheq El -Kharashi, Networkson - Chips: Theory and Practice, CRC Press, 2017. 3. SudeepPasricha, NikilDutt, On -Chip Communication Architectures: System on Chip Interconnect, Morgan Kaufmann, 2010. 138 Network Performance Modelling Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction to Network Modeling: Network modeling, Computer Network as a discrete event system, Modeling and measurement tools, Network performance metrics – first order and second order metrics, Network capacity, Difference between throughput and capacit y 8 Unit 2 Network Calculus: Models for data flows, arrival curves and service curves, Greedy shapers, Basic min -plus and maxplus calculus, min -plus and max -plus systems, Optimal smoothing, FIFO systems and aggregate scheduling, Time varying shapers, Systems with losses 6 Unit 3 Case studies – (1) Analyzing spanning tree based data forwarding using network calculus, (2) Bound on loss rate Stochastic Scheduling and Resource Allocation: Stochastic scheduling, dynamic resource allocation, Dynamic programming models for stochastic sch eduling, Queuing networks – open loop and closed loop networks, Jackson networks, Network fairness – proportional and max -min fairness, Markov process and its application for analyzing network resource allocation and fairness, available bandwidth estimatio n 11 Unit 4 Case studies – (1) TCP/IP flow and congestion control, (2) Modeling dynamic routing and scheduling as a queuing network problem, (3) Analysis of IEEE 802.11 channel access using two dimensional Markov process. Network Games: Introduction to game theory, Ze ro sum games, Nash equilibrium, Pareto optimality, Cooperative and Non -cooperative games, General network games – resource sharing games, routing games, congestion games, Mechanism design. Case studies – (1) Selfish routing in networks and price of anarchy , (2) Oblivious routing, (3) Network resource allocation games. 11 Unit 5 Protocol Analysis: Modeling discrete event system using petri -nets, basics of petri nets, stochastic petri nets, queuing petri nets, properties of petri nets, structural analysis of petri nets, Petri net modeling tools – simQPN, Case studies – (1) Wireless channel model using stochastic petri net, (2) Data center network throughput analysis using queuing Petri Nets 6 References: 1. "Routing, Flow, and Capacity Design in Communication and Computer Networks", Micha■Pióro, DeepankarMedhi, ISBN: 0125571895, Publisher: Morgan Kaufmann 2. The Network Calculus Book by Jean -Yves Le Boudec and Patrick Thiran is available for free download:http://ica1www.epfl.ch/PS_files/NetCal.html 3. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" Morgan Kaufman Publishers 4. Dimitri P. Bertsekas and Robert G. Gallager, "Data Networks": Materials are available at http://web.mit.edu/dimitrib/www/datanets.html 5. "Network Optimization: Continuous and Discrete Models", D. Bertsekas 6. Research Publications - will be discussed and distributed time to time 139 Parallel Processing & Algorithms Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction to parallel computing. Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O. 8 Unit 2 The PRAM Shared -Memory Model, Distributed -Memory or Graph Models, Circuit Model and Physical Realizations PRAM and Basic Algorithms, PRAM Submodels and Assumptions, Data Broadcasting, Semigroup or Fan -In Computation, Parallel reduction, Prefix sums, List r anking, Preorder tree traversal, Merging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS. 10 Unit 3 Thread and process level parallel architectures: MIMD, multi -threaded architectures. Distributed and shared memory MIMD architectures. Dynamic interconnection networks.Mapping and scheduling: Mapping data to processors on processor arrays and multicomputer s, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock. Parallel programming and parallel algorithms: Programming models, parallel programming on multiprocessors and multicomputers. 10 Unit 4 Parallel algorithm structure, analyzing parallel algorithm. Elementary parallel algorithms, Matrix algorithms, sorting, Graph algorithms. Parallel Algorithm Complexity, Asymptotic Complexity, Algorithm Optimality and Efficiency, Complexity Classes, Paralle lizable Tasks and the NC Class, Parallel Programming Paradigms, Solving Recurrences 8 Unit 5 Sorting and Selection Network: Design of Sorting Networks, Batcher Sorting Networks, Mesh -Base Architectures: Sorting on a 2D Mesh or Torus, Routing on a 2D Mesh or Torus, Numerical 2D Mesh Algorithms, Low -Diameter Architectures: Hypercubes and Their Algorithms, Sorti ng and Routing on Hypercubes 6 References: 1. J. Jaja, An Introduction to Parallel Algorithms, Addison Wesley, 1992 2. F. T. Leighton, Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kaufmann Publishers, San Mateo,California,1992 3. BehroozParhami , Introduction to Parallel Processing, Algorithms and Architecture, kluwer academic publishers,2002ed 140 Parallelizing Compiler Prerequisite: Basic course in Compiler Design L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction – Compilation for parallel machines and automatic detection of parallelism, structure of a parallelizing compiler. 8 Unit 2 Dependence Theory and Practice - Types of dependences, data and control dependencies, dependence analysis. 10 Unit 3 Direction vectors, loop carried and loop independent dependences, tests for data dependence and their applicability, construction of data dependence and control dependence graphs. 10 Unit 4 Parallel Code Generation - Automatic extraction of parallelism, representation of iteration spaces of nested loops, loop based transformations such as loop distribution, loop coalescing, loop interchange and cycle shrinking transformation. 8 Unit 5 Interprocedural Analysis and Optimization - aliasing information, summary data flow analysis, interprocedural constant propagation, interprocedural data dependence analysis and parallelization of call statements. 6 References: 1. Randy Allen, Ken Kennedy: Optimizing compilers for modern architectures. Morgan Kaufmann 2. Steven Muchnick : Advanced Compiler Design & Implementation, Morgan Kaufmann. 141 Pattern Recognition Prerequisite: An undergraduate level understanding of probability, statistics and linear algebra is assumed. A basic knowledge of Python is essential. L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 The classification process: features, training and learning, approaches to classification Non metric methods: Information, Entropy and Impurity, decision tree classifier - ID3, C4.5. Discriminant functions: linear discriminant functions, piece - wise linear discriminant functions, generalized discriminant functions. 8 Unit 2 Statistical pattern recognition: measured data and measurement errors, probability theory, conditional probability and Bayes rule, Naive Bayes classifier, Continuous random variables, The multivariate Gaussian, Covariance matrix and MahalanobisdistancePara metric learning: Bayesian decision theory, discriminant functions and decision boundaries, MAP (Maximum A Posteriori Estimator) 10 Unit 3 Non Parametric learning: Histogram estimator and Parzen windows, k -NN classification, Artificial Neural Networks, Kernel Machines, SVM. Feature extraction and selection: reducing dimensionality, feature selection - Inter/Intra class distance. 10 Unit 4 Feature extraction: Principal component analysis, Linear discriminant analysis.Unsupervised learning: Clustering, K - Means clustering, Fuzzy c -Means clustering, (Agglomerative) Hierarchical clustering 8 Unit 5 Estimating and Comparing Classifiers: No free lunch, Bias and variance trade -off, cross -validation and resampling methods, Measuring classifier performance, Comparing classifiers - ROC curves, McNemar’s test, other statistical tests 6 References: 1. Pattern Classification, Duda Hart, Wiley 2. Pattern Recognition and Classification, Geoff Dougherty, Springer 3. Statistical Pattern Recognition, Andrew R Webb, Wiley 4. Pattern Recognition and Machine Learning, Christopher Bishop, Springer 5. Pattern Recognition and Image Analysis, Earl Gose, Johnsonbaugh, PHI 142 Public Key Infrastructure and Trust Management Prerequisite: L T P C Total hours: 4 0 3 0 0 3 Course Content Hrs. Unit 1 Public key infrastructure - components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross certification. 10 Unit 2 Repository, Certification Authority (CA) and Registration Authority (RA), trusted third party, digital certificates PKI services – authentication, non -repudiation, privilege management, privacy, secure communication. 12 Unit 3 Key management – certificate revocation list, root CA, attacks on CA, key backup. 12 Unit 4 PKI standards – SSL, LDAP, IPSec, X.500, X.509, S/MIME Trust models – strict v/s loose hierarchy, four corners distribution. Certificate path processing – path construction and path validation. 6 References: 1. Ashutosh Saxena, Public Key Infrastructure, Tata McGraw Hill 2. Carlisle Adams, Steve Lloyd. Understanding PKI: Concepts, Standards, and Deployment Considerations, Addison Wesley. 3. John R. Vacca. Public Key Infrastructure: Building Trusted Applications and Web Services, AUERBACH. 4. Messaoud Benantar, Introduction to the Public Key Infrastructure for the Internet, Pearson Education. 143 Quantum Computing Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction to quantum computing 8 Unit 2

Relevant Linear algebra for quantum computing, Postulates of quantum mechanics, 10 Unit 3 Classical computing, Quantum circuits, Quantum Fourier Transform 10 Unit 4 Quantum search algorithms, Physical realization of quantum computers. 8 Unit 5 Quantum noise, Quantum operations, quantum information and quantum channel 6 References: 1. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press. 3. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 144 Quantum Cryptography Prerequisite: L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Preliminaries: Quantum Information Theory, Quantum Information Theory, Unconditional Secure Authentication and Entropy. 8 Unit 2 Quantum Key Distribution: Quantum Channel, Public Channel, QKD Gain, Finite Resources, Adaptive Cascade: Introduction, Error Correction and the Cascade Protocol, Adaptive Initial Block -Size Selection, Fixed Initial Block -Size, Dynamic Initial BlockSize. 10 Unit 3 Attack Strategies on QKD Protocols: Attack Strategies in an Ideal Environment, Individual Attacks in an Realistic Environment. QKD Systems, Statistical Analysis of QKD Networks in Real -Life Environment: Statistical Methods, Results of the Experiments, Stat istical Analysis. 10 Unit 4 QKD Networks Based on Q3P : QKD Networks, PPP, Q3P, Routing and Transport. QuantumCryptographic Networks from a Prototype to the Citizen. 8 Unit 5 The Ring of Trust Model, Model of the Point of Trust Architecture, Communication in the Point of Trust Model, Exemplified Communications, A Medical Information System Based on the Ring of Trust. 6 References: 1. Quantum Cryptography and Secret -Key Distillation, Gilles van Assche, Cambridge University Press, 2006. 2. Paul Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press (2007). 3. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press (2000). 145 Real Time Systems Prerequisite: None L T P C Total hours: 40 3 0 0 3 Course Content Hrs. Unit 1 Introduction : Definition, Typical Real Time Applications; Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processo rs and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency 7 Unit 2 Real Time Scheduling: Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective -Deadline -First (EDF) and Least -Slack - Time -First (LST) Algorithms, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clo ck Driven Systems 8 Unit 3 Resources Access Control: Effect of Resource Contention and Resource Access Control (RAC), Nonpreemptive Critical Sections, Basic Priority -Inheritance and Priority -Ceiling Protocols, Stack Based Priority -Ceiling Protocol, Use of Priority -Ceiling Protocol i n Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple - Unit Resources, Controlling Concurrent Accesses to Data Objects 8 Unit 4 Multiprocessor System Environment :Multiprocessor and Distributed System Model, Multiprocessor Priority -Ceiling

Protocol, Schedulability of FixedPriority End -to-End Periodic Tasks, Scheduling Algorithms for End -to-End Periodic Tasks, Endto -End Tasks in Het erogeneous Systems, Predictability and Validation of Dynamic Multiprocessor Systems, Scheduling of Tasks with Temporal Distance Constraints. 9 Unit 5 Real Time Communication : Model of Real Time Communication, Soft and Hard RTCommunication systems , Priority -Based Service and Weighted Round -Robin Service Disciplines for Switched Networks, Medium Access Control Protocols forBroadcast Networks, Internet and Resource Reservation P rotocols, Real Time Protocols, Communication in Multicomputer System. An Overview of Real Time Operating Systems and Databases: Features of RTOS, UNIX as RTOS, POSIX Issues, Temporal Consistency, Concurrency Control. 8 References: 1. Real Time Systems: Theory and Practice – Mall Rajib, Pearson Education, 2009 2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley, 2002. 3. H. Kopetz, "Real time systems: Design Principles for distributed embedded applications”, Springer Publications, 2011. 4. Douglass, Real Time UML: Advances in the UML for Real -Time Systems, 3/e, AddisonWesley, 2004. 5. Awad, Kuusela& Ziegler, Object -Oriented Technology for Real Time Systems: A Practical Approach Using OMT and Fusion, l/e, Pearson Education, 1996. 6. Ward & Mellor, Structured Development for Real -Time Systems, Vol. III: Implementation Modeling Techniques, Prentice Hall, 1986. 146 Robotics and Control Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction to robotics -origin of automation, Classification of robots, Rotations and translation of vectors. 8 Unit 2 Transformations and Euler angle representations, Homogeneous transformations, Problems, Trajectory planning. 10 Unit 3 Actuators, Velocity and position sensors. Range, proximity, touch sensors. 10 Unit 4 Control of Robot Manipulators: PD control, Nonlinear Control, Stability, Lyapunov’s Direct Method. 8 Unit 5 Adaptive Control, Robot Vision, Image segmentation, Template matching, Polyhedral objects, Shape analysis, Grasping and industrial automation. 6 References: 1. M. Spong, S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control Wiley (2006) 2. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", 3. Craig. J. J. “Introduction to Robotics - mechanics and control”, Addison - Wesley, 1999 4. Nagrath Gopal “Control Systems Engineering -Principles and Design” New Age Publishers 5. K. Ogata, “Modern control engineering”, Pearson 2002. 147 Security Analysis of Protocols Prerequisite: L T P C Total hours: 4 0 3 0 0 3 Course Content Hrs. Unit 1 Cryptographic background; Authentication, Key establishment and IP security; 8 Unit 2 Denial of service; Anonymity and MIX networks; Fairness and contract signing, Privacy and protection of individual information; Wireless security (mobile phones, WiFi); 12 Unit 3 Protocol analysis tools: Finite -state checking; Infinite -state symbolic analysis; Probabilistic model checking; Game -based verification; Process algebras (spi -calculus and applied pi calculus); Protocol logics (BAN, DDMP, Isabelle); 12 Unit 4 Introduction to Probabilistic polynomial time calculus; Relating cryptographic and formal models. 8 References: 1. Latest reputed conference and journal articles as chosen by the instructor. 2. Maximum Security, 2nd Edition, SAMS Books by Anonymous, 1998 3. Maximum Linux Security, SAMS Books by Anonymous, 2000, ISBN: 0 -672- 31670 -6. 4. 10 Risks of PKI: What You're not Being Told about Public Key Infrastructure, by Ellison and Schneier 148 Selected Topics in Cryptography Prerequisite: L T P C Total hours: 4 0 3 0 0 3 Course Content Hrs. Unit 1 Basic Concepts: Information theoretic vs. computational security. One way functions, Pseudo randomness generators and functions, Permutations, hash functions. 8 Unit 2 Private -key encryption using pseudo randomness. Private -key authentication. – Public key encryption (and number theory). Public key authentication. 12 Unit 3 Interactive protocols: Touch of complexity theory, Interactive proof systems; 0 - knowledge proof systems,0 -knowledge authentication, Electronic cash; non - interactive zero -knowledge. 12 Unit 4 Oblivious transfer: Definitions, constructions, and applications, Secure Multiparty computations, Database (differential) privacy. – Proofs of work – Block -chain consensus protocols. 8 References: 1. Introduction to Modern Cryptography: Principles and Protocols, by Jonathan Katz and Yehuda Lindell 2. A Graduate Course in Applied Cryptography by Dan Boneh and Victor Shoup 3. The Joy of Cryptography by Mike Rosulek. 4. OdedGoldreich: Foundations of Cryptography Vol 1 and Vol 2 149 Social Media Mining Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Online Social Networks (OSNs): Introduction - Types of social networks (e.g., Twitter, Facebook), Measurement and Collection of Social Network Data. 8 Unit 2 Social Networks - Basic Structure and Measures, Basics of Text Processing over Social Data, Entity linking and entity resolution for Social data. 10 Unit 3 Characteristics of OSNs: Information Diffusion, Experimental studies over OSNs, Sampling, Fundamentals of Social Data Analytics: Topic Models, Random Walks, Heterogeneous Information Networks 10 Unit 4 Applied Social Data Analytics: Recommendation Systems, Community identification and link prediction. 8 Unit 5 Advanced Topics: Online experiments for Computational Social Science, Big Data Sampling 6 References: 1. Matthew A. Russell. Mining the Social Web: Data Mining Facebook, Twitter, Linkedin, Google+, Github, and More, 2nd Edition, O'Reilly Media 2. Jennifer Golbeck, Analyzing the social web, Morgan Kaufmann 3. Charu Aggarwal (ed.), Social Network Data Analytics, Springer 4. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, Social Media Mining An Introduction, Cambridge University Press 150 Software Project Management Prerequisite: Software Engineering, Computer Programming (C/Java/Python/C++), Microsoft Excel L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Software Project Concepts: Software Project Categorization, Stakeholders, Software project Activities, Practices & Standards, Selecting Process Models (Spiral, Incremental, Prototyping, RAD, Agile). 8 Unit 2 Estimation & Evaluation techniques,Cost Benefit Analysis, Risk Analysis for Project Evaluation, Program management, Project effort and cost estimation; Basis of estimation, Estimation method categorization, SLOC, Function Point Analysis, COCOMO, Putnam’s w ork. Estimation using FP. 10 Unit 3 Project Planning: Stepwise planning, Activity based approach (WBS), Sequencing and Scheduling of Activities, Critical Path Method. Risk Analysis and Management: Risk Identification, Projection, Risk Identification, Projection, Risk Refinement, Risk Monitor ing and Management Schedule and Cost Monitoring: Collecting Data & Reporting, Graphical Visualization techniques, Cost Monitoring, Earned Value analysis, Requirements management, Change Control. 10 Unit 4 Contract Management: Types of Contracts, Stages in Contract Placement, Typical Terms of a Contract, Contract Management and Acceptance. 6 Unit 5 Software Configuration Management (SCM), SCM Tools, Project Reviews Testing and Software Reliability, Metrics, ISO and CMMI, Project Scheduling & Tracking, Software Quality Assurance, Software Configuration Management 8 References: 1. Bob Hughes, Mike Cotterell, Rajib Mall, “Software Project Management”, 6th Edition, Tata McGraw Hill, 2017. 2. Pankaj Jalote, Software Project Management in Practice. 3. Roger S. Pressman, Software Engineering 4. Royce, “Software Project Management”, Pearson Education, 1999. 5. Robert K. Wysocki, Effective Software Project Management, Wiley, 2009. 151 System on Chip Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Transaction -Level Modeling& Electronic System -Level Languages, 8 Unit 2 Hardware Accelerators, Media Instructions, Co -processors 10 Unit 3 System -Level Design Methodology ,High -Level Synthesis (Cto -RTL), 10 Unit 4 Hardware Synthesis and Architecture Techniques Source -Level Optimizations. 8 Unit 5 Scheduling Resource, Binding and Sharing. 6 References: 1. De Micheli, editor Special Issue on Hardware/Software Co -design Proceedings of IEEE, Vol 85, No. 3, March 1997 2. D. D. Gajski, F. Vahid, S. Narayan, J. Gong :Specification and Design of Embedded Systems, Prentice Hall, Englewood Cliffs, NJ, 1994 3. J. Staunstrup and W. Wolf, editors: Hardware/Software Co -Design: Principles and Practice Kluwer Academic Publishers, 1997 4. G. DeMicheli, R. Ernst, and W. Wolf, editors, Readings in Hardware/Software Co -Design, Academic Press, 2002. 152 Wireless Sensor Networks Prerequisite: None L T P C Total hours: 42 3 0 0 3 Course Content Hrs. Unit 1 Introduction: Introduction to adhoc /sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of adhoc/sensor network, driving applications, issues in adhoc wireless networks/sensor network, data dissemination and gathering, Historical Survey of Sensor Networks 8 Unit 2 Basic Architectural Framework:Traditional layered stack, Cross -layer designs, Sensor network architecture, Physical Layer, Basic Components, Hardware Platforms: Motes, Sensor Devices, Types of Sensors, Sensor's Specification 8 Unit 3 MAC Protocols : Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contention Based protocols - Schedule -based protocols - SMAC - BMAC - Traffic -adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol. Routing P rotocols: Issues in designing a routing protocol, classification of routing protocols, table -driven, on -demand, hybrid, flooding, hierarchical, and power aware routing protocols. 12 Unit 4 Sensor network security: Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Dis tribution and Management. 8 Unit 5 Secure Routing – SPINS, reliability requirements in sensor networks. Programming in WSNs: Challenges and limitations of programming WSNs, Introduction to TinyOS, - Programming in Tiny OS using NesC, Emulator TOSSIM, Open research issues 6 References: 1. Feng Zhao, Leonidas Guibas, “ Wireless Sensor Network”, Elsevier, 1st Ed. 2004 (ISBN: 13 - 978-1-55860 -914-3) 2. Kazem, Sohraby, Daniel Minoli, TaiebZnati, “Wireless Sensor Network: Technology, Protocols and Application”, John Wiley and Sons 1st Ed., 2007 (ISBN: 978 -0-471-74300 -2). 3. Raghavendra, Cauligi

S, Sivalingam, Krishna M., ZantiTaieb, “Wireless Sensor Network”, Springer 1st Ed. 2004 (ISBN: 978 -4020 -7883 -5). 4. E. H. Callaway, Jr. E. H. Callaway, Wireless Sensor Networks Architecture and Protocols:, CRC Press , 2009 MTech_2021_CS.pdf MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR DEPARTMENT of Computer Science and Engineering M.Tech. Computer Science and Engineering Semester. I S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CST501 Advanced Data Structures and Algorithms PC Theory 3 3 0 0 2 21CST503 Parallel and Distributed Computing PC Theory 4 3 0 2 3. 21CST502 Advanced Databases PC Theory 3 3 0 0 4. 21CST813 Department Elective – 1 PE Theory 3 3 0 0 5. 21CST814 Department Elective – 2 PE Theory 3 3 0 0 6. 21CSP504 Programming Lab -1 PC Lab 2 0 1 2 Total 18 Semester. II S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CST507 Research Methodology PC Theory 2 2 0 0 2 21CST842 Department Elective – 3 PE Theory 3 3 0 0 3. 21CST843 Department Elective – 4 PE Theory 3 3 0 0 4. 21CST844 Department Elective – 5 PE Theory 3 3 0 0 5. 21CST845 Department Elective – 6 PE Theory 3 3 0 0 6. 21CSP506 Programming Lab -2 PC Lab 2 0 1 2 7. 21CSP505 Design Lab /Computing Tools PC Lab 2 0 1 2 Total 18 Semester. III S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CSS603 Technical Documentation and Presentation PC --- 2 0 1 2 2 21CSP602 Literature Review PC --- 2 0 1 2 3. 21CSD601 Dissertation – 1 PC --- 8 0 0 16 Total 12 Semester. IV S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CSD604 Dissertation – 2 PC --- 12 0 0 24 Total 12 Total Credits: 60 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST501 Course Name : Advanced Data Structures and Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis, Recurrence equations. Advanced Data Structures: B -Trees, Binomial Heaps, Fibonacci Heaps, AVL trees, Red -black trees, B -trees, Splay trees, Interval trees; Disjoint set – union and path compression, Amortized analysis Greedy Algorithms: shortest distance, minimum spanning tree, interval scheduling, interval partitioning; Divide and Conquer: sorting, integer and polynomial mu ltiplication; Dynamic programming: Longest common subsequence. Chain of matrix multiplication, sequence alignment, Bellman Ford Convex hull and Voronoi diagrams, line segments, Optimal polygon triangulation; Primality testing, Integer factorization; Graph algorithms: Matching and Flows; Parallel algorithms: Basic techniques for sorting, searching, merging. Intractability: Independent Set, Vertex Cover, Randomized algorithms, Probabilistic algorithms. Approximate Algorithms: Vertex -cover, set -covering proble ms, Travelling Salesman problem. Complexity classes - NP-Hard and NP -complete Problems - Cook's theorem NP completeness reductions, undecidability Recommended Readings Text Books: - 1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall o f India. 2. AhoA.V , J.D Ulman: Design and analysis of Algorithms, Addison Wesley 3. Brassard : Fundamental of Algorithmics, PHI. 4. Sara Baase: Computer Algorithms: Introduction to Design and Analysis, Pearson Education. 5. Papadimitriou, Steiglitz: Combi natorial Optimization: Algorithms and Complexity, PHI 6. Motwani and Raghavan:

Randomized Algorithms, Cambridge University Press 7. Vazirani: Approximation Algorithms, Springer Verlag 8. Joseph Ja'Ja': Introduction to Parallel Algorithms, Addison -Wesley 9. Kleinberg, Tardos: Algorithm Design, Addison Wesley. 10. Dexter Kozen: The Design and Analysis of Algorithms. Springer, 1992 11. SanjoyDasgupta, Christos Papadimitriou, and UmeshVazirani: Algorithms, McGraw Hill. 12. Robert Sedgewick and Kevin Wayne. Algo rithms 4/e. Addison -Wesley. 13. Robert Tarjan: Data Structures and Network Algorithms, Society for Industrial and Applied Mathematics MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST503 Course Name : Parallel and Distributed Computing Credits : 4 L - 3 T - 0 P - 2 Course Type : Core Prerequisites: Programming in C, Data Structures, Operating Systems, Computer Architecture and Organization, Computer Networks Course Contents Parallel Computing, Sequential programs, Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity on Performance, Scalability of Parallel Systems, Parallel Programming Platforms, Implicit Parallelism, SIMD & MIMD systems, Clusters, Single -Core and Multi -Core Processors, Physical Organization of Parallel Platforms, Cache Coherence, Interconnection Networks for Parallel Computers. Programming Using the Message -Passing Paradigm - MPI Principles of Message Passing Programmin g; Building blocks (Sending and Receiving Operations); Communication Library calls; Collective communication and Computation library calls, Programming Shared Address Space Platforms – OpenMP, Directive Parallel Programming; The OpenMP programming Model (C oncurrent Tasks, Synchronization Constructs, Data Handling); Open libraries; OpenMP -Environment Variables; Parallel Programs, Matrix Computations, Matrix Vector Multiplication, Matrix - Matrix Multiplication, Solving system of Linear Equations; Parallel I mplementation of Sparse Matrix Computations with Vector; Sorting algorithms, Issues in Sorting on Parallel Computers; Bubble Sort and its Variants, Quicksort; Parallelizing Quicksort; Sequential and Parallel Implementation of all -pairs of Shortest Paths Al gorithms; Sequential & Parallel Search Algorithms; Depth -First Search Algorithms; Best - First Search Algorithms, Programming on Multi -Core Systems with GPU accelerators An Overview of Brief History of GPUs; An Overview of GPU Programming; An Overview of GP U Memory Hierarchy Features; An Overview of CUDA enabled NVIDIA GPUs, Introduction to CUDA C, Parallel Programming using OpenACC, CUDA APIs, CUDA Libraries for Numerical and Non -Numerical Computations; The OpenCL – Heterogeneous Programming; OpenCL Librari es, The OpenCL Memory Model, Execution Model; Platform and Devices; An Overview of OpenCL API; An Overview of MapReduce, An Overview of MapReduce Programming, An Overview of Hadoop Architecture /Execution (Master/slave, Namenode/Datanode); Hadoop Distr ibuted File System (HDFS), An Overview of Hadoop Components, Hadoop – Control Flow and Data Flow; An overview of Hive (Distributed Data Warehouse); Hbase (Distributed Column based database, PIG –(Data Flow Language); Recommended Readings Text Books: - 1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Second Edition Pearson Education – 2007 2. Peter Pacheco, An Introduction to Parallel Programming, Morgan Kaufman Publishers, Elsevier (2011) 3. Jason

Sanders, Edw ard Kandrot, CUDA By Example – An Introduction to General -Purpose GPU Programming, Addison Wesley (2011) 4. RohitChnadra, Leonardo Dagum, Dave Kohr, DrorMaydan, Jeff McDonald, Ramesh Menon, Parallel Programming in OpenMP, Academic Press (2001) 5. Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, (2011), Heterogeneous Computing with OpenCL McGraw -Hill, Inc. Newyork 6. Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw -Hill International Ed (2003) 7. Aru C Murthy, Vinod Kumar Vavilapalli, Doug Eadline, Joseph Niemiec, and Jeff Markham, Apache Hadoop YARN Moving beyond MapReduce and Batch Processing with Apache Hadoop 2, Addison Wesley, 2014 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST502 Course Name : Advances in Databases Credits : 3 L - 3 T - 0 P - 0 Course Type : Core Prerequisites: Basic course in Database Management Systems Course Contents Query Processing and Optimization – Implementation of Database operations, External Sorting, Size Estimations, Equivalence Rules, Heuristic -based Optimization, Materialized Views, Incremental View Maintenance. Transaction Processing - Concurrency Control Management, Serializability, Two -phase Lock Protocol, Deadlock Prevention and Detection, Timestamp -based Ordering Protocol, Log -based Recovery Management. Modern Database Systems - Database System Architectures, Distributed Database Systems, Parallel Data bases, Times in Databases, Multimedia Databases Distributed Databases - Data Storage, Global Catalog, Distributed Transaction Processing, Two -Phase Commit Protocol, Distributed Query Processing. Recommended Readings Text Books: - 1. Silberschatz ,Korth, Sudarshan : Database System Concepts, McGraw Hill. 2. Elmasri and Navathe : Fundamentals of Database Systems, 3rd Edition, Addison MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP504 Course Name : Programming Lab – 1 Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: Course Contents Programming exercises and experiments in Algorithms Dynamic programming and Approximate Algorithms. Combinatorial algorithm s, Randomized algorithms, Graph algorithms: Parallel algorithms: Basic techniques for sorting, searching, merging Programming exercises and experiments in Parallel and Distributed Computing. Parallel processing terminology, Pipelining Vs Data parallelism, multi -threaded architectures. Parallel reduction, Prefix sums, List ranking, preorder tree traversal, Merging two sorted lists Distributed and shared memory, Hadoop and MapReduce Programming exercises and experiments in Advanced Data structure and database . Advanced Lists, Segment Tree,Trie,Binary indexed tree. Self -Balancing BSTs, N -ary Tree. Disjoint Set, Suffix Array and Tree. Recommended Readings Text Books: - 1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India 2. N. Deo: Graph Theory with Application to Engineering and Computer Science, Prentice -Hall 3. Ghosh, Moona and Gupta, Foundations of parallel processing, Narosa publishing. 4. Ed. Afonso Ferreira and Jose' D. P. Rolin, Parallel Algorithms for irregular pr oblems - State of the art, Kluwer Academic Publishers MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code :

21CST507 Course Name : Research Methodology Credits : 2 L - 2 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents Unit I: Data Structures and Algorithms: Review of Data Structures, and most commonly used algorithms in Computer Science and Engineering – Sorting, DFS/BFS, Pattern Searching. Unit II: Linear Al gebra: Vectors - linear vector spaces, linear independence, norms and inner products, Basis and dimension, Matrices, Matrix operations, Inverse of a matrix Orthogonalization, Properties of determinants, Eigenvalues and eigenvectors, SVD and pseudo inverse, KL or hotelling transform. Unit III: Transforms Signals and representation, Convolution, Frequency Transforms, Properties of Fourier Transform, DFT, DCT and FFT, Introduction to wavelets, applications in Computer Science and Engineering Unit III: Probab ility and Statistics Statistics: Introduction to statistical analysis, hypothesis testing – null and alternate, statistical tests – chi- square, ANOVA, data validation Probability models and axioms, Bayes' rule, discrete and continuous random variables, P robability distributions: normal distribution and properties, conditional, marginal and joint probability distribution, PRNG (pseudo random number generators) - randomness tests, introduction to information theory and cryptography: an Introduction Unit IV: Machine Learning: Linear and non -linear regression, supervised learning – neural network, binary decision diagram, SVM, k -NN, unsupervised learning – Clustering, Hidden Markov Models, Introduction to deep learning. Unit V: Case Studies in Research Domain s of CSE. Recommended Readings Text Books: - 1. Gilbert Strang: Linear Algebra, MIT Cambridge Press. 2. Sheldon Ross: First Course in Probability, Pearson. 3. Mark Girolami, Simon Rogers: First Course In Machine Learning, CRC Press. 4. Anirban Das Gupta: Probability and Statistics for Machine Learning, Springer. 5. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, second ed, Springer 6. Ian Goodfellow: Deeplearning, MIT Cambridge Press. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP506 Course Name : Programming Lab – 2 Credits : 2 L - 1 T - 0 P - 3 Course Type : Elective Prerequisites: Programming Sk ills, Data Structures, Computer Networks Course Contents 1) Programming exercises and experiments in Operating Systems a. Kernel compilation and configuration, kernel modules, system calls and in -line assembly. b. Memory management, process management and scheduling c. Interrupts and interrupt handlers, synchronization etc. 2) Programming exercises and experiments in Advanced Database management systems. a. Cloud Databases: MongoDB/Cassandra etc. b. Transaction Processing: Practice on transaction process ing 3) Programming assignments on NetSim and Libalium Recommended Readings Text Books: - 1. Stevens, W. R., "Unix Network Programming: Vol. II", 2nd Ed., Pearson Education 2. Daniel P.Bovet, Marco Cesati, O`Reilly , "Understanding the Linux Kernel" Thir d Edition, 2005 3. Robert Love , "Linux Kernel Development", Pearson Education, Third Edition, 2010 4. LAN Trainer user Manual. 5. Lee chao, "Cloud Database Development and Management", CRC Publisher, 2013 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAI PUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP505 Course Name : Design Lab / Computing Tools Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: Students must have prior programming experience in C/C++ or any language; mathematics through differential equations, and numerical analysis Course Contents Operating Systems and Unix Environments: features of UNIX/Linux for scientific and technical compu ting; languages, compilers, debuggers, performance tools, make files, build systems, shell scripting, file management, source code control. Research Documentation and Simple Data Visualization: tools for generating research and code documentation: LATEX, D oxygen, plotting tools. Software Best Practices: software design cycle, regression testing, defensive programming, verification, code coverage Scientific Libraries: availability of common math libraries and usage for scientific computing.High performance C omputing (HPC): Tool and techniques. Recommended Readings Text Books: - 1. Eric S. Raymond, The Art of Unix Programming, Addison -Wesley 2003 2. Heister, T. and Rebholz, L. G., Introduction to Scientific Computing for Scientists and Engineers. De Gruyter Press, 2015. 3. John Levesque, High Performance Computing: Programming and Applications Electives Courses for PG -CSE 1. 21CST802 Advanced Computer Networks 2. 21CST824 Network on Chip 3. 21CST803 Advances in Compiler Design 4. 21CST804 Android Programming 5. 21CST806 Computer Vision 6. 21CST807 Cyber Physical Systems 7. 21CST808 Data Analytics 8. 21CST809 Data Compression 9. 21CST810 Data Mining 10. 21CST812 Deep Learning 11. 21CST815 Distributed Systems 12. 21CST816 E-Commerce 13. 21CST817 Hardware Software Codesign 14. 21CST818 Image Analysis 15. 21CST819 Information Retrieval 16. 21CST820 Internet of Things 17. 21CST822 Natural Language Processing 18. 21CST823 Nature Inspired Algorithms 19. 21CST825 Network Performance Modelling 20. 21CST826 Neural Networks 21. 21CST827 Parallel Processing & Algorithms 22. 21CST828 Parallelizing Compiler 23. 21CST830 Quantum Computing 24. 21CST831 Real Time Systems 25. 21CST832 Robotics and Control 26. 21CST801 5G Technology 27. 21CST834 Selected Topics in Operating System 28. 21CST833 Selected Topics in Computing 29. 21CST835 Social Media Mining 30. 21CST836 Social Network Analysis 31. 21CST837 Software Project Management 32. 21CST838 Software Testing and Validation 33. 21CST840 VLSI Algorithms 34. 21CST841 Wireless Sensor Networks 35. 21CST821 Machine Learning 36. 21CST829 Pattern Recognition 37. 21CST805 Big Data Analytics 38. 21CST811 Data Visualization 39. 21CST839 System on Chip 40. 21CSL760 Program Analysis MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST802 Course Name : Advanced Computer Networks Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Wireless networking: Bluetooth, 802.11 standards Information theory, bandwidth, multiple access Wireless Terahertz Networks 5G and 6G communication Intelligent Transportation Systems Emerging networking technologies: Host configuration and service discov ery principles Future routing architectures IPv6 deployment scenarios and challenges, IPv6 transition/integration Advanced IP multicast, including IPv6 multicast and SSM Software -defined networking Delay - tolerant networking Future home network architecture s IP network management and monitoring. Social Networks Recommended Readings Text Books: - 1. Tanenbaum A S and Wetherall D J (2010). Computer Networks. 2. Hagen S, (2006). IPv6 Essentials. 3. Recent publications on the relevant fields MALAVIYA NATI ONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST824 Course Name : Network on Chip Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Computer Architecture, Logic System Design Course Contents The Concept of route packet not wires for On -Chip Interconnection Networks, Topology and design architecture of Network -on-Chip, Area and power trade off NoC protocols, Routing and Flow Control me chanism, Verification of Communications in Networks -on-Chips. Application Mapping on Network -on-Chip, Resource Allocation for QoS On -Chip Communication, routing techniques in different 2D/ 3D NoC topology, performance evaluation in terms of throughput, latency, gitter. Signal Integrity and Reliability of Network -on-Chip, Testing of Network -on- Chip Architectures, Test and Fault Tolerance for NoC Infrastructures, Reconfigurable Network -on-Chip Design, Security in NoCs. Energy and Power estimation techniques Network -on-Chips Recommended Readings Text Books: - 1. Giovanni De Micheli, Luca Benini, DavideBertozzi, Networks on Chips:Technology and Tools, Morgan Kaufmann, 2006. 2. Fayez Gebali, HaythamElmiligi, Mohamed Watheq El -Kharashi, Networkson - Chips: Theory and Practice, CRC Press, 2017. 3. SudeepPasricha, NikilDutt, On -Chip Communication Architectures: System on Chip Interconnect, Morgan Kaufmann, 2010. MALAVIYA NATIONA L INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST803 Course Name : Advances in Compiler Design Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic course in Compile r Design Course Contents Modern Compiler Design – Structure of Compilers for Modern Programming Languages, Cross Compiler, Just -In-Time (JIT) and Adaptive Compilation, Runtime System Architectures. Parser Development - LR Parsers and LR Grammars – Design and Implementation, Parser and Ambiguity, Conflict Resolution, Lex and Yacc Tools. Optimizing Compiler - Control -flow Analysis, Control -flow Graphs, Basic Blocks, Data -flow Analysis Methods, Dependence Analysis, Global Optimizations, Loop Optimizations, Pe ephole Optimization and Optimal Code Generation, Data Dependence Analysis in Loops, Loop Scheduling. Recommended Readings Text Books: - 1. Aho, Lam, Sethi and Ullman: Compilers – Principles, Techniques and Tools, Pearson Education 2. Steven Muchnick : A dvanced Compiler Design & Implementation, MorganKaufmann 3. Holub: Compiler Design in C, Prentice Hall India. 4. Keith Cooper and Linda Torczon : Engineering a Compiler, Morgan Kaufmann. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST804 Course Name : Android Programming Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Basics: Review of Java Programming, Setting up and configuring Android Studio setup, Android Emulator Hello Android example, AndroidManifest.xml, R.java file, Activity, Fragment, Layout Manager - Relative Layout, Linear Layout, Table Layout, Grid Layout. A ctivity, Intent & Fragment: Activity Lifecycle, Activity Example, Intent – implicit and explicit, Intent filters, Fragment Lifecycle, Fragment Example, UI Widgets – buttons (toggle, switch, image), check box; Android Menu: Option Menu, Context Menu, Popup Menu; View. Android Service: lifecycle, example, Data Storage, Shared Preference, SQLite, Content Provider, Android Notification Adding functionality: Multimedia API, Speech API, telephony API, Location API Sensors: Sensor API, Working with WiFi, Working w ith Camera, Motion Sensor, Position Sensor; Android Graphics App development project. Recommended Readings Text Books: - 1. Official Android Website MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST806 Course Name : Computer Vision Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction, Pixels and Filters, Image pyramids and Fourier transform, Hough transform, Edge detection, RANSAC, Feature detectors, Harris, Feature descriptors, Corner detection and matching, 2D transformations, Image homographs, Camera models, camera cali bration, radiometry, color, shading, Bag of words, SIFT, SURF, Segmentation, Image indexing and search, Nearest Neighbor Match, Object Recognition, Face recognition, Differential motion: Optical flow, Feature Tracking & Motion Layers, Performance Evaluatio n Recommended Readings Text Books: - 1. Computer Vision: Algorithms and Applications, by Richard Szeliski 2. Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce. 3. Computer Vision: Models, Learning, and Inference by, Simon J. D. Prince, Cambridge University Press. 4. Concise Computer Vision: An Introduction Into Theory and Algorithms, by ReinhardKlette, Springer MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST807 Course Name : Cyber Physical Systems Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Characteristics of Cyber -Physical Syst ems (CPS) Cyber -Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS, Industry 4.0, AutoSAR, IIOT implications, Building Automation, Medical CPS CPS physical systems modeling and formalisms: CPS - Platform components - CPS HW platforms - Processors, Sensors, Actuators, CPS Network - WirelessHart, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks. Principles of Dynamical Systems - Dynamical Systems and Stability, Controller Design Techniques and Performance under Packet drop and Noise CPS implementation issues - From features to automotive software components, Mapping software components to ECUs, CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, and building real -time networks for CPS Safe Reinforcement Learning: Robot motion control, Autonomous Vehicle control Gaussian Process Learning, Smart Grid Demand Response , Building Automation Secure Deployment of CPS: Secure Task mapping and Partitioning, State estimation for attack detection, Automotive Case study : Vehicle ABS hacking, Power Distribution Case study : Attacks on SmartGrids Recommended Readings Text Books: - 1. "Introduction to Embedded Systems – A Cyber –Physical Systems Approach" - E. A. Lee, SanjitSeshia 2. “Principles of Cyber -Physical Systems” - Rajeev Alur MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST808 Course Name : Data Analytics Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Fundamentals of Learning, Basic Programming skills, Course Contents Introduction: Data Analytics, Big Data, Current lands cape of perspectives -

Skill sets needed; Statistical Inference -Populations and samples, Statistical modeling, Probability: Probability theory, conditional probability; probability distributions, fitting a model. Basic Analysis Techniques, Basic analysis t echniques, Statistical hypothesis generation and testing, Chi -Square test, t -Test, Analysis of variance, Correlation analysis, Maximum likelihood test Exploratory Data Analysis (EDA) and the Data Science Process: Basic tools (plots, graphs and summary stat istics) of EDA - Philosophy of EDA - The Data Science Process, Data Visualization - Basic principles, ideas and tools for data visualization. Python for common data analysis: libraries like NumPy, Pandas matplotlib, and seaborn. Data wrangling and manageme nt:Accessing database, CSV, and JSON data, Data cleaning and transformations, APIs and other tools for scraping the Web, Data Management : knowledge of SQL such as MySQL, NoSQL like MongoDB, Cassandra etc. Python for Data cleaning and transformations using Pandas and Sklearn. Mining Social -Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs. Recommended Readings Text Books: - 1. Trevor H astie Robert Tibshirani Jerome Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction, 2nd Edn, Springer, 2014 2. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014. 3. Jiawe i Han, MichelineKamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011. 4. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST809 Course Name : Data Compression Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Object Oriented Analysis and Design Course Contents Introduction: Compression techniques, lossless compression, lossy compression, measures of performance, modeling and coding. Mathematical preliminaries - Overview, introduction to information theory, models, physical models, probability models, Markov mode ls. Basic Coding Schemes: Statistical Methods - Shannon -Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding. Arithmetic Coding (Encoding, Decoding, Adaptive Coding). Dictionary Methods - LZ77, LZ78, LZW Algorithms. Case study of lossless compression standards. Lossless Compression standards: zip, gzip, bzip, unix compress, GIF, JBIG. Image and Video Compression: Discrete Cosine Transform, JPEG. Wavelet Methods - Discrete Wavelet Transform, JPEG 2000. Motion Compensation, Temporal and Spatial Predicti on. MPEG and H.264. Audio Compression: Digital Audio, WAVE, FLAC, MPEG -1/2 Audio Layers. Recommended Readings Text Books: - 1. Khalid Sayood. 2012. Introduction to Data Compression (4th ed.). Elsevier 2. David Salomon, Giovanni Motta. 2010. Handbook of Data Compression. Springer, London MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST810 Course Name : Data Mining Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to data mining: Motivation and significance of data mining, data mining functionalities, interestingness measures, classification of data mining system, major issues in data mining. Data pre -processing: Need, data summarization, data cleaning, data integration and transformation, data reduction techniques – Singular Value Decomposition (SVD), Discrete Fourier Transform (DFT), Discrete Wavelet Transform ((DWT), data discretization and concept hierarchy generalization. Mining frequent patterns, a ssociations and correlations: Basic concepts, efficient and scalable frequent itemset mining algorithms, mining various kinds of association rules – multilevel and multidimensional, association rule mining versus correlation analysis, constraint based asso ciation mining. Classification and prediction: Definition, decision tree induction, Bayesian classification, rule based classification, classification by backpropagation and support vector machines, associative classification, lazy learners, prediction, ac curacy and error measures. Cluster analysis: Definition, clustering algorithms partitioning, hierarchical, density based, grid based and model based; Clustering high dimensional data, constraint based cluster analysis, outlier analysis – density based and distance based. Data mining on complex data and applications: Algorithms for mining of spatial data, multimedia data, text data; Data mining applications, social impacts of data mining, trends in data mining. Recommended Readings Text Books: - 1. Han, J . and Kamber, M., “Data Mining - Concepts and Techniques”, 3rd Ed., Morgan Kaufmann Series . 2. Ali, A. B. M. S. and Wasimi, S. A., “Data Mining - Methods and Techniques”, Cengage Publishers. 3. Tan, P.N., Steinbach, M. and Kumar, V., “Introduction to Data Mining”, Addison Wesley – Pearson 4. Pujari, A. K., “Data Mining Techniques”, 4th Ed., Sangam Books. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST812 Course Name : Deep Learning Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Course Overview: Introduction to Deep Learning and its Applications. Introduction to Statistical Learning: Multi -Layer Perceptron, Back P ropagation, Linear Regression, etc. Convolutional Neural Networks: Convolution, pooling, Activation Functions, Back propagation of CNN, Weights as templates, Translation invariance, Training with shared parameters. CNN Architecture Design and Discussion: A lexNet, VGG, GoogLeNet, ResNet, Capsule Net, etc. Loss Functions and Optimization: Optimization, stochastic gradient descent, dropout, batch normalization, etc. Sequential Modelling: Recurrent and Recursive Nets, RNN, LSTM, GRU, Image captioning, visual qu estion answering, etc. Visualization and Understanding: Visualizing intermediate features and outputs, Saliency maps, Visualizing neurons, Cam -Grad, etc. Generative Models: VariationalAutoencoders, Generative Adversarial Networks like pix2pix, CycleGAN, et c Deep Reinforcement Learning: Reinforcement Learning (RL) Background, Policy gradients, hard attention Q -Learning Deep Learning Applications: Object Detection: RCNN, Fast RCNN, Faster RCNN, YOLO, Retina Net, SSD, etc. Semantic Segmentation: DeepLabV3, PS P Net, etc. Adversarial Attacks on CNN Recommended Readings Text Books: - 1. Ian Goodfellow and YoshuaBengio and Aaron Courville, “Deep Learning,” MIT Press. 2. Michael A. Nielsen, “Neural Networks and Deep Learning,” Determination Press, 2015. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST815 Course Name : Distributed Systems Credits : 3

L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to Distributed Systems, OS and Advanced OS, various distributed systems, Trends in Distributed System and challenges, Networking: network protocols, point -to-point communication. Introduction – Clocks, events and process states – Synchronizing physical clocks - Logical time and logical clocks – Global states,Limitations, Lamport's logical clock, vector clock, causal ordering, global state, Cuts. Distributed Mutual Exclusion: Lamport, Recart -agrawala, and Maekawa's algorithms; Suz uki-kasami broadcast algorithm, and Raymond's tree based algorithm , Elections algorithms , Transactions and Concurrency Control – Transactions -Nested transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic Commit Distributed transactions: two phase commit, three -phase commit, ACID/BASE models Techniques of Inter process Communication: the API for internet protocols – External data representation and Multicast communication, Sun RPC: programming and implementation, Network virtua lization: Overlay networks. Case study: MPI Remote Method Invocation And Objects: Remote Invocation – Introduction – Request -reply protocols – Remote procedure call – Remote method invocation. Case study: Java RMI – Group communication – Publish -subscribe systems – Message queues – Shared memory approaches – Distributed objects – Case study: Enterprise Java Beans -from objects to components. Distributed Deadlock Detection: Resource Vs. Communication deadlock, Replication, Strategies to handle deadlock, Ho -Ramamoorthy, Path -Pushing, Edge -Chasing, Diffusion Computation -based algorithms. Agreement Protocols: System model, Classification of agreement problems, Solutions to Byzantine Agreement (BA) problems.Distributed Scheduling: Issues in Load Distribution, Com ponents of a load distribution algorithm, Load Distribution Algorithms, V -system, Sprite, and Condor. Network file systems: design, NFS, AFS (scale), DFS & CIFS (cache control), CODA (redundancy) Google File System (GFS), Hadoop Distributed File System (HD FS)Distributed Shared Memory: Algorithms for implementing DSMs, Memory Coherence, and Coherence Protocols, IVY Process Management: Process Migration: Features, Mechanism – Threads: Models, Issues, Implementation. Resource Management: Introduction - Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach Recovery: Classification of failures, Synchronous and Asynchronous Check pointing and Recovery. Fault Tolerance: Commit Protocols, Voting Protocols, Failu re Resilient Processes. Protection and Security: Access Matrix Model, Implementation of access matrix, Unix, and Amoeba. Case study -Distributed systems Recommended Readings Text Books: - 1. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems Pr inciples and Paradigm," 2nd Edition, Pearson 2. George Coulouris, Jean Dollinmore, Tim Kindberg, Gordon Blair "Distributed Systems - Concepts and Design," 5th Edition, Pearson 3. M. Singhal& N. Shivaratri, "Advanced Concepts in Operating Systems: Distributed , Database and Multiprocessor Operating Systems", Tata McGraw Hill, 2015 4. John Bloomer, "Power Programming with RPC," O'Reilly & Associates, Inc 5. Advanced Programming in the Unix Environment by W. Richard Stevens, Addison -Wesley, 6. Liu M.L., "Distribu ted Computing, Principles and Applications", Pearson Education, 7. Distributed Systems - An Algorithmic approach by Sukumar Ghosh MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY

JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST816 Course Name : E -Commerce Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: knowledge of Digital Market, Basics of Computer Network and security Course Contents Introduction: Definition of Electronic Commerce, tech nology and prospects, incentives for engaging in electronic commerce, needs of E -Commerce, E -Commerce Infrastructure, advantages and disadvantages, Impact of E -commerce on business, E -Commerce Models. Network Infrastructure for E - Commerce. Internet and In tranet based E -commerce: Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication. Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile Information device. Web Security: Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls. Encryption: Encryption techniques, Symmetric Encryption: Keys and data encryption standard, Triple encryption, Secret key encryption; Asymmetric encryption: public and private pair key encryption, Digital Signatures, Virtual Private Network. Customer Service Expectations of the E -commerce Exp erience, Electronic Payments: Overview, The SET protocol, Payment: Smart card, credit card, magnetic strip card, E -Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E- Commerce Law, Forms of Agreement, Govt. policies and Age nda Recommended Readings Text Books: - 1. Turban, “Electronic Commerce 2004: A Managerial Perspective”, Pearson Education 2. Pete Lohsin , John Vacca “Electronic Commerce”, New Age International 3. Bajaj and Nag, “E -Commerce the cutting edge of Business”, TMH 6 4. Laudon, “E -Commerce: Business, Technology, Society”, Pearson Education MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST817 Course Name : Hardware Software Codesign Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Logic System Design/ Digital Logic Design Course Contents Codesign overview, device Modeling and methodologies of system design, Hardware software partitioning and scheduling, Co simulation, synthesis and verifications, Architecture, Interface and reconfiguration, System on chip, Application specific processors (DSP), Codesign tools and case studies Recommended Readings Text Books: - 1. A Practical Introduction to Hardware/Software Codesign, Patrick Schaumont,Springer, 2009, ISBN 978 -1-4419 -5999 -7 2. Specification and Design of Embedded Systems Daniel D. Gajski , Frank Vahid, S. Narayan, & J. Gong, Prentice Hall, 1994 3. Hardware / Software Co -Design: Principles and Practice,JStaunstrup and Wayne Wolf, Prentice Hall, 1994. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Compu ter Science & Engineering Course Code : 21CST818 Course Name : Image Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Image Preliminaries & Image Processing: Overview, Computer imaging systems, Human visual system, image model, etc. Geometric transformations: Translation, rotation, scaling and shearing. Frequency transformation: Discrete Fourier transform (DFT), fast Fourier transform (FFT), short - time Fourier transform (STFT), Multi -resolution Expansions:

Wavelet Transforms in 1 -D and 2 - D. The Fast Wavelet Transform Wavelet Packets Transform. Feature Extraction and Dimension Reduction Color, Texture, Shape and structure Features in spatial an d frequency domains, Corner Detection, Hough Transform, Principal Component Analysis, Linear Discriminant Analysis, Feature Reduction in Input and Feature Spaces. Image Segmentation. Gray -level thresholding, Supervised vs. Unsupervised thresholding, Binari zation using Otsu's method, Locally adaptive thresholding, Color -based segmentation, Region oriented segmentation, Use of motion in segmentation, Spatial techniques, Frequency domain techniques. Features Based Image Matching:Scale Space Image Processing, D ifferent Feature descriptors: Key Point Detection, SIFT descriptor SURF descriptor Bag of Visual Words approach, Geometric consistency check, Vocabulary tree Panoramic Imaging, Template Matching, Mono Panorama, Stereo Panorama. Recommended Readings Text Books: - 1. J G Proakis and D G Manolakis, "Digital Signal Processing," Pearson, Fourth edition 2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Prentice Hall, 3rd Edition, 2007. 3. Bishop, Pattern Recognition and Machine Learning 4. Dud a, Pattern Classification MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST819 Course Name : Information Retrieval Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to Information Retrieval: The nature of unstructured and semi -structured text. Inverted index and Boolean queries. Text Indexing, Storage and Compression: Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings, lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n -gram indexes, real -world issues. Retrieval Models: Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and que ry expansion. Rocchio. Performance Evaluation: Evaluating search engines. User happiness, precision, recall, F -measure. Creating test collections: kappa measure, interjudge agreement. Text Categorization and Filtering: Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting. Text Clustering: Clustering versus classification. Partitioning methods. k -means clustering. Mixture of Gaussians model. Hierarchical agglomerative clustering. Clustering terms using documents. Advanced Topics: Summarization, Topic detection and tracking, Personalization, Question answering, Cross language information retrieval. We b Information Retrieval: Hypertext, web crawling, search engines, ranking, link analysis, PageRank, HITS, XML and Semantic web. Recommended Readings Text Books: - 1. Manning, Raghavan and Schutze, Introduction to Information Retrieval, Cambridge University Press. 2. Baeza -Yates and Ribeiro -Neto, Modern Information Retrieval, Addison -Wesley. 3. SoumenChakrabarti, Mining the Web, Morgan -Kaufmann 4. David A. Groosman, Information Retrieval, Algorithm and Heuristics, Springer MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY

JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST820 Course Name : Internet of Things Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Networks, Wireless Communication Course Contents Introduction: Internet of Things and Connected Products, IoT paradigm, Smart objects, Goal orientation, Convergence of technologies; Business Aspects of the Internet of Things. Internet and “Things”: Layers, Protocols, Packets, Services, Performance parame ters of a packet network and applications: Web, Peer -to-peer, Sensor networks, and Multimedia. Hardware and Software: Hardware components, Microcontrollers and Software; Operating Systems. Protocols and Platforms -IoT Communication Protocols, Transport Pro tocols, Application Protocols; Cloud computing for IoT. Services and Attributes: Data creation, Data gathering and Data dependency; Robustness, Scaling, Privacy, Security, Trust. Designing & Developing IoT applications: Introduction, IoT Design Methodology , Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages Application: Implications for the society, IoT case study. Recommended Readings Text Books: - 1. The Intern et of Things: Key Applications and Protocols, David Boswarthick, Olivier Hersent, and Omar Elloumi, Wiley 2. Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley. 3. Latest research articles MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST822 Course Name : Natural Language Processing Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Data structures and algorithms, and strong programming skills Course Contents Introduction to NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguit y. The role of machine learning. Brief history of the field. N -gram Language Models. The role of language models. Simple N -gram models. Estimating parameters and smoothing. Evaluating language models. Part Of Speech Tagging and Sequence Labeling Lexical s yntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). Neural Networks and LSTM Introduction to perceptron and backpropagation, LSTM Recurrent Neural Networks Syntactic parsing Grammar formalisms and treebanks. Efficient parsing for context -free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift -reduce dependency parsing Semantic Analysis Lexical semantics and word -sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing. Information Extraction (IE) Named entity recognition and relation extraction. IE using sequence labeling. Machine Translation (MT) Basic issues in MT. Statistical translation, word alignment, phrase -based translation, and synchronous grammars. Advanced Language Processing Advance language modeling (including LDA), other applications like summarization, question answering Recommended Readings Text Books: - 1. Speech and Language Processing: An Introduction to Natural Language MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST823 Course Name : Nature Inspired Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Programm ing languages, Data structures and Algorithms Course Contents Introduction to

Algorithms, Optimization, Search for optimality, computational intelligence, Nature Inspired solutions and characteristic, Nature inspired Metaheuristics and its brief history, Analysis of Optimization Algorithms, Nature Inspired Algorithms, parameter Tuning and control Constrained and unconstrained optimizations, Random Walks and Optimizations, evolutionary strategies and Evolutionary Algorithms (EA), Simulated Annealing (SA) Al gorithm and its behavior, Genetic Algorithms(GA) - genetic operator, parameters, fitness functions, genetic programming and convergence analysis, GA variants, Differential Evolution (DE), various Applications. Swarm Intelligence optimization, Particle Swarm Optimization(PSO) Algorithm, Ant Colony Optimization (ACO) Algorithms, Artificial Bee Colony ACO) optimization algorithms, Cuckoo Search (CS) Algorithms, Intelligent Water Drop Algorithm (IWD), Bat Algorithms(BA), Firefly Algorithms(FA) Framework for self -tuning algorithms, Dealing with constraints, constraints handling, fitness functions ,multi -objective optimization techniques and its applications , Hybrid algorithms, Ways to Hybridize Recommended Readings Text Books: - 1. Nature -Inspired Optimization Algorithms – by Xin -She Yang (Author), June 30, 2016 2. Mathematical Foundations of Nature -Inspired Algorithms, Xin -She Yang, Xing -Shi He, Springer; 1st ed. 2019 edition 3. Nature -Inspired Metaheuristic Algorithms: Second Ed ition, Xin -She Yang, Luniver Press 4. Introduction to Evolutionary Computing, A. E Eiben and J. E. Smith, Second Printing, Springer, 2007 5. Evolutionary Algorithms in Engineering Applications, Editors: DipankarDasgupta and ZbigniewMichalewicz, Springer -Verlag, 1997 6. D. E. Goldberg, Genetic Algorithms in search, Optimization and Machine Learning, Pearson India , 7. Optimization Techniques and Applications with Examples By Xin -She Yan, wiley publisher MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST825 Course Name : Network Performance Modelling Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to Network Modeling: Network modeling, Computer Network as a discrete event system, Modeling and measurement tools, Network performance metrics – first order and second order metrics, Network capacity, Difference between throughput and capacit y Network Calculus: Models for data flows, arrival curves and service curves, Greedy shapers, Basic min -plus and max - plus calculus, min -plus and max -plus systems, Optimal smoothing, FIFO systems and aggregate scheduling, Time varying shapers, Systems with losses, Case studies – (1) Analyzing spanning tree based data forwarding using network calculus, (2) Bound on loss rate Stochastic Scheduling and Resource Allocation: Stochastic scheduling, dynamic resource allocation, Dynamic programming models for stocha stic scheduling, Queuing networks – open loop and closed loop networks, Jackson networks, Network fairness – proportional and max -min fairness, Markov process and its application for analyzing network resource allocation and fairness, available bandwidth e stimation, Case studies – (1) TCP/IP flow and congestion control, (2) Modeling dynamic routing and scheduling as a queuing network problem, (3) Analysis of IEEE 802.11 channel access using two dimensional Markov process. Network Games: Introduction to game theory, Zero sum games, Nash equilibrium, Pareto optimality, Cooperative and Non -cooperative games, General network games – resource sharing games, routing games, congestion games, Mechanism design, Case studies – (1) Selfish routing in networks and price of anarchy, (2) Oblivious routing, (3) Network resource allocation games Protocol Analysis: Modeling discrete event system using petri -nets, basics of petri nets, stochastic petri nets, queuing petri nets, properties of petri nets, structural analysis of petri nets, Petri net modeling tools – simQPN, Case studies – (1) Wireless channel model using stochastic petri net, (2) Data center network throughput analysis using queuing Petri Nets Recommended Readings Text Books: - 1. "Routing, Flow, and Capacity Design in Communication and Computer Networks", Micha■Pióro, DeepankarMedhi, ISBN: 0125571895, Publisher: Morgan Kaufmann 2. The Network Calculus Book by Jean -Yves Le Boudec and Patrick Thiran is available for free download:http://ica1www.epfl.ch/PS_files/ NetCal.htm 3. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" Morgan Kaufman Publishers 4. Dimitri P. Bertsekas and Robert G. Gallager, "Data Networks" : Materials are available at http://web.mit.edu/dimitrib/www/datanets.html 5. "Network Optimization: Continuous and Discrete Models", D. Bertsekas 6. Research Publications - will be discussed and distributed time to time MALAVIYA NATIONAL INSTITUTE OF TE CHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST826 Course Name : Neural Networks Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential. Course Contents Introduction to Neural Architecture, McCulloch -Pitts networks, Learning Rules, Perceptrons, Regression and least mean square algorithm, Multilayer perceptrons, Back propagation: generalized delta rule, limitations, modifications – momentum, variable learning rate, conjugate gradient. Radial -basis function networks, Support vector Machines, Unsupe rvised learning and self-organization, Boltzmann machines and deep networks, Convolutional networks, Recurrent networks, Associative Memories, Adaptive Resonance Theory, Applications of Neural Networks. Recommended Readings Text Books: - 1. Simon Haykin : Neural Networks: A Comprehensive Foundation, Pearson MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST827 Course Name : Parallel Processing & Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to parallel computing. Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O. The PRAM Shared -Memory Model, Distri buted -Memory or Graph Models, Circuit Model and Physical Realizations PRAM and Basic Algorithms, PRAM Submodels and Assumptions, Data Broadcasting, Semigroup or Fan -In Computation, Parallel reduction, Prefix sums, List ranking, Preorder tree traversal, Mer ging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS. Thread and process level parallel architectures: MIMD, multi -threaded architectures. Distributed and shared memory MIMD architectures. Dyn amic interconnection networks.Mapping and scheduling: Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock. Parallel programming and parallel algori thms: Programming models, parallel programming on multiprocessors and multicomputers. Parallel algorithm structure, analyzing parallel algorithm. Elementary parallel algorithms, Matrix algorithms, sorting, Graph algorithms. Parallel Algorithm Complexity, Asymptotic Complexity, Algorithm Optimality and Efficiency, Complexity Classes, Parallelizable Tasks and the NC Class, Parallel Programming Paradigms, Solving Recurrences Sorting and Selection Network: Design of Sorting Networks, Batcher Sorting Networks , Mesh -Base Architectures: Sorting on a 2D Mesh or Torus, Routing on a 2D Mesh or Torus, Numerical 2D Mesh Algorithms, Low -Diameter Architectures: Hypercubes and Their Algorithms, Sorting and Routing on Hypercubes Recommended Readings Text Books: - 1. J. Jaja, An Introduction to Parallel Algorithms, Addison Wesley, 1992. 2. F. T. Leighton, Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kaufmann Publishers, San Mateo,California,1992 3. BehroozParhami, Introduction t o Parallel Processing, Algorithms and Architecture, kluwer academic publishers,2002ed MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST828 Course Name : Parallelizing Compiler Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic course in Compiler Design Course Contents Introduction – Compilation for parallel machines and automatic detection of parallelism, structure of a parallelizing compiler. Dependence Theory and Practice - Types of dependences, data and control dependencies, dependence analysis, direction vectors, loop carried and loop independent dependences, tests for data dependence and their applicability, con struction of data dependence and control dependence graphs. Parallel Code Generation - Automatic extraction of parallelism, representation of iteration spaces of nested loops, loop based transformations such as loop distribution, loop coalescing, loop int erchange and cycle shrinking transformation. Interprocedural Analysis and Optimization - aliasing information, summary data flow analysis, interprocedural constant propagation, interprocedural data dependence analysis and parallelization of call statement s. Recommended Readings Text Books: - 1. Randy Allen, Ken Kennedy: Optimizing compilers for modern architectures. Morgan Kaufmann 2. Steven Muchnick : Advanced Compiler Design & Implementation, Morgan Kaufmann. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST830 Course Name :Quantum Computing Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Conte nts Introduction to quantum computing, Relevant Linear algebra for quantum computing, Postulates of quantum mechanics, Classical computing, Quantum circuits, Quantum Fourier Transform Quantum search algorithms, Physical realization of quantum computers. Quantu m noise, Quantum operations, quantum information and quantum channel Recommended Readings Text Books: - 1. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press. 3. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific . MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY

JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST831 Course Name : Real Time Systems Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction : Definition, Typical Real Time Applications; Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models f or Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency. (7 hours) Real Time Scheduling: Common Approaches to Real Time Scheduling: Clock Driven Approach, W eighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective -Deadline -First (EDF) and Least -Slack -Time -First (LST) Algorithms, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Pri ority Driven and Clock Driven Systems. (8 hours) Resources Access Control: Effect of Resource Contention and Resource Access Control (RAC), Non - preemptive Critical Sections, Basic Priority -Inheritance and Priority -Ceiling Protocols, Stack Based Priority -Ceiling Protocol, Use of Priority -Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple -Unit Resources, Controlling Concurrent Accesses to Data Objects. (8 hours) Multiprocessor System Environment :Multiproces sor and Distributed System Model, Multiprocessor Priority -Ceiling Protocol, Schedulability of Fixed - Priority End -to-End Periodic Tasks, Scheduling Algorithms for End -to-End Periodic Tasks, End - to-End Tasks in Heterogeneous Systems, Predictability and Valid ation of Dynamic Multiprocessor Systems, Scheduling of Tasks with Temporal Distance Constraints. (9 hours) Real Time Communication : Model of Real Time Communication, Soft and Hard RTCommunication systems , Priority -Based Service and Weighted Round -Robin Service Disciplines for Switched Networks, Medium Access Control Protocols forBroadcast Networks, Internet and Resource Reservation Protocols, Real Time Protocols, Communication in Multicomputer System. An Overview of Real Time Operating Systems and Databa ses: Features of RTOS, UNIX as RTOS, POSIX Issues, Temporal Consistency, Concurrency Control. (8 hours) Recommended Readings Text Books: - 1. Real Time Systems: Theory and Practice – Mall Rajib, Pearson Education, 2009 2. Real -Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley, 2002. 3. H. Kopetz, "Real time systems: Design Principles for distributed embedded applications”, Springer Publications, 2011. 4. Douglass, Real Time UML: Advances in the UML for Real -Time Systems, 3/ e, Addison - Wesley, 2004. 5. Awad, Kuusela& Ziegler, Object -Oriented Technology for Real Time Systems: A Practical Approach Using OMT and Fusion, l/e, Pearson Education, 1996. 6. Ward & Mellor, Structured Development for Real -Time Systems, Vol. III: Impleme ntation Modeling Techniques, Prentice Hall, 1986. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST832 Course Name : Robotics and Control Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to robotics -origin of automation, Classification of robots, Rotations and translation of vectors, Transformations and Euler angle representations, Homogeneous transformations, Problem s, Trajectory planning, Actuators, Velocity and position sensors. Range, proximity, touch sensors, Control of Robot Manipulators: PD control, Nonlinear Control, Stability, Lyapunov's Direct Method, Adaptive Control, Robot Vision, Image segmentation, Templa te matching, Polyhedral objects, Shape analysis, Grasping and industrial automation Recommended Readings Text Books: - 1. M. Spong, S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control Wiley (2006) 2. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", 3. Craig. J. J. "Introduction to Robotics - mechanics and control", Addison - Wesley, 1999 4. Nagrath Gopal "Co ntrol Systems Engineering -Principles and Design" New Age Publishers 5. K. Ogata, "Modern control engineering", Pearson 2002. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST801 Course Name : 5G TECHNOLOGY Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction and Key Specs of 5G Technologies, Opportunities and Challenges in mmWave MIMO Communication, Channel Models for m mWave MIMO Systems, Hybrid Signal Processing for mmWave MIMO, Digital and AnalogBeamforming, Hybrid RF/ BB Precoder and Combiner Design for mmWave MIMO, Hybrid Transceiver Architectures for mmWave MIMO, Sparse Signal Processing and Channel Estimation for m mWave MIMO, Optimal Design of Beams and Sensing Matrix for Channel Estimation. Overview of Sub 6GHz Multiple Antenna, MIMO and MU-MIMO Technologies, Signal Processing for MIMO Systems, Optimal Power Allocation and Precoding for MIMO, Introduction to 5G Ma ssive MIMO Systems, Key Features of Massive MIMO and Advantages over Point -to-Point and MU -MIMO, Signal Processing Operations for Massive MIMO in UL and DL,Massive MIMO Channel Model – Large/ Small Scale Fading, Properties of Random Vectors and Massive MIMO Analysis, Analysis of Spectral Efficiency in Massive MIMO Systems and Power Scaling, Pilot Design and Channel Estimation in Massive MIMO Systems Transmitter and Receiver Schemes with Imperfect CSI, Spectral Efficiency Analysis of Massive MIMO with Imperf ect CSI, Power Scaling in Massive MIMO with Imperfect CSI and Comparison with Perfect CSI, Multi -Cell Massive MIMO Model, Channel Estimation with Pilot Reuse and Pilot Contamination. New Modulation Schemes for 5G - Spatial Modulation (SM), Space Shift Keyin g (SSK) and Optimal Receiver, Generalized Spatial Modulation (GSM), Spectral Efficiency Comparison of GSM with Conventional V -BLAST. Introduction to Non - Orthogonal Multiple Access (NOMA) Technology, Efficiency of NOMA wrto Conventional Orthogonal Multiple Access (OMA), Fixed NOMA Protocol for UL/ DL – Performance Analysis, Ordered NOMA Protocol and Performance Analysis, Comparison with Fixed NOMA, Optimal Power Allocation for NOMA Systems Overview of Multicarrier Modulation , Introduction to OFDM and MIMO OFDM Transceiver Design, Motivation for Filter Band Multi Carrier (FBMC) Technology in 5G, System Model for FBMC and Signal Processing, Offset QAM (OQAM) Modulation and Transceiver Design, MIMO -FBMC System – Transmit/ Receive Signal Processing, Introducti on to Full -Duplex Technology, Key Features and Advantages of Full Duplex Systems, Linear/ Non -Linear Self -Interference and Analog, Digital Cancellation Stages Introduction to 5G New Radio (NR) Standard, Introduction to 5G

NB -IoT Technology, Overview of LT E- Cat M1 and Cat NB 1 Standards/ Systems 5G advanced concepts : Softwareization, virtualization, NFV, VNFV, 5G Slicing and etc Machine Type Communication(MTC) : Use cases and categorization, MTC Requirements, Fundamental techniques for MTC, Massive MTC, Ultra - reliable low -latency MTC, D2D Communication: from 4G to 5G, Radio resource management for mobile broadband D2D, Multi -hop D2D, communications for proximity and emergency services, Multi -operator D2D communication. 5G Radio Access Technologies: Acce ss design principles for multi -user communications, Multi -carrier with filtering, Non -orthogonal schemes for efficient multiple access, Radio access for dense deployments, Radio access for V2X communication, Radio access for massive machine -type communicat ion. Recommended Readings Text Books: - 1. Asif Osseiran, Jose F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016. 2. Jonathan Rodriquez, "Fundamentals of 5G Mobile Networks", Wiley, 2015 3. Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, "5G System Design – Architectural and Functional Considerations and Long Term Research", Wiley, 2018 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST834 Course Name : Selected Topics in Operating System Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Operating Systems Course Contents Introduction: I ntroduction and Background, Power of abstractions, Hardware resources, OS Functionalities, Managing the CPU and Memory. OS -Structure: Commercial OS, Monolithic structure, DOS like -structures. SPIN Approach to extensibility, Logical Protection Domains, Customized OS, Mechanism for events. Exokernel and MicroKernel: Approach to extensibility, Default core services in Exokernel, Secure Binding, Memory Management, L3 MicroKernel Approach, Potentials for Performance Loss, Strikes against Microkernel, Address Spa ce Switches, Thread switches and IPC. Virtualization: Introduction, Platform Virtualization, Hypervisors, Full Virtualization, Para Virtualization. Memory Virtualization: Memory Subsystem recall, Shadow page table. VM oblivious page sharing, Memory Allocat ion Policies. CPU Virtualization and Device Virtualization: Control and Data transfer in Action, Disk IO Virtualization Protection & Security: Potential Security violations, External versus Internal Security, Policies and Mechanisms, Protection Domain, Des ign Principles for Secure Systems, Access Matrix Model & its Implementation., Case Studies: Unix Operating system, Hydra Kernel, Amoeba, Andrew. Recommended Readings Text Books: - 1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, 9th Edition, Wiley 2. Virtualization Essentials by Matthew Portnoy, Second Edition 3. Advanced Concepts In Operating Systems by Singhal, Tata McGraw -Hill Education 4. Daniel Bovet and Marco Cesati, Understanding the Linux Kernel, 3rd Edition, O' Reilly Media, 2008. 5. https://in.udacity.com/course/advanced -operating -systems --ud189/ MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST833 Course Name : Selected Topics in Computing Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Programming in C / Python, Operating Systems, Database Management Systems, Computer Networks, Computer Architecture Course

Contents Topics will be announced by the Course Instructor at the beginning of the course depending on the emerging and evolving architectures. However, a sample list of topics are given for 2020 -21 as below: Cluster and Grid Computing, Cloud Computing Big Data Ana lytics, Data Science, Data Lakes Internet of Things, 5G and beyond Software Defined Networks, Network Function Virtualization Quantum Computing, Block Chain Recommended Readings Text Books: - 1. Request for Comments, Red Books, White Papers 2. Research Papers on various aspects as decided by the Instructor 3. Lecture Notes of the Instructor 4. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, Addison -Wesley Professional, 2016 5. Kai Hwang, Min Chen, Big -Data Analytics fo r Cloud, IoT and Cognitive Computing, Wiley - Blackwell, 2017 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST835 Course Name : Social Media Mining Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Online Social Networks (OSNs): Introduction - Types of social networks (e.g., Twitter, Facebook), Measurement and Collection of Social Network Data, Social Networks - Basic Structure and Measures, Basics of Text Processing over Social Data, Entity linking and entity resolution for Social data. Characteristics of OSNs: Information Diffusion, Experimental studies over OSNs, Sampling, Fundamentals of Social Data Analytics: Topic Models, Random Walks, Heterogeneous Information Networks Applied Social Data An alytics: Recommendation Systems, Community identification and link prediction. Advanced Topics: Online experiments for Computational Social Science, Big Data Sampling Recommended Readings Text Books: - 1. Matthew A. Russell. Mining the Social Web: Data Mining Facebook, Twitter, Linkedin, Google+, Github, and More, 2nd Edition, O'Reilly Media 2. Jennifer Golbeck, Analyzing the social web, Morgan Kaufmann 3. Charu Aggarwal (ed.), Social Network Data Analytics, Springer 4. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, Social Media Mining An Introduction, Cambridge University Press MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST836 Course Name : Social Network Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Network Models: Properties of Real -World Networks: Degree Distribution, Clustering Coe■cient, Average Path Length. Random Graphs , Small -World Model, Preferential Attachment Model, Modeling of Real -World Networks using Random Graphs, Small -World Model and Preferential Attachment Model Network Measures: Centrality: Degree Centrality, Eigenvector Centrality, Katz Centrality, PageRank, Centrality, Closeness Centrality, Group Centrality. Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence. Community Analysis: Community Detection, Community Detection Algorithms: Member -Based Community Detection, Group -Based Community Detection. Community Evolution: How Networks Evolve, Community Detection in Evolving Networks. Community Evaluation: Evaluation with Ground Truth, Evaluation without Ground Truth . Recommendation: Classical Recommendation A lgorithms: Content -Based Methods, Collaborative Filtering (CF), Extending Individual Recommendation to Groups of Individuals, Recommendation

Using Social Context, Evaluating Recommendations: Evaluating Accuracy of Predictions, Evaluating Relevancy of Recom mendations Graph Representation Learning, Knowledge Graphs and Meta Paths, Graph Convolutional Networks, Link Prediction, Influence Maximization & Outbreak Detection. Recommended Readings Text Books: - 1. Networks, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg. 2. Networks: An introduction by Mark Newman. 3. The Development of Social Network Analysis" by Linton C Freeman 4. Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. Social media mining: an introduction. Cambridge University Press MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST837 Course Name : Software Project Management Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Software Engineering, Computer Programming (C/Java/Python/C++), Microsoft Excel Course Contents Software Project Concepts : Software Project Categorization, Stakeholders, Software project Activities, Practices & Standards, Selecting Process Models (Spiral, Incremental, Prototyping, RAD, Agile). Estimation & Evaluation techniques,Cost Benefit Analysis, Risk Analysis for Projec t Evaluation, Program management, Project effort and cost estimation; Basis of estimation, Estimation method categorization, SLOC, Function Point Analysis, COCOMO, Putnam's work. Estimation using FP. Project Planning: Stepwise planning, Activity based appr oach (WBS), Sequencing and Scheduling of Activities, Critical Path Method. Risk Analysis and Management: Risk Identification, Projection, Risk Identification, Projection, Risk Refinement, Risk Monitoring and Management Schedule and Cost Monitoring: Collect ing Data & Reporting, Graphical Visualization techniques, Cost Monitoring, Earned Value analysis, Requirements management, Change Control. Contract Management: Types of Contracts, Stages in Contract Placement, Typical Terms of a Contract, Contract Manageme nt and Acceptance. Software Configuration Management (SCM), SCM Tools, Project Reviews Testing and Software Reliability, Metrics, ISO and CMMI, Project Scheduling & Tracking, Software Quality Assurance, Software Configuration Management Recommended Rea dings Text Books: - 1. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", 6th Edition, Tata McGraw Hill, 2017. 2. PankajJalote, Software Project Management in Practice. 3. Roger S. Pressman, Software Engineering 4. Royce, "Software Proj ect Management", Pearson Education, 1999. 5. Robert K. Wysocki, Effective Software Project Management, Wiley, 2009. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST838 Course Name : Software Testing and Validation Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Software engineering, basic computer programming skills Course Contents Testing Environment and Test Processes: Software Testing Environment, Overview of Software Testing Process, Organizing for Testing, Developing the Test Plan, Verification Testing, Analyzing and Reporting Test Results, Acceptance Testing. Levels of Testing, Unit Testing, Integration Testing, Defect Bash Elimination. System Testing, Usability and Accessibility Testing, Configuration Testing, Compatibility Testing. Functional and Non -functional system testing, Compliance Testing, Load Testing, Performance Tes ting and Security Testing. Static and dynamic testing, Black -box or functional testing, Equivalence partitioning, BVA, structural, White box or glass box testing, Mutation Testing, Data flow testing. Test Automation: Software Testing Tools, Software Test A utomation, Debugging, Case study. Recommended Readings Text Books: - 1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education 2. A.P. Mathur, Foundations of Software Testing, Pearson publications 3. NareshChauhan , “Software Testing Principles and Practices ” Oxford University Press , New Delhi . 4. Ilene Burnstein, “ Practical Software Testing”, Springer International Edition. 5. RenuRajani, Pradeep Oak, “Software Testing – Effective Methods, Tools an d Techniques”, Tata McGraw Hill. 6. William Perry, “Effective Methods of Software Testing”, Third Edition, Wiley Publishing MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21C ST840 Course Name : VLSI Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Logic synthesis & verification: Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High -level synthesis. VLSI Algorithms Partitioning: Problem formulation, classification of partitioning algorithms, Group migration algorithms, simul ated annealing & evolution, other partitioning algorithms. Placement, floor planning & pin assignment: Problem formulation, simulation base placement algorithms, other placement algorithms, constraint -based floorplanning, floor planning algorithms for mixe d block & cell design. General & channel pin assignment. Global Routing: Problem formulation, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches. Detailed routing: problem formulation, classification of routing algorithms, single layer routing algorithms, two -layer channel routing algorithms, three -layer channel routing algorithms, and switchbox routing algorithms. Over the cell routing & via minimization: two layers over the cell routers, constrained & unconstrained via minimization Compaction: problem formulation, one -dimensional compaction, two dimension -based compaction, hierarchical compaction. Recommended Readings Text Books: - 1. NaveedSherwani, “Algorithms for VLSI Physical Design Automation”, 3rd Edition, 2005, Springer International Edition 2. S.H. Gerez, “Algorithms for VLSI Design Automation”, 1999, WILEY Student Edition, John Wiley & Sons (Asia) Pvt. Ltd. 3. ChristophMeine l& Thorsten Theobold, “Algorithms and Data Structures for VLSI Design”, KAP, 2002. 4. Rolf Drechsheler : “Evolutionary Algorithm for VLSI”, Second edition MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Scienc e & Engineering Course Code : 21CST841 Course Name : Wireless Sensor Networks Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction: Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor n etworks, unique constraints and challenges, advantages of adhoc/sensor network, driving applications, issues in adhoc wireless networks/sensor network, data dissemination and gathering, Historical Survey of Sensor Networks Basic Architectural Framework:Tra ditional layered stack, Cross -layer designs, Sensor network architecture, Physical Layer, Basic Components, Hardware Platforms: Motes, Sensor Devices, Types of Sensors, Sensor's Specification MAC

Protocols : Fundamentals of MAC protocols - Low duty cycle p rotocols and wakeup concepts - Contention Based protocols - Schedule -based protocols - SMAC - BMAC - Traffic -adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol. Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table -driven, on -demand, hybrid, flooding, hierarchical, and power aware routing protocols. Sensor network security: Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks. Programming in WSNs: Challenges and limitation s of programming WSNs, Introduction to TinyOS, -Programming in Tiny OS using NesC, Emulator TOSSIM, Open research issues Recommended Readings Text Books: - 1. Feng Zhao, Leonidas Guibas, " Wireless Sensor Network", Elsevier, 1st Ed. 2004 (ISBN: 13 - 978-1-55860 -914-3) 2. Kazem, Sohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Network: Technology, Protocols and Application", John Wiley and Sons 1st Ed., 2007 (ISBN: 978 -0-471-74300 -2). 3. Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, "Wire less Sensor Network", Springer 1st Ed. 2004 (ISBN: 978 -4020 -7883 -5). 4. E. H. Callaway, Jr. E. H. Callaway, Wireless Sensor Networks Architecture and Protocols:, CRC Press , 2009 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST821 Course Name : Machine Learning Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic understanding of probability and statistics, linear algebra an d calculus. A basic knowledge of programming (preferably Python) is essential. Course Contents Advanced linear Algebra (e.g., SVD). The learning problem – learning versus design, types of learning - supervised, unsupervised, reinforcement and other views o f learning.LinearModeling: A least squares approach, linear modeling, making predictions, vector/matrix notation, linear regression, nonlinear response from a linear modelz. Generalization and over -fitting. The Bayesian approach to machine learning: exact posterior, marginal likelihoods Probability based learning: Bayes theorem, Bayesian prediction, conditional independence and factorization, the Naive Bayes model.Error based learning: simple linear regression, multi variable linear regression with gradient descent Logistic regression – gradient descent, non linear transformations the Z space. Similarity based learning: nearest neighbor, k - nearest neighbors, efficient distance computations: the KD trees Information based learning: learning and trees, Classi fication and regression trees. Ensemble methods, Boosting, Bagging, Random forests. Neural networks – the perceptron, Multilayer perceptron, activation functions, gradient descent, deriving back propagation. Multi -task and transfer learning, Deep -learning. Linear discriminant analysis (LDA), Principal component analysis (PCA)SVM - optimal separation, the margin and support vectors, a constrained optimization problem, kernels – polynomial, radial basis, sigmoid Performance Measures and Evaluation – for categ orical targets, prediction scores, multinomial targets, continuous targets. Clustering – the general problem, hierarchical and partitional clustering, K -means clustering. Recommended Readings Text Books: - 1. Learning from Data, Yaser S Abu -Mostafa, AML books 2. Machine learning, Marsland, CRC press 3. An Introduction to Machine Learning, KubatMiroslav, Springer 4. Fundamentals of Machine Learning for predictive data analytics, John D Kelleher, MIT Press MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST829 Course Name : Pattern Recognition Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: An undergraduate level understanding of probability, statistics and linear algebra is assumed. A basic knowledge of Python is essential. Course Contents The classification process: features, training and learning, approaches to classification Non metric methods: Information, Entropy and Impurity, decision tree classifier - ID3, C4.5. Discriminant functions: linear discriminant functions, piece -wise linear discriminant functions, generalized discriminant functions. Statistical pattern recognition: measured data and measurement errors, probability theory, conditional probability and Bayes rule, Naive Bayes classifier, Continuous random variables, The multiva riate Gaussian, Covariance matrix and MahalanobisdistanceParametric learning: Bayesian decision theory, discriminant functions and decision boundaries, MAP (Maximum A Posteriori Estimator)Non Parametric learning: Histogram estimator and Parzen windows, k -NN classification, Artificial Neural Networks, Kernel Machines, SVM. Feature extraction and selection: reducing dimensionality, feature selection - Inter/Intra class distance, Feature extraction: Principal component analysis, Linear discriminant analysis.Un supervised learning: Clustering, K - Means clustering, Fuzzy c -Means clustering, (Agglomerative) Hierarchical clustering Estimating and Comparing Classifiers: No free lunch, Bias and variance trade -off, cross -validation and resampling methods, Measuring cl assifier performance, Comparing classifiers - ROC curves, McNemar’s test, other statistical tests Recommended Readings Text Books: - 1. Pattern Classification, Duda Hart, Wiley 2. Pattern Recognition and Classification, Geoff Dougherty, Springer 3. Statis tical Pattern Recognition, Andrew R Webb, Wiley 4. Pattern Recognition and Machine Learning, Christopher Bishop, Springer 5. Pattern Recognition and Image Analysis, Earl Gose, Johnsonbaugh, PHI MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department /Centre : Department of Computer Science & Engineering Course Code : 21CST805 Course Name : Big Data Analytics Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Overview of Database Management Systems, Introduction to Big Data, Introduction to distributed file system, Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics. Apache Hadoop & Hadoop Eco -System, Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data S erialization. Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, Name -Node, Secondary Name -Node, and Data -Node, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup, SSH & Hadoop Configuration – HDFS Administering, Monitoring & Maintenance. Pig, Pig Latin Language, Hive Introduction, Hive queries. Spark Introduction. Cassandra CQL query language and CQL data model: Key space, Table definition, Column, and Data Types. Mongo DB Cluster analysis, K -means algorithm, Naïve Bayes, Parallel k -means using Hadoop, parallel particle swarm algorithm using MapReduce, case studies on big data mining. Parallel swarm Intelligence.

Recommended Readings Text Books: - 1. Dan Sulliva ,NoSQL for Mere Mortals 1st Edition., Pearson Publishers, 2014 2. Pramod J. Sadalage, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition, Pearson Publishers,ISBN -13: 978-0321826626, 2017. 3. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies (The MIT Press) 4. John D. Kelleher, Brendan Tierney, Data Science (MIT Press Essential Knowl edge series). MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST811 Course Name : Data Visualization Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Modern Visualisation tools and techniques, Create multiple versions of digital visualizations using various software packages; Identify appropriate data visualization techniques given particular requirements imposed by the data; App ly appropriate design principles in the creation of presentations and visualizations; Analyse, critique, and revise data visualizations Information overload and issues in decision making Design of visual encoding schemes to improve comprehension of data and their use in decision making Use of Tableau - Data visualization tool for data analysts, scientists, statisticians, etc. to visualize the data and get a clear opinion based on the data analysis, Comparing classifiers - ROC curves, McNemar’s test, other statistical tests. Recommended Readings Text Books: - 1. A first course Sosulski, K. (2018). Data Visualization Made Simple: Insights into Becoming Visual. New York: Routledge. 2. The Visual Display of Quantitative Information (2nd Edition). E. Tufte. G raphics Press, 2001. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST839 Course Name : System on Chip Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Transaction -Level Modeling& Electronic System -Level Languages, Hardware Accelerators, Media Instructions, Co -processors, System -Level Design Methodology ,High -Level Synthesis (C - to-RTL), Hardware Synthesis and Architect ure Techniques Source -Level Optimizations. Scheduling Resource, Binding and Sharing. Recommended Readings Text Books: - 1. De Micheli, editor Special Issue on Hardware/Software Co -design Proceedings of IEEE, Vol 85, No. 3, March 1997 2. D. D. Gajski, F. Vahid, S. Narayan, J. Gong :Specification and Design of Embedded Systems, Prentice Hall, Englewood Cliffs, NJ, 1994 3. J. Staunstrup and W. Wolf, editors: Hardware/Software Co -Design: Principles and Practice Kluwer Academic Publishers, 1997 4. G. DeMichel i, R. Ernst, and W. Wolf, editors, Readings in Hardware/Software Co -Design, Academic Press, 2002. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSL760 Course Name : Pro gram Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to analysis tools: debugging, disassembly, emulators, virtualization Introduction: Program Representation, Syntactic Analysis, Program Semantics, Static and dynamic analysis, Syntactic Analysis, Dataflow Analysis and Abstract Interpretation , Interprocedural analysis, Context -sensitive, Pointer analysis, Call Graph Construction, slicing and profiling, Control Flow Analysis, Dynamic

Analysis for Data Race Detection Model Checking, Symbolic execution, Program Repair, Hoare Logic, SMT solver s Recommended Readings Text Books: - 1. Pierce, Benjamin C. Types and Programming Languages. MIT Press, 2002. 2. Winskel, Glynn. The Formal Semantics of Programming Languages: An Introduction. MIT Press, 1993. 3. Nielson, Nielson, and Hankin. Principles of Program Analysis. Springer, 2010. 4. Baier, and Katoen. Principles of Model Checking. MIT Press, 2008. 5. Chlipala, Adam. Certified Programming with Dependent Types: A Pragmatic Introduction to the Coq Proof Assistant. MIT Press, 2013. MTech_2021_IS.pdf MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR DEPARTMENT of Computer Science and Engineering M.Tech. Computer Science and Information Security Semester. I S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CST523 Cryptography PC Theory 3 3 0 0 2 21CST521 Advanced Data Structures and Algorithms PC Theory 3 3 0 0 3. 21CST522 Computer and Network Security PC Theory 4 3 0 2 4. 21CST854 Department Elective – 1 PE Theory 3 3 0 0 5. 21CST855 Department Elective – 2 PE Theory 3 3 0 0 6. 21CSP524 Programming Lab -1 PC Lab 2 0 1 2 Total 18 Semester. II S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CST526 Research Methodology PC Theory 2 2 0 0 2 21CST872 Department Elective – 3 PE Theory 3 3 0 0 3. 21CST873 Department Elective – 4 PE Theory 3 3 0 0 4. 21CST874 Department Elective – 5 PE Theory 3 3 0 0 5. 21CST875 Department Elective – 6 PE Theory 3 3 0 0 6. 21CSP525 Design Lab PC Lab 2 0 1 2 7. 21CSP527 Security Tools Lab PC Lab 2 0 1 2 Total 18 Semester. III S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CSS623 Technical Documentation and Presentation PC --- 2 0 1 2 2 21CSP622 Literature Review PC --- 2 0 1 2 3. 21CSD621 Dissertation – 1 PC --- 8 0 0 16 Total 12 Semester. IV S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CSD624 Dissertation – 2 PC --- 12 0 0 24 Total 12 Total Credits: 60 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST523 Course Name : Cryptography Credits : 3 L - 3 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents Number theory: Prime numbers, GCD, Euclidean Algorithm, Extended Euclidean Algorithm, Fermat's theorem, Euler's theorem, Chinese remainder theorem, Discrete logarithms, Primality testing algorithms, Probability, Bays Theorem. Introduction to Information s ecurity and cryptography, Basic terminology and concepts, Classical Cryptographic techniques and their cryptanalysis, Shannon perfect secrecy, One Time Pad, Pseudo random generators, Semantic security, indistinguishability based Security. Stream ciphers a nd RC4, Various types of attacks, Chosen -Plaintext Attack. Chosen -Ciphertext Attack etc. Block Ciphers: Data Encryption Standard (DES), Advanced Encryption Standard (AES), DES attacks, Modes of operations One -way function, trapdoor one -way function, Publi c key cryptography, RSA cryptosystem, Diffie -Hellman key exchange algorithm, ElGamal Cryptosystem Cryptographic hash functions, secure hash algorithm, Message authentication, digital signature, RSA digital signature. Recommended Readings Text Books: - 1. William Stallings, Cryptography and Network Security: Principles and Practice, Prentice Hall 2. Douglas R. Stinson, Cryptography: Theory and Practice, Chapman and Hall 3. J. Katz and Y. Lindell, Introduction to Modern Cryptography, CRC press 4. N. Koblit z, Number Theory and Cryptography, Springer, 2001 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST521 Course Name : Advanced Data Structures and Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis, Recurrence equations. Advanced Data Structures: B -Trees, Binomial Heaps, Fibonacci Heaps, AVL trees, Red -black trees, B -trees, Splay trees, Interval trees; D isjoint set – union and path compression, Amortized analysis. Greedy Algorithms: shortest distance, minimum spanning tree, interval scheduling, interval partitioning; Divide and Conquer: sorting, integer and polynomial multiplication; Dynamic programming: Longest common subsequence. Chain of matrix multiplication, sequence alignment, Bellman Ford. Convex hull and Voronoi diagrams, line segments, Optimal polygon triangulation; Primality testing, Integer factorization; Graph algorithms: Matching and Flows; Parallel algorithms: Basic techniques for sorting, searching, merging. Intractability: Independent Set, Vertex Cover Randomized algorithms, Probabilistic algorithms. Approximate Algorithms: Vertex -cover, set -covering problems, Travelling Salesman problem. N Complexity classes - NP-Hard and NP -complete Problems - Cook's theorem NP completeness reductions, undecidability. Recommended Readings Text Books: - 1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India. 2. AhoA.V , J.D Ulm an: Design and analysis of Algorithms, Addison Wesley 3. Brassard : Fundamental of Algorithmics, PHI 4. Sara Baase: Computer Algorithms: Introduction to Design and Analysis, Pearson Education. 5. Papadimitriou, Steiglitz: Combinatorial Optimization: Algori thms and Complexity, PHI. 6. Motwani and Raghavan: Randomized Algorithms, Cambridge University Press 7. Vaizirani: Approximation Algorithms, Springer Verlag 8. Joseph Ja'Ja': Introduction to Parallel Algorithms, Addison -Wesley 9. Kleinberg, Tardos: Algorit hm Design, Addison Wesley. 10. Dexter Kozen: The Design and Analysis of Algorithms. Springer, 1992. 11. SanjoyDasgupta, Christos Papadimitriou, and UmeshVazirani: Algorithms, McGraw Hill. 12. Robert Sedgewick and Kevin Wayne. Algorithms 4/e. Addison -Wesle y. 13. Robert Tarjan: Data Structures and Network Algorithms, Society for Industrial and Applied Mathematics. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST522 Course Name : Computer and Network Security Credits : 4 L - 3 T - 0 P - 2 Course Type : Core Prerequisites: None Course Contents Introduction (a) Security(b) Malware(c) OWASP top ten and other major security issues in the world(d) CVE and other information(e) Introduce various type of security areas Software and OS Security: Common Bugs, Buffer Overflow, Runtime Defences against memory safety vulnerabilities, program verification and other vulnerabilities, Principles in OS Security; Mechanisms for confining bad code, Mechanisms for confining bad code : isolation, sandboxing, SFI and Virtualization, Trusted Computing Network and Web Security: Secure web site design (SQL injection, XSS, etc.), Browser Security, Security problems in network protocols: TCP/IP, DDoS Attacks, Network worms and bot -nets: attacks and defences, DNS and BGP security, Network defence tools – Firewall and In trusion

Detection. Future Networks Security: Introduction - The Security in Existing wireless Networks, Upcoming wireless networks and challenges, Thwarting and malicious behaviour – Naming and addressing, security association and secure neighbour discover y, secure routing in multichip wireless networks and privacy protection. Mobile OS Security and Privacy: Android, IOS security challenges, processor security, privacy, anonymity and censorship and other security issues according to the current situations a nd future requirements Recommended Readings Text Books: - 1. Security in Computing (3rd edition) 2. Research publications on security MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP524 Course Name : Programming Lab 1 Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: Programming skills required Course Contents Programming exercises and experiments in Computer Networks and Security. a. Experiments on LAN Trainer Kit: Performance study of data link layer protocols, implementation and testing Network Layer routing protocols, understanding the steps involved in RC4 algorithm encryption b. Programming exercises using sockets c. Design and implementation of a Data Sniffer Programming exercises and experiments in Advanced Data Structures a. Primality testing b. Recursive algorithms c. Sorting algorithms d. Heaps, priority queues, and binary search trees e. Red-black trees f. Graph based algorithms g. String matching algorithms Programming on advanced data structures by choosing the right data representation formats based on the requirements of the problem and selecting the right algorithmic paradigm (such as greedy, dynamic programming, divide a nd conquer etc.). Implement the basic cryptographic algorithms: a. Euclidean and Extended Euclidean algorithm for finding the Greatest Common Divisor of two large integers. b. Chinese remainder theorem. c. Modular polynomial arithmetic d. Diffie - Hellman Key exchange protocol Implement the advanced cryptographic algorithms: Congruence of squares. Finding a congruence of squares modulo n to factor n. Construction of Finite Field of characteristic 2. Computations in elliptic curve over a finite field Recommended Readings Text Books: - 1. Menezes, P.C. van Oorschot, S.A. Vanstone: Handbook of Applied Cryptography: CRC Press, 1996. 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, “Introduction to Algorithms (3rd Edition)”, T. Publisher: MIT Press. 3. Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2008. 4. Abhijit Das and C.E.VeniM adhavan, Public -key Cryptography: Theory and Practice, Pearson, 2009.Bottom of Form 5. Introduction to Modern Cryptography, Jonathan Katz and Yehuda Lindell. 6. LAN Trainer user Manual MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST526 Course Name : Research Methodology Credits : 2 L - 2 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents Unit I: Data Structures and Algorithms: Review of Data Structures , and most commonly used algorithms in Computer Science and Engineering – Sorting, DFS/BFS, and Pattern Searching. Unit II: Linear Algebra: Vectors - linear vector spaces, linear independence, norms and inner products, Basis and dimension, Matrices, Matri x operations, Inverse of a matrix Orthogonalization, Properties of determinants, Eigenvalues and eigenvectors, SVD and pseudo inverse, KL or hotelling transform.

Unit III: Transforms Signals and representation, Convolution, Frequency Transforms, Propertie s of Fourier Transform, DFT, DCT and FFT, Introduction to wavelets, applications in Computer Science and Engineering Unit III: Probability and Statistics Statistics: Introduction to statistical analysis, hypothesis testing – null and alternate, statistic al tests – chi-square, ANOVA, data validation Probability models and axioms, Bayes' rule, discrete and continuous random variables, Probability distributions: normal distribution and properties, conditional, marginal and joint probability distribution, PR NG (pseudo random number generators) - randomness tests, introduction to information theory and cryptography: an Introduction Unit IV: Machine Learning: Linear and non -linear regression, supervised learning – neural network, binary decision diagram, SVM, k -NN, unsupervised learning – Clustering, Hidden Markov Models, Introduction to deep learning. Unit V: Case Studies in Research Domains of CSE. Recommended Readings Text Books: - 1. Gilbert Strang: Linear Algebra, MIT Cambridge Press. 2. Sheldon Ross: Fi rst Course in Probability, Pearson. 3. Mark Girolami, Simon Rogers: First Course In Machine Learning, CRC Press. 4. Anirban Das Gupta: Probability and Statistics for Machine Learning, Springer. 5. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, second ed, Springer 6. Ian Goodfellow: Deeplearning, MIT Cambridge Press. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP525 Course Name : Design Lab Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: Students must have prior programming experience in C/C++ or any language; mathematics through differential equations, and numerical analysis Course Contents Operating Systems and Unix Enviro nments: features of UNIX/Linux for scientific and technical computing; languages, compilers, debuggers, performance tools, make files, build systems, shell scripting, file management, source code control. Research Documentation and Simple Data Visualizatio n: tools for generating research and code documentation: LATEX, Doxygen, plotting tools. Software Best Practices: software design cycle, regression testing, defensive programming, verification, code coverage Scientific Libraries: availability of common ma th libraries and usage for scientific computing. High performance Computing (HPC): Tool and techniques operating Systems and Unix Environments: features of UNIX/Linux for scientific and technical computing; languages, compilers, debuggers, performance tool s, make files, build systems, shell scripting, file management, source code control. Research Documentation and Simple Data Visualization: tools for generating research and code documentation: LATEX, Doxygen, plotting tools. Software Best Practices: softwa re design cycle, regression testing, defensive programming, verification, code coverage Scientific Libraries: availability of common math libraries and usage for scientific computing. High performance Computing (HPC): Tool and techniques. Recommended R eadings Text Books: - 1. Eric S. Raymond, The Art of Unix Programming, Addison -Wesley 2003. 2. Heister, T. and Rebholz, L. G., Introduction to Scientific Computing for Scientists and Engineers. De Gruyter Press, 2015. 3. John Levesque, High Performance Com puting: Programming and Applications MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP527 Course Name :

Security Tools Lab Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: NIL Course Contents Etherreal/ Wireshark real time network analyzer, packet sniffing techniques ,TCPDump, Safety control using Metasploit , Vulnerability assessment using Nessus tool, Intrusion detection using Snort, Wireless safety tools, Network tracking using Nagios, Kali Linux tools, Hardware and software security tools Recommended Readings Text Books: - 1. On line resources Electives Courses for CS -IS 1. 21CST802 Advanced Computer Networks 2. 21CST804 Android Programming 3. 21CST848 Biometrics 4. 21CST850 Cloud Security 5. 21CST851 Cyber Security 6. 21CST852 Data Compression 7. 21CST853 Deep Learning 8. 21CST856 Digital Forensics 9. 21CST857 Embedded System Security 10. 21CST858 Internet of Things 11. 21CST871 Wireless Security 12. 21CST859 Intrusion Detection 13. 21CST861 Nature Inspired Algorithms 14. 21CST862 Network Performance Modelling 15. 21CST863 Pattern Recognition 16. 21CIL736 Program Analysis 17. 21CST864 Public Key Infrastructure and Trust Management 18. 21CST865 Quantum Cryptography 19. 21CST866 Security Analysis of Protocols 20. 21CST821 Machine Learning 21. 21CST867 Selected Topics in Cryptography 22. 21CST868 Social Network Analysis 23. 21CST869 Software Testing and Validation 24. 21CST870 VLSI Algorithms 25. 21CST849 Blockchain Technologies MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST802 Course Name : Advanced Computer Networks Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Wireless networking: a. Bluetooth, 802.11 standards b. Information theory, bandwidth, multiple access c. Wireless Terahertz Networks d. 5G and 6G communication e. Intelligent Transportation Systems Emerging networking technologies: a. Host configuration and service discovery principles b. Future routing architectures c. IPv6 deployment scenarios and challenges, IPv6 transition/integration d. Advanced IP multicast, including IPv6 multicast and SSM e. Software -defined networki ng f. Delay -tolerant networking g. Future home network architectures h. IP network management and monitoring i. Social Networks Recommended Readings Text Books: - 1. Tanenbaum A S and Wetherall D J (2010). Computer Networks. 2. Hagen S, (2006). IPv6 Essentials. 3. Recent publications on the relevant fields MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST804 Course Name : Android Programming Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Basics: Review of Java Programming, Setting up and configuring Android Studio setup, Android EmulatorHello Android example, Android Manifest.xml, R.java file, Activity, Fragment, Layout Manager - Relative Layout, Linear Layout, Table Layout, Grid Layout A ctivity, Intent & Fragment: Activity Lifecycle, Activity Example, Intent – implicit and explicit, Intent filters, Fragment Lifecycle, Fragment Example, UI Widgets – buttons (toggle, switch, image), check box; Android Menu: Option Menu, Context Menu, Popup Menu; View Android Service: lifecycle, example, Data Storage, Shared Preference, SQLite, Content Provider, Android Notification Adding functionality: Multimedia API, Speech API, telephony API, Location API Sensors: Sensor API, Working with WiFi, Working with Camera, Motion Sensor, Position Sensor; Android Graphics App development project Recommended

Readings Text Books: - 1. Official Android Website MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST848 Course Name : Biometrics Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: A basic knowledge of statistics, linear algebra, and programming is expected. Course Contents Introduction: Person recognit ion, Biometric systems, Biometric functionalities, biometrics system errors, the design cycle of biometric systems. Fingerprint recognition: friction ridge patterns, fingerprint acquisition, feature extraction and matching, palm prints. Face recognition: image acquisitions, face detection, feature extraction and matching, handling pose, illumination and expression variations Iris recognition: image acquisition, Iris segmentation, Iris normalization, Iris encoding and matching, Iris quality assessment tec hniques Additional Biometric Traits: Ear, Gait, Hand geometry, Soft biometrics Multibiometrics: sources of multiple evidence, fusion levels: sensor, feature, score, rank and decision level fusion. Security of biometric systems: adversary attacks, attack s at user interface, attacks on biometric processing, attacks on template database. Recommended Readings Text Books: - 1. Introduction to Biometrics, Anil K Jain Arun Ross, Springer 2. The Science of Biometrics, Ravindra Das, Springer 3. Practical Biometrics, Julian Ashbourn, Springer MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST850 Course Name : Cloud Security Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Computer Networks, Operating System Course Contents Introduction of Cloud Computing: Taxonomy and related technologies, Essential Characteristics, Service and Deployment Models. Virtualization: Types of Virtualizati on and Hypervisors, Virtualization at Storage, Compute and Network, Hypervisors (Types and Case studies), Virtual Machine Provisioning, Virtual Machine Migration. Architectures:Standards, Orchestration, Provisioning, Portability, Interoperability, Federate d Cloud, Security: CIA Triad, Vulnerabilities in Cloud, Threats to Infrastructure, Data and Access Control;Identity Management; Multi Tenancy Issues; Attack taxonomy; Intrusion Detection, VM Specific attacks, VM Introspection, Management; Trusted Cloud I nitiative of Cloud Security Alliance (CSA). Forensics: NIST Forensics Reference Architecture, Forensic Science Challenges, Architectural Issues, Evidence Collection and Analysis, Anti -Forensics, Incident Response, Standards and Framework Recommended Rea dings Text Books: - 1. K. Hwang, G. C. Fox, and J. Dongarra, Distributed and Cloud Computing, 1st ed.: Morgan Kaufmann, 2011 2. R. Buyya, J. Broberg, and A. M. Goscinski, Cloud Computing: Principles and Paradigms: Wiley -Blackwell, 2011 3. S. Dinkar and G. Manjunath, Moving to the Cloud: Developing Apps in the New World of Cloud Computing Syngress Media, U.S., 2012. 4. W. Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, 1st ed.: Addison -Wesley Professional, 2015. 5. T. Erl, Z. Mahm ood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture: Prentice Hall/PearsonPTR, 2014. 6. R. L. Krutz and R. D. Vines, Cloud Security - A Comprehensive Guide to Secure Cloud Computing, Wiley Publishing, 2010 7. T. Mather, S. Kumaraswamy, and S. Latif, Cloud Security and Privacy - An Enterprise Perspective on Risks and Compliance, O Reilley Publishers, 2009. 8. V. (J.

R.) Winkler, G. Speake, P. Foxhoven, Securing the Cloud: Cloud Computer Security Techniques an d Tactics, Syngress, 2011. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST851 Course Name : Cyber Security Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: NIL Course Contents Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats, Need for a Comprehensive Cyber Security Policy. Cyber Security Safeguards (Overview): Access control, Audit, Authentication, B iometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management. Network Security & Web Security: Security Issues in TCP/IP, which includes TCP, DNS, Routing (basic problems of security in TCP/IP, IPsec, BGP Security, DNS Cache poisoning, etc), Network Defense tools such as Firewalls, Filtering, DNSSec, NSec3, Distributed Firewalls, Web Application Security: Cross -Site Scripting Attacks, Cross -Site Request Forgery, SQL Injection Attacks Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti - Malware software, Network based Intrusion detection Systems, N etwork based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation. Cyber Forensics: Introduction to Cyber Forensics, Handling Preliminary Investigatio ns, Controlling an Investigation, Conducting disk - based analysis, Investigating Information -hiding, Scrutinizing E -mail, Validating Email header information, Tracing Internet access, Tracing memory in real -time. Security in Mobile Platforms: Android vs. ioS security model, threat models, information tracking, rootkits, Threats in mobile applications, analyzer for mobile apps to discover security vulnerabilities, Viruses, Spywares, and keyloggers and malware detection. Cyberspace and the Law Recommended Readings Text Books: - 1. Latest research papers, journals and articles 2. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and SunitBelapure. 3. Cybersecurity Essentials By Charles J. Brooks, Christoph er Grow, Philip Craig, Donald Short · 2018 4. Cybersecurity: Attack and Defense Strategies: Infrastructure Security with Red Team and Blue Team TacticsBook by ErdalOzkaya and Yuri Diogenes MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Cent re : Department of Computer Science & Engineering Course Code : 21CST852 Course Name : Data Compression Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Object Oriented Analysis and Design Course Contents Introduction: Compression techniques, lossless compression, lossy compression, measures of performance, modeling and coding. Mathematical preliminaries - Overview, introduction to information theory, models, physical models, probability models, Markov mode ls. Basic Coding Schemes: Statistical Methods - Shannon -Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding. Arithmetic Coding (Encoding, Decoding, Adaptive Coding). Dictionary Methods - LZ77, LZ78, LZW Algorithms. Case study of lossless compressio n standards. Lossless Compression standards: zip, gzip, bzip, unix compress, GIF, JBIG. Image and Video Compression: Discrete Cosine Transform, JPEG. Wavelet

Methods - Discrete Wavelet Transform, JPEG 2000. Motion Compensation, Temporal and Spatial Predi ction. MPEG and H.264. Audio Compression: Digital Audio, WAVE, FLAC, MPEG -1/2 Audio Layers. Recommended Readings Text Books: - 1. Khalid Sayood. 2012. Introduction to Data Compression (4th ed.). Elsevier. 2. David Salomon, Giovanni Motta. 2010. Handbook of Data Compression. Springer, London. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST853 Course Name : Deep Learning Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Course Overview: Introduction to Deep Learning and its Applications. Introduction to Statistical Learning: Multi -Layer Perceptron, Back Propagation, Linear Regres sion, etc.Convolutional Neural Networks: Convolution, pooling, Activation Functions, Back propagation of CNN, Weights as templates, Translation invariance, Training with shared parameters.CNN Architecture Design and Discussion: AlexNet, VGG, GoogLeNet, Res Net, Capsule Net, etc. Loss Functions and Optimization: Optimization, stochastic gradient descent, dropout, batch normalization, etc.Sequential Modelling: Recurrent and Recursive Nets, RNN, LSTM, GRU, Image captioning, visual question answering, etc. Vis ualization and Understanding: Visualizing intermediate features and outputs, Saliency maps, Visualizing neurons, Cam -Grad, etc. Generative Models: VariationalAutoencoders, Generative Adversarial Networks like pix2pix, CycleGAN, etc. Deep Reinforcement Lea rning: Reinforcement Learning (RL) Background, Policy gradients, hard attention Q -Learning Deep Learning Applications: Object Detection: RCNN, Fast RCNN, Faster RCNN, YOLO, Retina Net, SSD, etc., Semantic Segmentation: DeepLabV3, PSP Net, etc. Adversaria l Attacks on CNN. Recommended Readings Text Books: - 1. Ian Goodfellow and YoshuaBengio and Aaron Courville, “Deep Learning,” MIT Press. 2. Michael A. Nielsen, “Neural Networks and Deep Learning,” Determination Press, 2015. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST856 Course Name : Digital Forensics Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Operating Systems, Computer Networks & Security Course Contents File System Forensics: Duplicating hard disks for "dead analysis”, reading hidden data on a disk's Host Protected Area (HPA), Direct versus BIOS access, dead versus live acquisition, Disk partitions - DOS, Apple, and GPT partitions, BSD disk labels, Sun Volume; multiple disk volumes - RAID and disk spanning; Analyzing FAT, NTFS, Ext2, Ext3, UFS1, and UFS2 file systems, Finding evidence: File metadata, recovery of deleted files, Using The Sleut h Kit (TSK), Autopsy Forensic Browser, and related open source tools Web Forensics: network -based evidence in Windows and Unix environments, Reconstructing Web browsing, email activity, Tracing domain name ownership and the source of e -mails System Forensi cs: Windows Registry changes, Duplicating and analyzing the contents of PDAs and flash memory devices Electronic document, computer image verification and authentication. Recommended Readings Text Books: - 1. Brian Carrier. File System Forensic Analysis, Addison Wesley. 2. Chris Prosise, Kevin Mandia. Incident Response and Computer Forensics, McGraw Hill. Course Technology. 3. Linda Volonino, Reynaldo Anzaldua, and Jana Godwin. Computer Forensics: Principles and

Practices, Prentice Hall. 4. Keith J. Jone s, Richard Bejtlich, and Curtis W. Rose. Real Digital Forensics: Computer Security and Incident Response, Addison Wesley. 5. Vacca, John R., Computer Forensics Computer Crime Scene Investigation, Charles River Media. 6. Nelson, Phillips, Enfinger, Steuart. Guide to computer Forensics and Investigation MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST857 Course Name : Embedded System Security Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Security Flaws and Attacks in Embedded systems: Code injection, Invasive and Non invasive physical and logical attacks Defenses Against Code Injection Attacks: Methods using Address Obfuscation and Software Encryption, Anomaly Detection. Safe Languages, C ode Analyzers Compiler, Library, and Operating System Support for embedded systems. security, Control Flow Checking, IP Protection: Encryption of IP Cores, additive and Constraint -Based watermarking. Implementation of DES 3DES, AES, RC4, MD5, RSA algo rithms Recommended Readings Text Books: - 1. Security in Embedded Hardware MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST858 Course Name : Internet of Things Credit s : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Computer Networks, Wireless Communication Course Contents Introduction: Internet of Things and Connected Products, IoT paradigm, Smart objects, Goal orientation, Convergence of technologies; Business Aspects of the Internet of Things.Internet and “Things”: Layers, Protocols, Packets, Services, Performance paramet ers of a packet network and applications: Web, Peer -to-peer, Sensor networks, and Multimedia. Hardware and Software: Hardware components, Microcontrollers and Software; Operating Systems. Protocols and Platforms -IoT Communication Protocols, Transport Prot ocols, Application Protocols; Cloud computing for IoT. Services and Attributes: Data creation, Data gathering and Data dependency; Robustness, Scaling, Privacy, Security, Trust. Designing & Developing IoT applications: Introduction, IoT Design Methodology , Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages Application: Implications for the society, IoT case study. Recommended Readings Text Books: - 1. The Intern et of Things: Key Applications and Protocols, David Boswarthick, Olivier Hersent, and Omar Elloumi, Wiley 2. Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley. 3. Latest research articles MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST871 Course Name : Wireless Security Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Computer Network s Course Contents Foundations of Wireless Security: Wireless as a necessity, advantages and disadvantages, information security and wireless LANs, wireless LAN standards and types, Wireless LAN vulnerabilities. Risks and Threats of Wireless: Social Engin eering, phishing, search engine scanning, Denial -of-service, malicious code, War driving, rogue access points, RFID. Wireless Security Models: Wireless Security Basics, Equivalent Privacy Standard (WEP), Extensible Authentication Protocol (EAP), Wi -Fi Pro tected Access (WPA), WPA2, 802.11i, attacks on WEP, EAP, WPA, 802.11i. Designing a secure wireless network: Basic principles of security design - layering, limiting, diversity, obscurity, simplicity; network segmentation, hardware placement, wireless device security. Wireless security Policy: policy overview, risk assessment, designing security policy, impact analysis, wireless security policy areas, types of wireless security policies. Recommended Readings Text Books: - 1. Wireless Security Handbook, by A aron E. Earle, Auerbach Publications 2. CWSP Guide to Wireless Security, by Mark Ciampa, 1st Edition. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST859 Course Name : Intrusion Detection Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction - Intrusion Detection System (IDS), Intrusion Prevention System (IPS), Unauthorized access – buffer overflow, packet fragmentation, out -of-spec packets Review of Network protocol – TCP/IP, Intrusion detection through tcpdump. IDS and IPS – Arch itecture and internals. Malicious and non -malicious traffic, IP headers, TCP, UDP and ICMP protocols and header formats, Header information to detect intrusion, logs and their analysis, IDS through reaction and response Intrusion analysis – data correlatio n, tools, SNORT - A case study. Recommended Readings Text Books: - 1. Matt Fearnow, Stephen Northcutt, Karen Frederick, and Mark Cooper. Intrusion Signatures and Analysis, SAMS. 2. Carl Endorf, Gene Schultz, Jim Mellander, Intrusion Detection and Prev ention, McGraw Hill. 3. Paul E. Proctor. The Practical Intrusion Detection Handbook, Prentice Hall. 4. Stephen Northcutt and Judy Novak. Network Intrusion Detection, SAMS. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST861 Course Name : Nature Inspired Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Data structures Course Contents Introduction to Algorithms, Optimization, Search for optimality, computational intelligence, Nature Inspired solutions and characteristic, Nature inspired Metaheuristics and its brief history, Analysis of Optimization Algorithms, Nature Inspired Algorithms , parameter Tuning and controlConstrained and unconstrained optimizations, Random Walks and Optimizations, evolutionary strategies and Evolutionary Algorithms (EA), Simulated Annealing (SA) Algorithm and its behavior, Genetic Algorithms(GA) - genetic operat or, parameters, fitness functions, genetic programming and convergence analysis, GA variants, Differential Evolution (DE), various Applications. Swarm Intelligence optimization, Particle Swarm Optimization(PSO) Algorithm, Ant Colony Optimization (ACO) Alg orithms, Artificial Bee Colony ACO) optimization algorithms, Cuckoo Search (CS) Algorithms, Intelligent Water Drop Algorithm (IWD), Bat Algorithms(BA), Firefly Algorithms(FA) Framework for self -tuning algorithms, Dealing with constraints, constraints hand ling, fitness functions ,multi -objective optimization techniques and its applications , Hybrid algorithms, Ways to Hybridize. Recommended Readings Text Books: - 1. Nature -Inspired Optimization Algorithms – by Xin -She Yang (Author), June 30, 2016 2. Mathematical Foundations of Nature -Inspired Algorithms, Xin -She Yang, Xing -Shi He, Springer; 1st ed. 2019 edition 3. Nature -Inspired Metaheuristic Algorithms: Second Edition, Xin -She Yang, Luniver Press 4. Introduction to Evolutionary Computing, A. E Ei ben and J. E. Smith, Second Printing, Springer, 2007 5.

Evolutionary Algorithms in Engineering Applications, Editors: DipankarDasgupta and ZbigniewMichalewicz, Springer -Verlag, 1997 6. D. E. Goldberg, Genetic Algorithms in search, Optimization and Machine Learning, Pearson India 7. Optimization Techniques and Applications with Examples By Xin -She Yan, wiley publisher MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST862 Course Name : Network Performance Modelling Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to Network Modeling: Network modeling, Computer Network as a discrete event system, Modeling and measurement tools, Network performance metrics – first order and second order metrics, Network capacity, Difference between throughput and capacit y Network Calculus: Models for data flows, arrival curves and service curves, Greedy shapers, Basic min -plus and max - plus calculus, min -plus and max -plus systems, Optimal smoothing, FIFO systems and aggregate scheduling, Time varying shapers, Systems with losses, Case studies – (1) Analyzing spanning tree based data forwarding using network calculus, (2) Bound on loss rate Stochastic Scheduling and Resource Allocation: Stochastic scheduling, dynamic resource allocation, Dynamic programming models for stoc hastic scheduling, Queuing networks – open loop and closed loop networks, Jackson networks, Network fairness – proportional and max -min fairness, Markov process and its application for analyzing network resource allocation and fairness, available bandwidth estimation, Case studies – (1) TCP/IP flow and congestion control, (2) Modeling dynamic routing and scheduling as a queuing network problem, (3) Analysis of IEEE 802.11 channel access using two dimensional Markov process. Network Games: Introduction to g ame theory, Zero sum games, Nash equilibrium, Pareto optimality, Cooperative and Non -cooperative games, General network games – resource sharing games, routing games, congestion games, Mechanism design, Case studies – (1) Selfish routing in networks and pr ice of anarchy, (2) Oblivious routing, (3) Network resource allocation games Protocol Analysis: Modeling discrete event system using petri -nets, basics of petri nets, stochastic petri nets, queuing petri nets, properties of petri nets, structural analysis of petri nets, Petri net modeling tools – simQPN, Case studies – (1) Wireless channel model using stochastic petri net, (2) Data center network throughput analysis using queuing Petri Nets Recommended Readings Text Books: - 1. "Routing, Flow, and Capaci ty Design in Communication and Computer Networks", Micha■Pióro, DeepankarMedhi, ISBN: 0125571895, Publisher: Morgan Kaufmann 2. The Network Calculus Book by Jean -Yves Le Boudec and Patrick Thiran is available for free download:http://ica1www.epfl.ch/PS_fil es/NetCal.htm 3. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" Morgan Kaufman Publishers 4. Dimitri P. Bertsekas and Robert G. Gallager, "Data Networks": Materials are available at http://web.mit.edu/dimitrib/w ww/datanets.html 5. "Network Optimization: Continuous and Discrete Models", D. Bertsekas 6. Research Publications - will be discussed and distributed time to time MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST863 Course Name : Pattern Recognition Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: An undergraduate level understanding of probability, statistics and linear algebra is assumed. A basic knowledge of Python is essential. Course Contents The classification process: features, training and learning, approaches to classification Non metric methods: Information, Entropy and Impurity, decision tree classi fier- ID3, C4.5. Discriminant functions: linear discriminant functions, piece -wise linear discriminant functions, generalized discriminant functions. Statistical pattern recognition: measured data and measurement errors, probability theory, conditional pr obability and Bayes rule, Naive Bayes classifier, Continuous random variables, The multivariate Gaussian, Covariance matrix and MahalanobisdistanceParametric learning: Bayesian decision theory, discriminant functions and decision boundaries, MAP (Maximum A Posteriori Estimator)Non Parametric learning: Histogram estimator and Parzen windows, k -NN classification, Artificial Neural Networks, Kernel Machines, SVM. Feature extraction and selection: reducing dimensionality, feature selection - Inter/Intra class d istance, Feature extraction: Principal component analysis, Linear discriminant analysis. Unsupervised learning: Clustering, K - Means clustering, Fuzzy c -Means clustering, (Agglomerative) Hierarchical clustering. Estimating and Comparing Classifiers: No fre e lunch, Bias and variance trade -off, cross -validation and resampling methods, Measuring classifier performance, Comparing classifiers - ROC curves, McNemar’s test, other statistical tests. Recommended Readings Text Books: - 1. Pattern Classification, Dud a Hart, Wiley 2. Pattern Recognition and Classification, Geoff Dougherty, Springer 3. Statistical Pattern Recognition, Andrew R Webb, Wiley 4. Pattern Recognition and Machine Learning, Christopher Bishop, Springer 5. Pattern Recognition and Image Analysis, Earl Gose, Johnsonbaugh, PHI MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CIL736 Course Name : Program Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to analysis tools: debugging, disassembly, emulators, virtualization Introduction: Program Representation, Syntactic Analysis, Program Semantics, Static and dynam ic analysis, Syntactic Analysis, Dataflow Analysis and Abstract Interpretation, Interprocedural analysis, Context -sensitive, Pointer analysis, Call Graph Construction, slicing and profiling, Control Flow Analysis, Dynamic Analysis for Data Race Detecti on Model Checking, Symbolic execution, Program Repair, Hoare Logic, SMT solvers Recommended Readings Text Books: - 1. Pierce, Benjamin C. Types and Programming Languages. MIT Press, 2002. 2. Winskel, Glynn. The Formal Semantics of Programming Language s: An Introduction. MIT Press, 1993. 3. Nielson, Nielson, and Hankin. Principles of Program Analysis. Springer, 2010. 4. Baier, and Katoen. Principles of Model Checking. MIT Press, 2008. 5. Chlipala, Adam. Certified Programming with Dependent Types: A P ragmatic Introduction to the Coq Proof Assistant. MIT Press, 2013. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST864 Course Name : Public Key Infrastructure and Trust Management Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Public key infrastructure - components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross - certification. Repository, Certification Authority (CA) and Registr ation Authority (RA), trusted third party, digital certificates PKI services – authentication, non -repudiation, privilege management, privacy, secure communication. Key management – certificate revocation list, root CA, attacks on CA, key backup. PKI sta ndards – SSL, LDAP, IPSec, X.500, X.509, S/MIME Trust models – strict v/s loose hierarchy, four corners distribution. Certificate path processing – path construction and path validation. Recommended Readings Text Books: - 1. AshutoshSaxena, Public Key In frastructure, Tata McGraw Hill 2. Carlisle Adams, Steve Lloyd. Understanding PKI: Concepts, Standards, and Deployment Considerations, Addison Wesley. 3. John R. Vacca. Public Key Infrastructure: Building Trusted Applications and Web Services, AUERBACH. 4. MessaoudBenantar, Introduction to the Public Key Infrastructure for the Internet, Pearson Education. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST865 Course Name : Quantum Cryptography Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Preliminaries: Quantum Information Theory, Quantum Information Theory, Unconditional Secure Authentication and Entropy. Quantum Key Distribution: Quantum Channel, Public Channel, QKD Gain, Finite Resources, Adaptive Cascade: Introduction, Error Correction and the Cascade Protocol, Adaptive Initial Block -Size Selection, Fixed Initial Block -Size, Dynamic Initial Block - Size. Attack Strategies on QKD Protocols: Attack Strategies in an Ideal Environment, Individual Attacks in an Realistic Environment. QKD Syst ems, Statistical Analysis of QKD Networks in Real-Life Environment: Statistical Methods, Results of the Experiments, Statistical Analysis. QKD Networks Based on Q3P : QKD Networks, PPP, Q3P, Routing and Transport. Quantum - Cryptographic Networks from a Pro totype to the Citizen. The Ring of Trust Model, Model of the Point of Trust Architecture, Communication in the Point of Trust Model, Exemplified Communications, A Medical Information System Based on the Ring of Trust. Recommended Readings Text Books: - 1. Quantum Cryptography and Secret -Key Distillation, Gilles van Assche, Cambridge University Press, 2006. 2. Paul Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press (2007). 3. Michael A. Nielsen and Is aac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press (2000). MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST866 Course Name : Security Analysis of Protocols Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Cryptographic background; Authentication, Key establishment and IP security; Denial of service; Anonymity and MIX netw orks; Fairness and contract signing, Privacy and protection of individual information;Wireless security (mobile phones, WiFi); Protocol analysis tools: Finite -state checking; Infinite -state symbolic analysis; Probabilistic model checking;Game -based verifi cation; Process algebras (spi -calculus and applied pi calculus); Protocol logics (BAN, DDMP, Isabelle); Introduction to Probabilistic polynomial time calculus; Relating cryptographic and formal models. Recommended Readings Text Books: - 1. Latest repute d conference and journal articles as chosen by the instructor. 2.

Maximum Security, 2nd Edition, SAMS Books by Anonymous, 1998, 3. Maximum Linux Security, SAMS Books by Anonymous, 2000, ISBN: 0 -672- 31670 -6. 4. 10 Risks of PKI: What You're not Being Told about Public Key Infrastructure, by Ellison and Schneier MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST860 Course Name : Machine Learning Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential. Course Contents Advanced linear Algebra (e.g., SVD). The learning problem – learning versus design, types of learning - supervised, unsupervised, reinforcement and other views of learning. Linear Modelling: A least squares approach, linear modeling, making predictions, vec tor/matrix notation, linear regression, nonlinear response from a linear modelz. Generalization and over -fitting. The Bayesian approach to machine learning: exact posterior, marginal likelihoods Probability based learning: Bayes theorem, Bayesian predictio n, conditional independence and factorization, the Naive Bayes model. Error based learning: simple linear regression, multi variable linear regression with gradient descent Logistic regression – gradient descent, non linear transformations the Z space. Similarity based learning: nearest neighbor, k - nearest neighbors, efficient distance computations: the KD trees Information based learning: learning and trees, Classification and regression trees. Ensemble methods, Boosting, Bagging, Random forests. Neural n etworks – the perceptron, Multilayer perceptron, activation functions, gradient descent, deriving back propagation. Multi - task and transfer learning, Deep learning. Linear discriminant analysis (LDA), Principal component analysis (PCA)SVM - optimal separati on, the margin and support vectors, a constrained optimization problem, kernels – polynomial, radial basis, sigmoid Performance Measures and Evaluation – for categorical targets, prediction scores, multinomial targets, continuous targets. Clustering – the general problem, hierarchical and partitional clustering, K -means clustering. Recommended Readings Text Books: - 1. Learning from Data, Yaser S Abu -Mostafa, AML books 2. Machine learning, Marsland, CRC press 3. An Introduction to Machine Learning, Kubat Miroslav, Springer 4. Fundamentals of Machine Learning for predictive data analytics, John D Kelleher, MIT Press 5. Learning from Data, Yaser S Abu -Mostafa, AML books MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Co mputer Science & Engineering Course Code : 21CST867 Course Name : Selected Topics in Cryptography Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Maths Course Contents Basic Concepts: Information theoretic vs. computational security. One way functions, Pseudo randomness generators and functions, Permutations, hash functions. Private -key encryption using pseudo randomness. Private -key authentication. – Public key encrypti on (and number theory). Public key authentication. Interactive protocols: Touch of complexity theory, Interactive proof systems; 0 -knowledge proof systems,0 -knowledge authentication, Electronic cash; non -interactive zero-knowledge. Oblivious transfer: Defi nitions, constructions, and applications, Secure Multiparty computations, Database (differential) privacy. – Proofs of work – Block -chain consensus protocols.

Recommended Readings Text Books: - 1. Introduction to Modern Cryptography: Principles and Protocols, by Jonathan Katz and Yehuda Lindell 2. A Graduate Course in Applied Cryptography by Dan Boneh and Victor Shoup 3. The Joy of Cryptography by Mike Rosulek. 4. OdedGoldreich: Foundations of Cr yptography Vol 1 and Vol2 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST868 Course Name : Social Network Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Electiv e Prerequisites: Data Structures and Algorithms Course Contents Network Models: Properties of Real -World Networks: Degree Distribution, Clustering Coe■cient, Average Path Length. Random Graphs , Small -World Model, Preferential Attachment Model, Modeling of Real -World Networks using Random Graphs, Small -World Model and Preferential Attachment Model Network Measures: Centrality: Degree Centrality, Eigenve ctor Centrality, Katz Centrality, PageRank, Centrality, Closeness Centrality, Group Centrality. Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence. Community Analysis: Community Detection, Community De tection Algorithms: Member -Based Community Detection, Group -Based Community Detection. Community Evolution: How Networks Evolve, Community Detection in Evolving Networks. Community Evaluation: Evaluation with Ground Truth, Evaluation without Ground Truth R ecommendation: Classical Recommendation Algorithms: Content -Based Methods, Collaborative Filtering (CF), Extending Individual Recommendation to Groups of Individuals, Recommendation Using Social Context, Evaluating Recommendations: Evaluating Accuracy of P redictions, Evaluating Relevancy of Recommendations Graph Representation Learning, Knowledge Graphs and Meta Paths, Graph Convolutional Networks, Link Prediction, Influence Maximization & Outbreak Detection. Recommended Readings Text Books: - 1. Network s, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg. 2. Networks: An introduction by Mark Newman. 3. The Development of Social Network Analysis” by Linton C Freeman 4. Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. Social media mining: an introduction. Cambridge University Press MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST869 Course Name : SOFTWARE TESTING & VALIDATION Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Software engineering, basic computer programming skills Course Contents Testing Environment and Test Processes: Software Testing Environment, Overview of Software Testing Pr ocess, Organizing for Testing, Developing the Test Plan, Verification Testing, Analyzing and Reporting Test Results, Acceptance Testing. Levels of Testing, Unit Testing, Integration Testing, Defect Bash Elimination. System Testing, Usability and Accessibi lity Testing, Configuration Testing, Compatibility Testing. Functional and Non -functional system testing, Compliance Testing, Load Testing, Performance Testing and Security Testing. Static and dynamic testing, Black -box or functional testing, Equivalenc e partitioning, BVA, structural, White box or glass box testing, Mutation Testing, Data flow testing. Test Automation: Software Testing Tools, Software Test Automation, Debugging, Case study. Recommended Readings Text Books: - 1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software

Testing – Principles and Practices", Pearson Education,. 2. A.P. Mathur, Foundations of Software Testing, Pearson publications 3. NareshChauhan , "Software Testing Principles and Practices " Oxford Un iversity Press , New Delhi . 4. LleneBurnstein, " Practical Software Testing", Springer International Edition. 5. RenuRajani, Pradeep Oak, "Software Testing – Effective Methods, Tools and Techniques", Tata McGraw Hill. 6. William Perry, "Effective Methods of Software Testing", Third Edition, Wiley Publishing. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST870 Course Name : VLSI Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Logic synthesis & verification: Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High -level synthesis. VLSI Algorithms Partitioning: Problem formulation, classification of partitioning algorithms, Group migration algorithms, simu lated annealing & evolution, other partitioning algorithms. Placement, floor planning & pin assignment: Problem formulation, simulation base placement algorithms, other placement algorithms, constraint -based floorplanning, floor planning algorithms for mi xed block & cell design. General & channel pin assignment. Global Routing: Problem formulation, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches. Detailed routing : problem formulation, classification of routing algorithms, single layer routing algorithms, two -layer channel routing algorithms, three -layer channel routing algorithms, and switchbox routing algorithms.Over the cell routing & via minimization: two layer s over the cell routers, constrained & unconstrained via minimization. Compaction: problem formulation, one -dimensional compaction, two dimension -based compaction, hierarchical compaction. Recommended Readings Text Books: - 1. Naveed Sherwani, "Algorith ms for VLSI Physical Design Automation", 3rd MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST849 Course Name : Blockchain Technologies Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Network Security, Cryptography, Course Contents INTRODUCTION TO BLOCKCHAIN Distributed Ledger Technology, Decentralization, Bitcoin Network and Architecture, Block in a Blockchain, Advantages over Traditional Databa ses, Mining Mechanism, Types of Blockchain: Public, Private, Consortium, Cryptography: Elliptic Curve Cryptography, Hash Functions, Merkle Tree, Merkle Patricia Trie, Digital Signature, Wallets and Keys, User Addresses and Privacy CRYPTO CURRENCY History, Distributed ledger, Creation of Coins, Double spending, Bitcoin protocols, Transaction in Bitcoin Network, AltCoins, Ethereum, EVM, Accounts, Transactions, Gas, Fees, Smart Contracts, Eth 2.0 MINING AND CONSENSUS Definitions, Types of Mining Algorithms, Proof of Work, Proof of Stake, Proof of Burn. Sharding Chains SMART CONTRACTS ON ETHEREUM Setting up Ethereum Node using Geth Client, Smart Contracts and DApps, Truffle, Ganache CLI, Metamask, Remix, Solidity, Writing and Deploying Smart Contracts in Sol idity, Connection to Web3.js Library, Vulnerabilities in Smart Contracts, Attacks, Prevention of Attacks, Decentralized Autonomous Organization (DAO), Building an Initial Coin Offering (ICO). BLOCKCHAIN USE CASES AND APPLICATIONS Use -Cases in Cryptocurre ncy and Other Sectors like Finance, Voting System, and Healthcare, etc. Future of Blockchain. Recommended Readings Text Books: - 1. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction MTech_2015_CSIS.pdf Department of Computer Science and Engineering Malaviya National Institute of Technology MTech Part-Time (Computer Engineering and Information Security) (2016-17 onwards) I Semester (Autumn Semester) CWS PRS MTE ETE PRE 1 CST701 Advance Cryptography PC 3 3 0 0 2 20 -30 50 - 2 3 CST705 Machine Learning PC 3 3 0 0 2 20 -30 50 - 4 5 6 CSP711 Information Security Lab PC 3 1 0 3 -60 - -40 9 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. II Semester (Spring Semester) CW S PRS MTE ETE PRE 1 Elective-I PE 3 3 0 0 2 20 -30 50 - 2 3 Elective-III PE 3 3 0 0 2 20 -30 50 - 4 5 6 Lab Elective -I PE 3 1 0 3 -60 - -40 9 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. ** Two Electives need to be taken from Department Elective List. 18 Exam DuratioRelative Weightage* Course Title Subject AREA CreditL T P S.NoCourse Code Total Relative Weightage* T P Exam DuratioS.NoCourse CodeCourse Title** Subject AREA CreditL Total TOTAL CREDITS (Sem I-II) Department of Computer Science and Engineering Malaviya National Institute of Technology MTech Part-Time (Computer Engineering and Information Security) (2016-17 onwards) III Semester (Autumn Semester) CWS PRS MTE ETE PRE 1 2 CST703 Advance Data Structures & Algorithms PC 3 3 0 0 2 20 -30 50 - 3 4 CST707 Security Engineering PC 3 3 0 0 2 20 -30 50 - 5 CSP709 Advance Programming Lab PC 3 1 0 3 -60 - -40 6 9 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. IV Semester (Spring Semester) CWS PRS MTE ETE PRE 1 2 Elective-II PE 3 3 0 0 2 20 -30 50 - 3 4 Elective-IV PE 3 3 0 0 2 20 -30 50 - 5 Elective-V PE 3 3 0 0 2 20 -30 50 - 6 9 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. ** Two Electives need to be taken from Department Elective List. 18 CreditL T P Exam DuratioRelative Weightage* S.NoCourse CodeCourse Title Subjec t AREA Total S.NoCourse CodeCourse Title** CreditL T P Exam DuratioRelative Weightage* Total TOTAL CREDITS (Sem III-IV) Subjec t AREA Department of Computer Science and Engineering Malaviya National Institute of Technology MTech Part-Time (Computer Engineering and Information Security) (2016-17 onwards) V Semester (Autumn Semester) CWS PRS MTE ETE PRE 1 CSISS600 Seminar PC 4 - - - - - - -100 - 2 CSISD601 Dissertation PC 16 - - - - - - - - - 20 VI Semester (Spring Semester) CW S PRS MTE ETE PRE 1 CSISD602 Dissertation PC 16 - - - - - - - - 16 36 72TotalS.NoCourse CodeCourse Title Subject AREA CreditL T P Exam DurationRelative Weightage* S.NoCourse CodeCourse Title Subject AREA CreditL T P Exam DurationRelative Weightage* TOTAL CREDITS (Sem I-VI)TOTAL CREDITS (Sem V-VI)Total Department of Computer Science and Engineering Malaviya National Institute of Technology MTech Full Time (Computer Engineering and Information Security) (2016-17 onwards) CST701 Advanced Cryptography (3-0-0) Introduction(10 T): Mathematical foundations: Group theory (Groups, Rings and Fields), Symmetric key cryptography vs. public key cryptography, One-way functions based on mathematical problems, Security problems of text book cryptosystems, Number theory, Algorithms in public key cryptography. Lattice Based

Cryptography(15 T): Introduction to Lattices, The Hermite normal form, Ajtai's worst-case/average-case connection, Discrete Gaussians, Smoothing Parameter, Leftover Hash Lemma, The lattice trapdoor construction of Micciciancio-Peikert, The Gorbunov-Vaikuntanathan- Wee LWE-based Attribute-Based Encryption Scheme, Attribute-Based Ecnryption, LWE-based homomorphic encryption, Continue LWE-based homomorphic encryption, Ideal Lattices, The NTRU cryptosystem, Multilinear maps from ideal lattices. Advanced Topics in Cryptography(15 T): Interactive Proofs, Zero-Knowledge Proofs (concurrent zero knowledge, upper and lower bounds on round complexity, black-box vs. non-blackbox zero knowledge), Zero-Knowledge Proofs of Knowledge, Non-Interactive Zero-Knowledge Proofs, Secure Protocols. Two-party Secure Computation, Multiparty Secure Computation, Chosen Ciphertext Security. Oblivious transfer: Definitions, constructions, and applications, Byzantine agreement, private information retrieval, threshold cryptography, voting protocols, auctions, privacy preserving data mining, credential systems, Text Books: 1. Cryptography: Theory and Practice , by Douglas R. Stinson. 2. A Course in Number Theory and Cryptography by Neal Koblitz ,Springer. 3. Algebraic aspects of cryptography Neal Koblitz ,Springer 4. Cryptography and Networks Security, William Stallings 5. Introduction to Modern Cryptography, Jonathan Katz and Yehuda Lindell 6. Security and cooperation in wireless networks, Levente buttyane and Jean-Pierre hubaux 7. Applied Cryptography, by Bruce Schneier 8. Lattice-based Cryptography, by Daniele Micciancio, Oded Regev 9. Complexity of Lattice problems: a cryptographic perspective, by Daniele Micciancio and Shafi Goldwasser's. 10. A Graduate Course in Applied Cryptography, by Dan Boneh and Victor Shoup CST702 Special Topics in OS (3-0-0)

Advanced Topics: Advanced scheduling techniques for processes and threads; kernel architectures and implementation of CFS in recent kernels; Access control schemes in OS; Multimedia OS and design features; Introduction to networked, distributed file systems; Virtualisation and cloud OS; Introduction to embedded and Mobile OS; Distributed shared memory : distributed scheduling, failure recovery, resource security and protection, Configuring Services Registry settings, System Configuration Settings, Manage Users Manage the system, Supporting address translation (NAT); Introduction to Performance Tuning : Maintenance and troubleshooting Introductions Text: Recent papers from USENIX and Journals

CST703 Advance Data Structures and Algorithms (3-0-0) RAM model: Growth of functions, Notations, Recurrence analysis - Master's theorem and its proof, Probabilistic analysis, Amortized analysis. Advanced Data Structures: B-Trees, Binomial Heaps, Fibonacci Heaps, A VL trees, Red-black trees, B-trees, Splay trees, Disjoint set, Hash tables, Bloom filters. Graph Algorithms: DFS, BFS, Shortest path, MST, Articulation Point, Topological sorting, Connected components, Network Flow, Matchings. Interval scheduling algorithms, Knapsack problem. Dynamic programming: Longest common subsequence. Chain of matrix multiplication, Optimal binary tree. Convex hull and V oronoi diagrams, line segments, Optimal polygon triangulation. Approximate Algorithms: Vertex-cover, set-covering problems, Travelling Salesman problem. Randomized algorithms: Use of probabilistic inequalities in analysis, applications using examples. Randomized Algorithms : Computing the Median, Randomized Divide-and-Conquer Number-Theoretic Algorithms: Greatest common divisor, Modular arithmetic, Chinese remainder theorem, Cryptosystems , Primality testing, Integer factorization, Discrete logarithm, Polynomial representations, Operations, FFT as an example. Parallel algorithms: Basic techniques for sorting, seraching, merging. Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem, Undecidability, NP completeness reductions. Texts/References: 1)Cormen, Leiserson, Rivest: Introduction to Algorithms , Prentice Hall of India. 2)Jon Kleinberg , Eva Tardos : Algorithm Design, Pearson 3)Aho A.V , J.D Ulman: Design and analysis of Algorithms , Addison Wesley 4)Motwani and Raghavan: Randomized Algorithms , Cambridge University Press 5)Joseph Ja'Ja': Introduction to Parallel Algorithms , Addison-Wesley 6)Vaizirani: Approximation Algorithms , Springer Verlag

CST704 Critical Infrastructure Protection (3-0-0) PRE-REQUISITES: Computer Networks, Network Security COURSE OUTCOMES: 1.Describe what digital investigation is, the sources of evidence, and the limitations of forensics. 2.Describe the legal requirements for use of seized data, data collection, and storage 3.Reconstruct application history from application artifacts and replay of attack 4.Capture and interpret network traffic, analyze mobile devices, and inspect for presence of malware 5.Apply forensics tools to investigate security breaches and identify anti-forensic methods. COURSE OUTLINE: Introduction to Critical Infrastructure Assurance and Protection: Critical Infrastructure Functions, Evolution of Critical Infrastructure Demand, Capacity, Fragility, and the Emergence of Networks Beyond National Frameworks: Areas of Potential Risk or Concern The Reinvention of Information Sharing and Intelligence: Data vs Information vs Intelligence, Open-Source Information and Intelligence Emergency Preparedness and Readiness: First Responder, First Responder Classifications Know Protocols to Secure, Mitigate, and Remove HAZMAT, Importance of Implementing an Emergency Response Plan Security Vulnerability Assessment: Risk Assessment, Threat Risk Equations , Quantitative vs Qualitative Risk Assessments, Threat, Vulnerability, Countermeasures, Vulnerability Assessment Framework Information Sharing and Analysis Centers: Critical Infrastructure Asset, Supply Chain, Public Transit, Transportation Technology, Water, Financial Services, Electricity, Information Technology, Internet Infrastructure, Cyber Threats & Cyber Security, Telecommunications, Energy Resource, Chemical, Healthcare, Food and Agriculture Supervisory Control and Data Acquisition: Vulnerability Concerns about Control Systems , Insecure Connectivity to Control Systems, Issues in Securing Control Systems Critical Infrastructure Information: Enforcement of FOUO Information, Export-Controlled Information, Source Selection Data, Privacy Information, Unclassified Controlled Nuclear Information, Critical Energy Infrastructure Information , Controlled Unclassified Information TEXT BOOKS: 1.Robert S. Radvanovsky and Allan McDougall, Critical Infrastructure: Homeland Security and Emergency Preparedness, Third Edition, CRC Press, 2013 2.Tyson Macaulay, Critical Infrastructure: Understanding Its Component Parts, Vulnerabilities, Operating Risks, and Interdependencies, CRC Press, 2008 3.Robert Radvanovsky and Jacob Brodsky, Handbook of SCADA / Control Systems, Second Edition, CRC Press, 2016 4.Eric D. Knapp and Joel Thomas Langill, Industrial Network Security: Securing Critical Infrastructure Networks for Smart Grid, SCADA, and Other Industrial Control Systems, Second Edition, CRC Press, 2014 CST705 Machine Learning (3-0-0) Introduction: Basic concepts. Supervised learning: Supervised learning setup. LMS. Logistic regression. Perceptron. Exponential family. Generative learning algorithms. Gaussian discriminant analysis. Naive Bayes. Support vector machines. Model selection and feature selection. Ensemble

methods: Bagging, boosting. Evaluating and debugging learning algorithms. Learning theory: Bias/variance tradeoff. Union and Chernoff/Hoeffding bounds. VC dimension. Worst case (online) learning. Unsupervised learning: Clustering. K-means. EM. Mixture of Gaussians. Factor analysis. PCA (Principal components analysis). ICA (Independent components analysis). Reinforcement learning and control: MDPs. Bellman equations.Value iteration and policy iteration. Linear quadratic regulation (LQR). LQG. Q-learning. Value function approximation. Policy search. Reinforce. POMDPs. References: 1. Tom M. Mitchell, Machine Learning, McGraw Hill, 2014 2. Bishop, C. M. Pattern Recognition and Machine Learning. Springer. 2007. 3. Marsland, S. Machine Learning: An Algorithmic Perspective. CRC Press. 2009. (Also uses Python.) 4. Richard O. Duda, David G.Stork,Peter E. Hart, Pattern Classification, Wiley 2007 5. Dougherty, Pattern Recognition and Classification, Springer 2011. 6. Bayesian Reasoning and Machine Learning, David Barber, CRC Press 7. A First Course in Machine Learning , Simon Rogers and Mark Girolami, Chapman & Hall/CRC

CST706 Malware Analysis (3-0-0) Malware: Types – Virus, Worms, Trojans, Logic Bombs, etc., infection modes, payload and its delivery mechanisms. Analysis Tools and their design: Disassemblers, Unpackers, Scanners, Decompilers, Emulators, Virtualization techniques Anti-analysis techniques: Obfuscation techniques, Packing, Encryption, Polymorphism, metamorphism. Analysis Techniques: Signature based, Non-signature based, Static, dynamic, behavioral, anomaly detection. Case Study: Android Malware Text/Reference Books 1.Peter Szor: The Art of Computer Virus Research and Defense, Addison Wesley Professional. 2.Eric Filiol: Computer Viruses: from theory to applications, Springer. 3.Michael Sikorski and Andrew Honig: Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software, No Starch Press 4.Christopher Elisan: Advanced Malware Analysis, McGraw-Hill Osborne Media. 5.Michael Hale Ligh, Andrew Case: The Art of Memory Forensics: Detecting Malware, Wiley. 6.Bruce Dang, Alexandre Gazet: Practical Reverse Engineering, Wiley. CST 707 Security Engineering (3-0-0) Introduction to Security Engineering: Passwords and their limitations, attacks on passwords, CAPTCHA, Biometrics. Access Control: ACL, sandboxing, virtualization, trusted computing. Multi-level and Multi-lateral security. Secure systems: hardware, software and communication systems – design issues and analysis. Secure software architecture: models and principles, hardware design related security – smart cards and other security solutions, communication protocols and application systems associated with security. Securing services: Security in Metered Services, pre-payment meters. Secure printing and Seals. Tamper resistance mechanisms. References: 1. Ross Anderson's Security Engineering , Second Edition 2. Bruce Schneier. Secrecy, Security, and Obscurity . Crypto-Gram, 2002 Additional References : 1.Latest reputed conference and journal articles as chosen by the instructor. 2.William R. Cheswick, Steven M. Bellovin, and Aviel D. Rubin. Firewalls and Internet Security, Second Edition , Addison-Wesley, 2003.

3.Bruce Schneier. Applied Cryptography, Second Edition , Wiley, 1996. 4.Niels Ferguson and Bruce Schneier. Practical Cryptography , Wiley, 2003. 5.Matt Bishop. Introduction to Computer Security , Addison-Wesley, 2004. 6.Andrew Tanenbaum. Modern Operating Systems, Fourth Edition , Pearson, 2014. 7.Andrew Tanenbaum and David Wetherall. Computer Networks, Fifth Edition , Pearson, 2010. 8.Steven M. Bellovin. Thinking Security, Addison-Wesley, 2015.

CST708 Advance Database Systems (3-0-0) Issues in the Implementation of Database Systems. Query Processing and Optimization – Implementation of Database operations, External Sorting, Size Estimations, Equivalence Rules, Heuristic-based Optimization, Materialized Views, Incremental View Maintenance. Transaction Processing - Concurrency Control Management, Serializability, Two-phase Lock Protocol, Deadlock Prevention and Detection, Timestamp-based Ordering Protocol, Log-based Recovery Management. Database System Architectures, Distributed Databases, Distributed Transactions, Data Storage, Two-Phase Commit Protocol, Distributed Query Processing, Parallel Databases, Times in Databases, Multimedia Databases. Text and References: 1.Silberschatz A, Korth HF, Sudarshan S, Database System Concepts, McGrall Hill. 2.Elmasri R and Navathe SB, Fundamentals of Database Systems, 3rd Edition, Addison Wesley,2000. This book covers most of the material on the course. 3.Ceri S, Pelagatti G, Distributed Databases – Principles and Systems, McGraw Hill. 4.Date CJ, An Introduction to Database Systems , 7th Edition, Addison Wesley. 5.Khashafian S and Baker AB, Multimedia and Imaging Databases , Morgan Kaufmann. CST710 Software Testing (3-0-0) Introduction to Faults, Errors, and Failures, Basics of software testing, Testing objectives, Principles of testing, Requirements, behavior and correctness, Testing and debugging, Verification, Validation and Types of testing. Static and Dynamic Testing: Static testing, static analysis tools, white box testing, Unit/Code functional testing, Code coverage testing, Code complexity testing, Black Box testing, Requirements based testing, Boundary value analysis, Equivalence partitioning, state/graph based testing, Model based testing and model checking, Differences between white box and Black box testing. Integration, System, and Acceptance Testing: Top down and Bottom up integration, Bi-directional integration, System integration, Design/Architecture verification, Beta testing, Scalability testing, Stress testing, Security testing, Penetration testing, Vulnerability testing, Acceptance testing: Acceptance criteria, test cases selection and execution. Test Selection & Minimization for Regression Testing: Regression testing, Regression test process, Initial Smoke or

Sanity test, Selection of regression tests, Execution Trace, Dynamic Slicing, Test Minimization, Tools for regression testing, Defect seeding. Test Management and Automation: Test Planning, Management, Execution and Reporting, Software Test Automation: Scope of automation, Design & Architecture for automation, Generic requirements for test tool framework, Test tool selection. References: 1. S. Desikan and G. Ramesh, “Software Testing: Principles and Practices”, Pearson Education. 2. Aditya P. Mathur, “Fundamentals of Software Testing”, Pearson Education. 3. Naik and Tripathy, “Software Testing and Quality Assurance”, Wiley. 4. Myers, Glenford J., “The art of software testing”, John Wiley & Sons.

CST712 Advances in Compiler Design (3-0-0) A Tour of Compiler Design, Structure of Compilers for Modern Programming Languages, LR Parsers and LR Grammars – Design and Development, Lex and Yacc Tools. Optimizing Compiler, Control-flow Analysis, Control-flow Graphs, Basic Blocks, Data-flow Analysis, Dependence Analysis, Global Optimizations, Loop Optimizations, Peephole Optimization and Optimal Code Generation, Data Dependence Analysis in Loops, Loop Scheduling, Static Single Assignment, Just-In-Time (JIT) and Adaptive Compilation, Runtime System Architectures and Automatic Memory Management Techniques. Text and References: 1.Aho, Alfred V ., Sethi, Ravi, Ullman, Jeffrey D., Compilers: Principles, Techniques and Tools, Addison-Wesley. 2.Steven Muchnick, Advanced Compiler Design & Implementation, Morgan Kaufmann. 3.Keith Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann. CST714 Advances in Real-time Systems (3-0-0) Misconceptions about Real-Time computing. Real-time System requirements. Specification of timing constraints. Real-time scheduling, Requirements and Issues, Terminology, Modeling, Static and Dynamic Scheduling schemes, priority driven scheduling of periodic tasks, Schedulability Tests, Aperiodic Task Scheduling, Practical factors/overheads. Resources and resource access control, Multiprocessor Real Time Systems, Problems and Issues. Scheduling in Multiprocessor Systems. Scheduling flexible computations and tasks with Temporal Distance Constraints. Time Critical Applications and Recent Trends in Real Time Computing. Reference Books 1. Real-Time Systems, Jane W.S.Liu, Pearson, 2006 2. Real-Time Systems, C.M.Krishna and Kang G.Shin , McGraw-Hill Education ,1997.

CST716 Image Analysis (3-0-0) Aim of the Course By the end of the semester, students will be able to: 1.Students can able to understand and perform basic image analysis, modelling and visualization problems. 2.Students can able to comprehend challenging research topics and proposes solutions for a real- time in image analysis. IMAGE PRELIMINARIES and IMAGE PROCESSING Digital image representation, Fundamental steps in image processing, Image Acquisition: Energy, the optical system, image sensor and digital image formation. Gray scale and color images. Elements of visual perception, Image model, Sampling and quantization, Relationship between pixels, imaging geometry. Image Point Processing : Gray-level mapping, non-liner gray-level mapping, image histogram, histogram stretching, histogram equalization, thresholding. Neighborhood Processing : Median filter, mean filter, correlation and image sharpening. Color image processing. Morphology: Dilation &

Errosion, closing & opening and boundary detection. Geometric transformations : Translation, rotation, scaling and shearing. Frequency transformation : Discrete Fourier transform (DFT), fast Fourier transform (FFT), short-time Fourier transform (STFT), Multi-resolution Expansions : Wavelet Transforms in 1-D and 2-D. The Fast Wavelet Transform, Wavelet Packets Transform. FEATURE EXTRACTION AND DIMENSION REDUCTION Color, Texture, Shape and structure Features in spatial and frequency domains, Corner Detection, Hough Transform, Principal Component Analysis, Linear Discriminate Analysis, Feature Reduction in Input and Feature Spaces. IMAGE SEGMENTATION Gray-level thresholding, Supervised vs. Unsupervised thresholding, Binarization using Otsu's method, Locally adaptive thresholding, Color-based segmentation, Region oriented segmentation, Use of motion in segmentation, Spatial techniques, Frequency domain techniques. FEATURES BASED IMAGE MATCHING: Scale Space Image Processing, Different Feature descriptors: Key Point Detection, SIFT descriptor SURF descriptor Bag of Visual Words approach, Geometric consistency check, V ocabulary tree PANORAMIC IMAGING Template Matching, Mono Panorama, Stereo Panorama. TEXT BOOKS 1. J G Proakis and D G Manolakis, "Digital Signal Processing," Pearson, Fourth edition 2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Prentice Hall, 3rd Edition, 2007. 3. Bishop, Pattern Recognition and Machine Learning 4. Duda-Pattern Classification CST718 Wireless Security (3-0-0) Introduction(10 T): Wireless networking technology: fundamentals in wireless communication, Wireless MAC standards, Wireless networks: wireless sensor networks, MANETs, WMNs, CRNs, etc. Security definitions and concepts, Attacks and risks in wireless networks/communications. Wireless MAC Security (7 T): attacks on IEEE 802.11, anonymity, confidentiality, availability and integrity in IEEE 802.11. WPA, WPA2 (IEEE 802.11i). Security issues IEEE 802.16, IEEE 802.15.

4, and IEEE 802.22. RFID Security(10 T): Introduction to RFID security, Physical form factor, threat and target identification and Management of RFID security. Tag data security : Potential attacks: skimming and eavesdropping , Measures to protect RFID data transmission, Physical security, Protocol-based security (Encryption and mutual authentication, Effect of security protocols on performance, Frequencies and security, ePassports: standardized security protocols). Safeguarding personal privacy: Potential threats to personal privacy, EPCglobal: recommended industry practices for safeguarding consumer privacy, Regulatory measures: India, U.S., Europe, and Japan. Advances in Wireless Security(13 T): Secure and resilient data aggregation, Key pre-distribution and management, Encryption and authentication, Security in group communication, Trust establishment and management, Denial-of-service attacks and Energy-aware security mechanisms. Text books: No text book and use selected research articles to teach. CST720 Security and Privacy in Social Networks (3-0-0) Brief introduction to OSNs: History and definition of Privacy; V ocabulary, history, terms; Types of consumers, privacy; Myths or why we don't care? Duality of privacy and security: Privacy and security; The role of usability; Crypto and its failure; Privacy and anonymity; Anonymization techniques; Why hasn't privacy/security duality yielded more? Terminology and key players: Tracking; Technologies for tracking; Technical vectors of leakage and ways of identifying them; Role of JavaScript; Role of protocols. Personally Identifiable Information: What is personally identifiable information; People search engines; Introduction to Mobile OSNs; Special purpose OSNs: Pinterest, SnapChat, Ask.fm, WhatsApp; Privacy settings in OSNs; PII leakage in OSNs Linkage: Semantics and the compositional problem; Collateral Damage of Privacy; Economics of Privacy: Privacy of mixed data sets, OSNs; Privacy across time References: 1.Latest reputed conference and journal articles as chosen by the instructor. 2.Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: Private Communication in a Public World, 2nd edition, 2002, Prentice Hall. 3.Simson Garfinkel, Gene Spafford, Web Security, Privacy and Commerce, 2002, O'Reilly 4.Ross Anderson, Security Engineering, John Wiley and Sons, 2001

5.Cryptography and Network Security: Principles and Practice, by William Stallings , Prentice Hall, Hardcover. Fifth Edition is out also. See http://williamstallings.com/Crypto3e/Crypto3e-student.html for student online help. 6. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall, Hardcover, Published November 1999, 366 pages, ISBN 0130160938 7.Secrets and Lies: Digital Security in a Networked World by Bruce Schneier John Wiley, Published August 2000, 412 pages, ISBN 0471253111.Kruegel, and G. Vigna.

CST722 Advances in Data Mining (3-0-0) UNIT-I Data mining Overview Data mining tasks – mining frequent patterns, associations and correlations, classification and regression for predictive analysis, cluster analysis , outlier analysis; advanced pattern mining in multilevel, multidimensional space – mining multilevel associations, mining multidimensional associations UNIT-II Classification, Clustering, Association Rule Mining Classification by back propagation, support vector machines, classification using frequent patterns, other classification methods – genetic algorithms, roughest approach, fuzz>set approach; Density - based methods –DBSCAN, OPTICS, DENCLUE; Grid-Based methods – STING, CLIQUE; Exception – maximization algorithm; clustering High- Dimensional Data; Clustering Graph and Network Data. Frequent Pattern matching, Association Rule Mining UNIT-III Web and Text Mining Introduction, web mining, web content mining, web structure mining, we usage mining, Text mining – unstructured text, episode rule discovery for texts, hierarchy of categories, text clustering. UNIT-V Temporal and Spatial Data Mining Introduction; Temporal Data Mining – Temporal Association Rules, Sequence Mining, GSP algorithm, SPADE, SPIRIT Episode Discovery, Time Series Analysis, Spatial Mining – Spatial Mining Tasks, Spatial Clustering. Data Mining Applications. TEXT BOOKS: 1. Data Mining Concepts and Techniques, Jiawei Hang Micheline Kamber, Jian pei, Morgan Kaufmannn. 2. Data Mining Techniques – Arun K pujari, Universities Press. REFERENCE BOOKS: 1. Introduction to Data Mining – Pang-Ning Tan, Vipin kumar, Michael Steinbach, Pearson. 2. Data Mining Principles & Applications – T.V Sveresh Kumar, B.Esware Reddy, Jagadish S Kalimani, Elsevier.

CST724 Web Security (3-0-0) PRE-REQUISITES: Computer Networks, Operating System, Web Application Development COURSE OUTCOMES: 3.Describe the browser security model including same-origin policy and threat models in web security. 4.Discuss the concept of web sessions, secure communication channels such as TLS and importance of secure certificates, authentication including single sign-on such as OAuth and SAML. 5.Describe common types of vulnerabilities and attacks in web applications, and defenses against them. 6.Use client-side security capabilities in an application. COURSE OUTLINE: Web Security Model: Browser security model including same-origin policy, Client-server trust boundaries Session Management and Authentication: Single sign-on, HTTPS and certificates Application Vulnerabilities and Defenses: SQL Injection, Cross Site Scripting (XSS), CSRF, Insecure Direct Object References, Security Misconfiguration, Sensitive Data Exposure, Missing Function Level Access Control, Using Components with Known Vulnerabilities, Invalidated Redirects and Forwards (OWASP Top 10) Client-Side Security: Cookies security policy, HTTP security extensions, Plugins, and web apps; Web user tracking Server-Side Security: Tools, Web Application Firewalls (WAFs) and Fuzzers TEXT BOOKS: 1.Dafydd Stuttard and Marcus Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, II Edition, Wiley Publishing Inc, 2011 2.Vincent Liu, Web Application Security - A Beginner's Guide, McGraw-Hill Osborne, 2012 3.Mike Shema, Seven Deadliest Web Application Attacks, Syngress, 2010 4.Jeremiah Grossman, Robert “RSnake” Hansen, Petko “pdp” D. Petkov, Anton Rager, Cross Site Scripting Attacks: XSS Exploits and Defense, 2007 5.Justin Clarke, SQL Injection Attacks and Defense, II Edition, Syngress, 2012 CST726 Quantum Cryptography (3-0-0) Preliminaries: Quantum Information Theory, Quantum Information Theory, Unconditional Secure Authentication and , Entropy. Quantum Key Distribution: Quantum Channel, Public Channel, QKD Gain , Finite Resources, Adaptive Cascade: Introduction, Error Correction and the Cascade Protocol, Adaptive Initial Block- Size Selection, Fixed Initial Block-Size, Dynamic Initial Block-Size. Attack Strategies on QKD Protocols: Attack Strategies in an Ideal Environment , Individual Attacks in an Realistic Environment. QKD Systems, Statistical Analysis of QKD Networks in

Real-Life Environment: Statistical Methods, Results of the Experiments, Statistical Analysis. QKD Networks Based on Q3P : QKD Networks, PPP, Q3P, Routing and Transport. Quantum- Cryptographic Networks from a Prototype to the Citizen. The Ring of Trust Model, Model of the Point of Trust Architecture, Communication in the Point of Trust Model, Exemplified Communications, A Medical Information System Based on the Ring of Trust. Text books: 1. Quantum Cryptography and Secret-Key Distillation, Gilles van Assche, Cambridge University Press, 2006. Paul Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press (2007). 2. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press (2000). CST728 Trust Management System (3-0-0) Introduction: Definition – Sociological perspective, technical perspective; Concept of Trust Evolution, Trust over Security and Privacy; Important of trust in future networks; properties of trust. Traditional Trust Management: Identification and Authentication mechanism; Overview of Public Key Infrastructure (PKI), Entities, Standards, design issues, implementation and deployment, Trust management challenges. Re-invention of “Trust” paradigm on future internet: Social Psychology to Social Network; Sociology of the Internet and Digital Sociology; Digital Personality; Trust origin, types, properties, models. Trust and Social Network: Overview of Social network, social agents, importance of trust, social capital and social trust, information collection, evaluation of trust. Trust and Internet of Things: Overview of Internet of Things, importance of trust, objective, frameworks, types of trust for IoT, evaluation models. Social IoT, trust in social IoT. Attacks on Trust: Classification criteria, system model, classification of trust attacks. Attack’s assumptions, characteristics, setup, effect in trust evaluation. Text and References: 1.Roles, Trust, and Reputation in Social Media Knowledge Markets: Theory and Methods, Elisa Bertino, Sorin Adam Matei, Springer. 2.The Internet of Things: Key Applications and Protocols, David Boswarthick, Olivier Hersent, and Omar Elloumi, Wiley. 3.Latest research articles. CST730 Cloud Security (3-0-0) PRE-REQUISITES: Computer Networks, Operating System COURSE OUTCOMES: 7.Understand the characteristics in terms of the systems, protocols and mechanisms in Cloud 8.Examine virtualization & its types, hypervisors and various aspects of VM management

9.Comprehend the design of Cloud Architectures with reference to scalability 10.Understand the vulnerabilities, threats and attacks in Cloud Environment and the defense mechanisms 11.Realize the post attack scenario and evaluate investigation and forensic techniques for Cloud COURSE OUTLINE: Introduction of Cloud Computing: Taxonomy and related technologies, Essential Characteristics, Service and Deployment Models Virtualization: Types of Virtualization and Hypervisors, Virtualization at Storage, Compute and Network, Hypervisors (Types and Case studies), Virtual Machine Provisioning, Virtual Machine Migration Architectures: Standards, Orchestration, Provisioning, Portability, Interoperability, Federated Cloud, Security: CIA Triad, Vulnerabilities in Cloud, Threats to Infrastructure, Data and Access Control; Identity Management; Multi Tenancy Issues; Attack taxonomy; Intrusion Detection, VM Specific attacks, VM Introspection, Management; Trusted Cloud Initiative of Cloud Security Alliance (CSA). Forensics: NIST Forensics Reference Architecture, Forensic Science Challenges, Architectural Issues, Evidence Collection and Analysis, Anti-Forensics, Incident Response, Standards and Framework TEXT BOOKS: 1.K. Hwang, G. C. Fox, and J. Dongarra, Distributed and Cloud Computing, 1st ed.: Morgan Kaufmann, 2011 2.R. Buyya, J. Broberg, and A. M. Goscinski, Cloud Computing: Principles and Paradigms: Wiley-Blackwell, 2011 3.S. Dinkar and G. Manjunath, Moving to the Cloud: Developing Apps in the New World of Cloud Computing Syngress Media, U.S., 2012. 4.W. Stallings, Foundations of Modern Networking: SDN, NFV , QoE, IoT, and Cloud, 1st ed.: Addison-Wesley Professional, 2015 5.T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture: Prentice Hall/Pearson PTR, 2014 6.R. L. Krutz and R. D. Vines, Cloud Security - A Comprehensive Guide to Secure Cloud Computing, Wiley Publishing, 2010 7.T. Mather, S. Kumaraswamy, and S. Latif, Cloud Security and Privacy - An Enterprise Perspective on Risks and Compliance, O Reilley Publishers, 2009 8.V . (J. R.) Winkler, G. Speake, P . Foxhoven, Securing the Cloud: Cloud Computer Security

Techniques and Tactics, Syngress, 2011

CST732 Database Security (3-0-0) Security and Information Technology, Database Security Architecture, Profiles, Password policies, Privileges and Roles, Virtual Private Databases, and Database Auditing. SQL Injections- Identification and Defense. Security Testing. Database Management Security Issues such as Administration of Users, Enforcing Access Controls, and related Issues. Security Issues in New-generation Database Systems like Distributed, Frame-based and Object-oriented Databases. Text: 1.Alfred Basta, Melissa Zgola, Database Security, Course Technology (Cengage Learning). 2.Hassan A. Afyduni, Database Security and Auditing: Protecting Data Integrity and Accessibility, Course Technology (Cengage Learning). 3.Ron Ben Natan, Implementing Database Security and Auditing, Elsevier. CST734 Secure Software (3,0,0) Unit 1: Introduction: Secure Software, assets, stakeholders, threats, security requirements, confidentiality, authentication, authorization, integrity. Unit 2: Secure Software Development Life Cycle: Security practices, Common criteria, built-in security, Agile Processes, Security Development Lifecycle (SDL), Secure Software Development Methodology (SecSDM), Security Design Patterns. Unit 3: Requirements Engineering: Functional and Non-functional requirements, security requirements, reliability, maintainability, portability, trustworthiness, robustness, usability, use cases, mis-use cases. Unit 4: Threat Modeling and Secure Design: Asset, Threat, Attack, Dataflow Diagram (DFD), Attack Tree, STRIDE, DREAD, Security Principles, Guidelines for Secure Software Development, Access Control. SecUML, model based security engineering with UML Unit 5: Secure Coding and Secure Testing: Secure Coding Practices, Vulnerabilities, Vulnerability Patterns, Code Checking Tools, Cross Site Scripting, Injection Flaws. Use of formal methods and verification for security, techniques for software protection. Test Cases, Security Test Plan, White Box Testing, Black Box Testing, Penetration Testing, Code Reviews, Regression Testing, Performance Testing. Recommended Books: 1.John Musa D, “Software Reliability Engineering”, 2nd Edition, Tata McGraw-Hill, 2005 (Units I, II and III) 2.Jan Jürjens, “Secure Systems Development with UML”, Springer; 2004 (Unit IV and V) 3.Frank Swiderski, Window Snyder, “Threat Modeling”, Microsoft Press, First Edition, 2005. 4.J. Viega and G. McGraw, “Building Secure Software: How to Avoid Security Problems the Right Way”, Addison-Wesley, 2002

5.A. Cockburn, “Writing Effective Use Cases”, Addison- Wesley, Boston, MA, 2001 CST-736 Fault Tolerant Computing (3-0-0) Introduction to Fault Tolerant Paradigm: Fault Classification, Byzantine Failures, Basic Measures of Fault Tolerance. Failure Rate, Reliability and Mean Time to Failure. Redundancy in Hardware, Software, Time and Information. Software Fault Tolerance : Acceptance Tests, Single- Version Fault Tolerance, N-Version Programming, Recovery Block Approach, Preconditions, Post conditions and Assertions, Exception-Handling, Software Reliability Models, Fault-Tolerance Remote Procedure Calls. Fault Tolerance Strategies in Distributed Systems: Fault detection and Prediction, Location, Masking, Containment, Reconfiguration, Self-Repairing, Self-Healing and Recovery. Simulation Techniques .

Reference Books 1.Fault-Tolerant Systems, Israel Koren and C. Mani Krishna, Morgan Kaufmann Publishers, 2007 2.Fault Tolerance in Distributed Systems, Pankaj Jalote, PTR Prentice Hall, 1994. 3.Fault Tolerant Computer System design by D. K. Pradhan, Prentice Hall. CST738 Pattern Classification (3-0-0) Introduction to Pattern Recognition: Clustering vs. Classification; Applications; Linear Algebra, vector spaces, probability theory, estimation techniques. Classification:Tree Classifiers Getting our feet wet with real classifiers: Decision Trees: CART, C4.5, ID3. Random Forests. Bayes decision rule, Error probability, Error rate, Minimum distance classifier, Mahalanobis distance; K-NN Classifier, Linear discriminant functions and Non-linear decision boundaries. Parametric Techniques Generative Methods grounded in Bayesian Decision Theory, Maximum Likelihood Estimation, Bayesian Parameter Estimation, Sufficient Statistics Non-Parametric Techniques: Kernel Density Estimators, Parzen Window, Nearest Neighbor Methods Single and Multilayer perceptron, training set and test sets, standardization and normalization. Unsupervised Methods: Component Analysis and Dimension Reduction, The Curse of Dimensionality, Principal Component Analysis, Fisher Linear Discriminant Clustering: Different distance functions and similarity measures, Minimum within cluster distance criterion, K-means clustering, single linkage and complete linkage clustering, MST, medoids, DBSCAN, Visualization of datasets, existence of unique clusters or no clusters. Feature selection: Problem statement and Uses, Probabilistic separability based criterion functions, interclass distance based criterion functions, Branch and bound algorithm, sequential forward/backward selection algorithms, (l,r) algorithm. Feature Extraction: PCA, Kernel PCA. Recent advances in PR: Structural PR, SVMs, FCM References 1. Richard O. Duda, David G.Stork,Peter E. Hart, Pattern Classification, Wiley 2007 2. Bishop, C. M. Pattern Recognition and Machine Learning. Springer. 2007. 3. Dougherty, Pattern Recognition and Classification, Springer 2011. 4. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4. Academic Press, 2008.

5. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence. 2003. 6. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995. 7. Andrew R. Webb, Kith D. Copsey, Statistical Pattern Recognition, Wiley 2011 CST740 Security Analysis of Protocols (3-0-0) Cryptographic background; Authentication; Key establishment and IP security; Denial of service; Anonymity and MIX networks; Fairness and contract signing; Privacy and protection of individual information; Wireless security (mobile phones, WiFi); Protocol analysis tools: Finite-state checking; Infinite-state symbolic analysis; Probabilistic model checking; Game-based verification; Process algebras (spi-calculus and applied pi- calculus); Protocol logics (BAN, DDMP, Isabelle); Introduction to Probabilistic polynomial- time calculus; Relating cryptographic and formal models; References: 1.Latest reputed conference and journal articles as chosen by the instructor. 2.Maximum Security, 2nd Edition , SAMS Books by Anonymous, 1998, ISBN: 0- 672-31341-3. Maximum Linux Security , SAMS Books by Anonymous, 2000, ISBN: 0-672- 31670-6. 3.The Cuckoo's Egg : Tracking a Spy Through the Maze of Computer Espionage ; by Clifford Stoll; Pocket Books; ISBN

0671726889 4.It's no secret: Measuring the security and reliability of authentication via 'secret' questions, by Schechter, Brush, and Egelman 5.10 Risks of PKI: What You're not Being Told about Public Key Infrastructure , by Ellison and Schneier 6.Computer Networks, a Systems Approach (3rd edition), by Peterson and Davie. 7.Network Security: Private Communication in a Public World" (2nd edition), by Kaufman, Perlman, and Speciner CST742 Biometrics (3-0-0) Introduction of Biometric traits and its aim, image processing basics, basic image operations, filtering, enhancement, sharpening, edge detection, smoothening, enhancement, thresholding, localization. Fourier Series, DFT, inverse of DFT. Biometric system, identification and verification. FAR/FRR, system design issues. Positive/negative identification. Biometric system security, authentication protocols, matching score distribution, ROC curve, DET curve, FAR/FRR curve. Expected overall error, EER, biometric myths and misrepresentations. Selection of suitable biometric. Biometric attributes, Zephyr charts, types of multi biometrics. Verification on multimodel system, normalization strategy, Fusion methods, Multimodel identification. Biometric system security, Biometric system vulnerabilities, circumvention, covert acquisition, quality control, template generation, interoperability, data storage. Leading technologies : Finger-scan –

Facial-scan – Iris-scan – V oice-scan – Hand Scan, Retina Scan - components, working principles, competing technologies, strengths and weaknesses. Recognition systems: Face,Signature, Fingerprint,Ear, Iris etc. Assessing the Privacy Risks of Biometrics – Designing Privacy-Sympathetic Biometric Systems – Need for standards – different biometric standards. References: 1. Introduction to Biometrics, Jain, Ross, Nandakumar, Springer 2011 2. Guide to Biometrics, Ruud M.Bolle,Sharath Pankanti, Nalini K. Ratha,Andrew W. Senior, Jonathan H. Connell,Springer 2009 3. Biometrics – Identity Verification in a Networked World, Samir Nanavati, Michael Thieme, Raj Nanavati, Wiley-dreamtech India Pvt Ltd, New Delhi, 2003 4. Biometric Technologies and Verification Systems, John R Vacca, Elsevier Inc, 2007 6. Digital Image Processing using MATLAB,By: Rafael C. Gonzalez, Richard Eugene Woods, 2nd Edition, Tata McGraw-Hill Education 2010 CST744 Digital Forensics (3-0-0) PRE-REQUISITES: Computer Networks, Network Security COURSE OUTCOMES: 6.Describe what digital investigation is, the sources of evidence, and the limitations of forensics. 7.Describe the legal requirements for use of seized data, data collection, and storage 8.Reconstruct application history from application artifacts and replay of attack 9.Capture and interpret network traffic, analyze mobile devices, and inspect for presence of malware 10.Apply forensics tools to investigate security breaches and identify anti-forensic methods. COURSE OUTLINE: Foundations: Basic Principles and methodologies for digital forensics, Design systems with forensic needs in mind Evidence Collection: Rules of Evidence, Jurisdictions, Chain of Custody; Search and Seizure of evidence: legal and procedural requirements; Digital Evidence methods and standards, Techniques and standards for Preservation of Data Evidence Analysis: OS / File System Forensics, Application Forensics, Web Forensics, Network Forensics, Mobile Device Forensics Investigation: Computer / Network / System attacks, Attack detection and investigation, Anti- forensics TEXT BOOKS: 1.Thomas J

Holt , Adam M Bossler, Kathryn C Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge, 2015 2.Eoghan Casey, Handbook of Digital Forensics and Investigation, Academic Press, 2009 3.Eoghan Casey, Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, III Edition, 2011 4.Angus McKenzie Marshall, Digital Forensics: Digital Evidence in Criminal Investigations, Wiley-Blackwell, 2008

CST746 Intrusion Detection (3-0-0) Overview of computer security solutions, Vulnerability assessment, firewalls, VPN's Review of Network protocol Vulnerabilities: buffer overflow, packet fragmentation, out-of-spec packets Overview of Intrusion Detection and Intrusion Prevention: Network and Host based IDS Classes of attacks: Network layer (scans, denial of service, penetration), Application layer (software exploits, code injection), Identity theft, root access, etc. Threats: Malware detection, Drones, Worms, Viruses, Botnets, Email/IM issues, Insider Threat issues IDS and IPS – Architecture and internals, tcpdump. Malicious and non-malicious traffic, IP headers, TDP, UPD and ICMP protocols and header formats, Header information to detect intrusion, logs and their analysis, Signature based Solutions, Snort, Snort rules Anomaly Detection Systems and Algorithms: Network Behavior Based Anomaly Detectors (rate based), Host based Anomaly Detectors, Attack trees and Correlation of alerts Collaborative Security Text & References: 1.Matt Fearnow, Stephen Northcutt, Karen Frederick, and Mark Cooper. Intrusion Signatures and Analysis, SAMS. 2.Carl Endorf, Gene Schultz, Jim Mellander, Intrusion Detection and Prevention , McGraw Hill. 3.Stephen Northcutt and Judy Novak. Network Intrusion Detection , SAMS. 4.Paul E. Proctor. The Practical Intrusion Detection Handbook , Prentice Hall. 5.Rebecca Gurley Bace: Intrusion Detection , CST748 Internet of Things (3-0-0) Introduction: Internet of Things and Connected Products, IoT paradigm, Smart objects, Goal orientation, Convergence of technologies; Business Aspects of the Internet of Things. Internet and "Things": Layers, Protocols, Packets, Services, Performance parameters of a packet network and applications: Web, Peer-to-peer, Sensor networks, and Multimedia. Hardware and Software: Hardware components, Microcontrollers and Software; Operating Systems. Protocols and Platforms: IoT Communication Protocols, Transport Protocols, Application Protocols; Cloud computing for IoT. Services and Attributes: Data creation, Data gathering and Data dependency; Robustness, Scaling, Privacy, Security, Trust. Application: Implications for the society, IoT case study. Text and References: 1.The Internet of Things: Key Applications and Protocols, David Boswarthick, Olivier Hersent, and Omar Elloumi, Wiley 2.Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley. 3.Latest research articles.

CST750 Ethical Hacking (3-0-0) PRE-REQUISITES: Computer Networks, Network Security COURSE OUTCOMES: 1.To know about hacking concept and apply it in ethical manner. 2.To provide awareness of security policies in defense field. 3.To learn about the tools and methods for hacking servers and Operating System. COURSE OUTLINE: Introduction & Overview: Ethical Hacking Terminology, Types, Different stages and phases in Ethical Hacking, Gaining Access, Hactivism, Footprinting and Social Engineering, E-Mail Tracking, Common Types of Attacks, Identity Theft, Phishing Attack, Online Scams, URL obfuscation. Scanning and Enumeration: Scanning, types of scanning, Ping Sweep Techniques, Proxy Servers, HTTP Tunneling Techniques, IP Spoofing Techniques, Enumeration, Null Session, SNMP Enumeration, System Hacking: Understanding Password Cracking Techniques, Understanding the LanManager, Hash Cracking Windows passwords, Redirecting the SMB logon to Attacker. Attacks: Trojans, Backdoors, viruses, worms, sniffers, Denial of Service and Session Hijacking Hacking: Hacking Web Servers, Web Application Vulnerabilities and Web-Based Password Cracking Techniques, SQL Injection and buffer overflows. Penetration Testing : Penetration testing methodology, Steps of penetration testing, Legal Framework, Penetration Testing Tools: Manual and Automated Tools, Penetration Testing Deliverables. Text Books: 1.Hands■On Ethical Hacking and Network Defense – By Michael T. Simpson, Kent Backman, James Corley 2.Official Certified Ethical Hacker Review Guide – By Steven DeFino, Barry Kaufman, Nick Valenteen. 3.CEH Official Certified Ethical Hacking Review Guide, Wiley India Edition. 4.Certified Ethical Hacker: Michael Gregg, Pearson Education. 5.Certified Ethical Hacker: Matt Walker, TMH. 6.The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy (Syngress Basics Series) 7.Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, Terron Williams, Gray Hat Hacking: The Ethical Hackers Handbook, 3rd Edition. CST752 Parallel and Distributed Systems (3-0-0) Parallel and Distributed Computing: Concepts and issues in parallel and distributed computing. Multi-core and GP GPU computing, Distributed Systems models and enabling technologies, computer clusters for scalable parallel computing, Virtual machines and Virtualization. Grid Computing systems and resource management, Cloud computing and related issues. Reference Book 1.Distributed and Cloud computing, Kai Hawang, Geoffrey C. Fox and Jack J. Dongarra, Morgan Kaufmann Publishers, 2012.

CST754 Cyber Laws and IPR (3-0-0) Understanding Copy Right in Information Technology : Understanding the technology of Software software-copyright vs Patent debate Authorship , Assignment issues Commissioned work, Work for hire Idea/Expression dichotomy, Copy right in internet, Legal Issues in internet and Software Copyright Jurisdiction Issues, Copyright Infringe Remedies of Infringement Multimedia, Copyright issues Software Piracy, Patents understanding; Cyber Crimes: Understanding Cyber Crimes in context of Internet, Indian Penal Law & Cyber Crimes Fraud Hacking Mischief, International law, Obscenity and Pornography Internet, Potential of Obscenity Indian Law On Obscenity & Pornography Technical, Legal solutions International efforts Changes in Indian Laws, Ecommerce & Taxation, Security and Evidence in E-Commerce Dual Key encryption Digital signatures security issues, UNCITRAL model law of E- Commerce, Indian Legal Position on E-Commerce IT Act 2000/Indian Evidence Act/Draft law on E-Commerce Procedures and security Polices , Risk assessment methodologies, Risk management, DRP/BCP-Business impact analysis, Asset classification, process level strategy, information classification organization, Crisis management plan, Resources recovery strategy, Framework, audits benchmarks, compliance, communications; Data protection for system designers : Evaluation criteria and security testing, International standards, Analysis and Logging, Recovery and data backs, Security policy development; Security Models: Frameworks, Standards, Security Certification ISO 17799/ ISO 27001, System Security Engineering Capacity Maturity Model, Laws and Legal Framework for Information Security, Recovery and risk analysis, Operating system and application specific auditing. Text Book: 1. V . D. Dudeja ,"Cyber Crime and Law Enforcement ", Commonwealth Publishers, 2003 2. C. Davis,"IT Auditing: Using Controls to protect Information Assets ", TMH, 2011 MTech_2013_CS_FT.pdf Department of Computer Engineering Malaviya National Institute of Technology MTech Full Time (Computer Engineering) (2012-13 onwards) I Semester (Autumn Semester) I Semester (Autumn Semester) Course Title Credit LTP CWS PRS MTE ETE PRE 1CP-501Topics in Algorithms PC3300220-3050- 2CP-513Topics in Databases PC3300220-3050- 3CP-523Topics in Computing PC3300220-3050- 4CP-505System Design Lab PC3103-60--40 5CP-509Programming Lab – I PC3103-60--40 6CP-506Security in Computing PC3300220-3050- Total 18 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. II Semester (Spring Semester) II Semester (Spring Semester) Course Title** Credit LTP CWS PRS MTE ETE PRE CWS 1Elective-I PE3300220-3050- 2Elective-II PE3300220-3050- 3Elective-III PE3300220-3050- 4Elective-IV PE3300220-3050- 5Elective-V PE3300220-3050- 6Lab Elective-I PE3103-60--40 Total 18 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. ** Two Electives need to be taken from Department Elective List. 36S.NoCourse Code Subject AREA Exam DurationRelative Weightage* S . N o 1 2 3 4 5 6 P E S.NoCourse Code Subject AREA Exam DurationRelative Weightage* S . N o 1 2 4 3T o t a l TOTAL CREDITS (Sem I-II) TOTAL CREDITS (Sem I-II) Department of Computer Engineering Malaviya National Institute of Technology MTech Full Time (Computer Engineering) (2012-13 onwards) III Semester (Autumn Semester) Course Title Credit LTP CWS PRS MTE ETE PRE CWS 1CP-600Seminar PC4-------100- 2CP-601Dissertation PC16--------- Total 20 IV Semester (Spring Semester) S.No Course Title Credit LTPRelative Weightage*CWS PRS MTE ETE PRE CWS 1CP-602Dissertation PC16-------- Total 16 TOTAL CREDITS (Sem III-IV) 36 TOTAL CREDITS (Sem V-VI) TOTAL CREDITS (Sem I-IV) 72 TOTAL CREDITS (Sem V-VI)S.NoCourse Code Subject AREA Exam DurationRelative Weightage* S . N o 1 2T o t a l Course Code Subject AREA Exam Duration S . N o 1T o t a l CPT601 Topics in Algorithms 3-0-0 RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis - Advanced Data Structures: B-Trees, Binomial Heaps, Fibonacci Heaps, A VL trees, Red-black trees, B- trees, Splay trees. Disjoint set – union and path compression, Amortized analysis Recurrence equations. Time and space complexity, NP, NPC and NP-Hard problems, undecidability. Convex hull and V oronoi diagrams, line segments, Optimal polygon triangulation. Primality testing, Integer factorization, Randomized algorithms, Probabilistic algorithms. Dynamic programming: Longest common subsequence. Chain of matrix multiplication, Approximate Algorithms: Vertex-cover, set-covering problems, Travelling Salesman problem. Combinatorial algorithms, Randomized algorithms: Use of probabilistic inequalities in analysis, applications using examples.

Graph algorithms: Matching and Flows. Parallel algorithms: Basic techniques for sorting, seraching, merging.. Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions. Texts/References: 1)Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India. 2)Horowitz and Sahani: Fundamental of Computer algorithms . 3)Aho A.V , J.D Ulman: Design and analysis of Algorithms , Addison Wesley 4)Brassard : Fundamental of Algorithmics , PHI. 5)Sara Baase: Computer Algorithms: Introduction to Design and Analysis , Pearson Education. 6)Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms and Complexity , PHI. 7)Motwani and Raghavan: Randomized Algorithms , Cambridge University Press 8)Joseph Ja'Ja': Introduction to Parallel Algorithms , Addison-Wesley 9)Vaizirani: Approximation Algorithms , Springer Verlag 10)N. Deo: Graph Theory with Application to Engineering and Computer Science , Prentice-Hall. 11)N. Deo: Combinatorial Algorithms: Theory and Practice , Prentice-Hall. CPT602Parallel and Distributed Computing 3-0-0 Introduction to parallel computing. Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O Parallel reduction, Prefix sums, List ranking, Preorder tree traversal, Merging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS Thread and process level parallel architectures: MIMD, multi-threaded architectures. Distributed and shared memory MIMD architectures. Dynamic interconnection networks. Mapping and scheduling: Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock. Parallel programming and parallel algorithms: Programming models, parallel programming on multiprocessors and multicomputers. Parallel algorithm structure, analyzing parallel algorithm. Elementary parallel algorithms, Matrix algorithms, sorting, Graph algorithms. Text & References: 1)Quinn, Parallel computing – theory and practice , Tata McGraw Hill. 2)Sima and Fountain, Advanced Computer Architectures , Pearson Education. 3)Mehdi R. Zargham, Computer Architectures single and parallel systems , PHI. 4)Ghosh, Moona and Gupta, Foundations of parallel processing , Narosa publishing. 5)Ed. Afonso Ferreira and Jose’ D. P. Rolin, Parallel Algorithms for irregular problems - State of the art, Kluwer Academic Publishers. 6)Selim G. Akl, The Design and Analysis of Parallel Algorithms , PH International. CPT603Selected Topics in Operating System 3-0-0 Introduction: Goals, Functions, Design issues of Distributed OS, Distributed v/s network operating system. Communication: Client Server, RPC Distributed OS: Issues, process management, inter-process communication, scheduling, deadlocks Design and implementation of distributed file systems, distributed shared memory Security: Concepts and Distributed Systems Distributed Concurrency, Transactions. Case study: Unix, Amoeba. Text/References: 1)Tanenbaum: Distributed Operating Systems, Pearson Education. 2)Bach, Design of Unix O/S. 3)Coulouris et al, Distributed Systems: Concepts and Design , Addison Wesley. 4)Mullender: Distributed Systems , Addison Wesley. 5)Tanenbaum and Steen: Distributed Systems: Principles and Paradigms , Pearson Education CPT627Information System Security 3-0-0 Number theory: Prime numbers, modular arithmetic, Fermat’s theorem, Euler’s theorem, Chinese remainder theorem, Discrete logarithms, Random number generation, factoring, prime number generation, one-way hash functions – MD5, SHA (Secure Hash Algorithm). Cryptography: Need, conventional techniques, stream ciphers, block cipher, steganography. Public v/s private key cryptography. Stream Ciphers: Caesar Cipher, mono-alphabetic and poly-alphabetic ciphers, Playfair Cipher, Hill Cipher, Rotor machines, One time pad,. Steganography: Visual, Textual, Cipher hiding, False errors. Private-key cryptography: Feistel structure, DES (Data encryption standard), design of S-boxes, AES, Triple DES, Public key cryptography: Key management, Key exchange – Diffie-Hellman, Authentication, Signatures, Deniability, RSA. Digital Signature: DSA and its variants, discrete logarithm based digital signatures. Cryptanalysis: Differential and linear cryptanalysis - cracking DES. Rabin, ElGamal, Goldwasser-Micali, Blum-Goldwaser cryptosystems. Digests: Message authentication, digital signature algorithms. Security handshake pitfalls, Strong password protocols. Text & References: 1.Stallings, Cryptography and Network Security , Pearson Education. 2.B Schneier, Applied Cryptography , Wiley. ISBN 0-471-11709-9 3.D Kahn. The Codebreakers, Sphere books. ISBN 0-7221-51497 4.A.J. Menezes, P.C. van Oorschot and S.A. Vanstone, Applied Cryptography , CRC Press. 5.D.R. Stinson, Cryptography - Theory and practice , CRC Press. CPT611Advanced Topics in Computer Graphics 3-0-0 Visibility: Polygon Meshes, Depth Sorting. Triangle decomposition, Geometric Sort, Warnock's Methods Hidden Lines and Surfaces : Special cases, Surfaces defined by a function y=f(x,y), Grid surfaces, visible surface determination . Colour in Computer Graphics : Color Vision, Measuring Color, Color Models, Color output, color usage. Object Lighting and Shading : Illumination and shading models, Local reflection models, shading surfaces, Texture and transparency, Forward & backward Ray-tracing Global Illumination and classical radiosity. Modeling natural phenomena : Fractals and chaos. Animation Techniques : Position, speed or orientation. Animation by hierarchic control, scenario-based systems, movement control. Shadows, Morphing, Texture mapping Text/ References: 1)J. Foley et al : Computer Graphics-Principles and Practice, Addison Wesley. 2)Alan Watt- 3D Computer Graphics . 3)A. Watt, M. Watt: Advanced Animation & Rendering Techniques , Addison-Wesley. 4)D. Rogers and Adams: Mathematical Elements of Computer Graphics , Mc Graw Hill. 5)Thomas Moller: Real-time Rendering , Eric Haines, A.K Peters Ltd CPT613Topics in Databases 3-0-0 Issues in Implementation of Database Systems, Query Processing, Query Optimization, Transaction Processing, Concurrency, Recovery Management. Database System Architectures, Distributed Databases, Distributed Transactions, Distributed Query Processing, Parallel Databases, Times in Databases, Multimedia Databases. Text/References 1)Silberschatz A, Korth HF, Sudarshan S, Database System Concepts, McGrall Hill. 2)Elmasri R and Navathe SB, Fundamentals of Database Systems, 3rd Edition, Addison Wesley,2000. This book covers most of the material on the course. 3)Ceri S, Pelagatti G, Distributed Databases – Principles and Systems, McGraw Hill. 4)Date CJ, An Introduction to Database Systems , 7th Edition, Addison Wesley. 5)Khashafian S and Baker AB, Multimedia and Imaging Databases , Morgan Kaufmann. CPT615Network Performance Modeling 3-0-0 Networking as resource sharing: current practices, Traffic Multiplexing, Traffic analysis, Stochastic

Traffic Models, Multiple Access: Wireless Networks. Routing: Virtual path routing and Elastic Aggregates, Routing of Stream Type sessions, Routing in Ad-hoc and Sensor Networks. Introduction to High Performance Switching and Routing. QoS and Modeling issues of the Networks. Text & References: 1)Communication Networking: An Analytical Approach, Anurag Kumar, D.Manjunath, Joy Kuri, Elsevier 2)High Performance Communication Networks, Jean Walrand, P.Vaiya, Elsevier 3)Selected papers and online references. CPT617Software Testing and Validation 3-0-0 Basic software testing principles – Software Quality, Software testing and test management. Acceptance Testing: User acceptance testing, alpha and beta testing. Functional and Non-functional system testing Static and dynamic testing, Black-box or functional testing, structural, white box or glass box testing. Integration testing, component testing. Software testing tools. Software Validation: Issues and Challenges. Books/References: 1)Selected papers and online references. CPT619Topics in SOC Design 3-0-0 Methodologies and design flows of front end and back end designs. Introduction to intellectual property core types and their design issues. Integration issues of IPs on SOC designs. Low power design issues and methodologies. Testing standards and architecture of SOCs. Text/Reference: 1)Farzad Nekoogar , F .Nekooqar, From ASICs to SOCs: A Practical Approach, Pearson. 2)Steve B. Furber, ARM System-on-Chip Architecture (2nd Edition), AWL 3)Recent papers from conferences and journals. CPT621Advances in Compiler Design 3-0-0 A Tour of Compiler Design, LR Parsers, Lex and Yacc Tools, Control-flow Analysis, Control-flow Graphs, Basic Blocks, Data-flow Analysis, Dependence Analysis, Global Optimizations, Loop Optimizations, Peephole Optimization and Optimal Code Generation, Data Dependence Analysis in Loops, Loop Scheduling, Static Single Assignment, Just-In-Time (JIT) and Adaptive Compilation, Runtime System Architectures and Automatic Memory Management Techniques. Text/Reference: 1)Aho, Alfred V ., Sethi, Ravi, Ullman, Jeffrey D., Compilers: Principles, Techniques and Tools , Addison-Wesley. 2)Steven Muchnick, Advanced Compiler Design & Implementation , Morgan Kaufmann. 3)Keith Cooper and Linda Torczon, Engineering a Compiler , Morgan Kaufmann. CPT623Topics in Computing 3-0-0 Advanced Architectures relevant to Modern OS. Multi core architectures (Power performance issues, virtualisation etc.). GPU Architecture. Architecture for cloud computing. Advanced concepts for multi media OS and scheduling. Disk management. MLFQ scheduling, Linux kernel features, hardware abstraction layer, Completely fair scheduling. Virtualisation and Cloud computing. Mobile OS. DVM and ART. Comparative study of mobile and desktop OS. Advanced topics on Networking: flow control in Networks. Software Defined Networks. QoS issues at transport and application layer of networks. Special and emerging topics in different areas of CSE. Text and References: 1. Recent papers from Journals 2. Computer Networks: Peterson and Davie 3. Linux kernel Internals CPT625Wireless Sensor Networks 3-0-0 Wireless Sensor Networks: Introduction, Overview and Applications. Sensor node – Design issues, power consumption, operating environment, sensor examples. Architecture - Single node, Network, Single hop v/s multi-hop, Performance metrics, QoS Wireless communication – Fundamentals, spread spectrum techniques, CDMA Protocols – Physical layer, MAC, link layer, Routing, middleware. Network management, Topology, operating system. Security in sensor networks. Open issues and Chanllenges. Texts/References: 1)Holger Karl, Andreas Willig. Protocols and Architectures for Wireless Sensor Networks , Wiley Interscience. 2)Kazem Sohraby, Daniel Minoli, and Taieb Znati: Wireless Sensor Networks: Technology, Protocols, and Applications , Wiley Interscience. 3)Selected papers and online reference material. CPT641 Digital Image Analysis 3-0-0 Digital Image Fundamentals, Point operations. Smoothing, Sharpening, Crispening, Image Enhancement in Spatial Domain, Image Enhancement in Frequency Domain Image Transforms: Hotelling, Hit and Miss transform. Color Image Processing, Multiview Image Processing, Epipolar geometry Image Warping and Restoration. Image Segmentation, Representation and Description Morphological Operators, Erosion, Dilation, Medial Axis, Thining, Skeleton. Image Matching and Classification Texts/References: 1)Rafael C Gonzalez, Richard E Woods, Digital Image Processing , Addison-Wesley. 2)Milan Sonka, Vaclav Hlavac, Roger Boyale, Image Processing, Analysis and Machine Vision : PWS Publishing (ITP-International Thomson Publishing). 3)Anil K Jain: Fundamentals of Digital Image Processing , Printice Hall of India (PHI). CPT643 Data Mining and Data Warehousing 3-0-0 Introduction to Decision Support Systems, Data Warehouse and Online Analytical Processing. Data Warehouse Architecture: System Processes, Process Architecture: Load Warehouse, Query, Detailed and Summarized Information. Design: Data Base Schema Facts, Dimensions and Attributes. Data Base and Metadata. Data Mining : Introduction and need, Descriptive and Predicative Data Mining. Data Processing : Data Cleaning, Data Integration and Transformation, Data Reduction. Data Mining Primitives:, Language DMQL and its Preliminary Clauses. Data Mining Methods: Association – Single and Multilevel, Characterization and Comparison, Regression Analysis, Classification and Predication. Data Mining Algorithms: Clustering, Association, Regression, Decision Trees. Application and Trends in Data Mining. Data Warehouse Implementation. Text & References: 1)Data Warehousing in the Real World – Anahory and Murray, Pearson Education. 2)Data Mining – Concepts and Techniques – Jiawai Han and Micheline Kamber. 3)Building the Data Warehouse – WH Inmon, Wiley. CPT645Topics in High Speed Networking 3-0-0 Overview of Internet Technologies, Issues in next generation Internet - Routing, Multicasting, Packet Scheduling, Quality of Service etc. Admission control in Internet: Effective bandwidth, Differentiated services, Policy-based networking, Real time communications over Internet, Internet telephony, V oice over IP, Integrated services. Web QoS, Intelligent caching, Traffic measurement and characterization. Text/References: 1)Kurose: Computer Networking A Top Down Approach , Pearson. 2)Peterson and Davie: Computer Networks: A systems approach , Morgan Kaufman and Elsevier. 3)J.Walrand, High Performance Computer Networks , Elesevier 4)A.Kumar, D.Manjunath, Communication Network MKP. 5)Recent papers from conferences and journals. CPT647e-Commerce 3-0-0 Introduction and concepts: networks and commercial transactions, the Internet environment, online commerce solutions. A generic business model for e-commerce. Security technologies: Introduction to cryptography, key distribution and clarification. Architecture for e-commerce: online commerce environment, servers and commercial environments, strategies, techniques and tools. Electronic payment methods: Secure online transaction models, digital payment system, cyber cash, digital currencies, Smart cash, digital purse, anonymity and authentication. Protocol for the public transport of private information: security protocols, secure socket layer. Open issues: legal and technical issues. Text & References: 1)Pete Loshin, Paul A Murphy: Electronic e-commerce , Jaico book. 2)Paul May: The Business of e-commerce , Cambridge University Press. 3)Recent papers from conferences and journals CPT649High Level Synthesis of Digital Systems 3-0-0 Overview. Design methodologies. Abstractions and views. Review of basic concepts in algorithms and graph theory Design representation and modeling, Modeling languages, Abstract models Synthesis at higher levels of abstraction Scheduling, Resource sharing Structural synthesis: Module selection. Pipeline. Control Synthesis at lower levels of abstraction, Logic synthesis Text/Reference: 1)G. D. Micheli. Synthesis and optimization of digital systems . 2)N.D. Dutt, D. D. Gajski. High level synthesis, Kluwer, 2000. 3)T. H. Cormen, C. E. Leiserson and R. L. Rivest, " Introduction to Algorithms ," McGraw-Hill, 1990. 4)Recent papers from journals and conferences. CPT651Parallelizing Compiler 3-0-0 Motivation and overview, structure of a parallelizing compiler. Review of code optimization techniques in compilers for sequential machines. Parallelism detection - data dependence analysis, direction vectors, loop carried and loop independent dependences; tests for data dependence and their applicability, construction of data dependence graph. Control dependence and control dependence graph. Restructuring transformations and automatic extraction of parallelism; representation of iteration spaces of multiply nested loops; loop based transformations such as loop distribution, loop coalescing, loop inter-change and cycle shrinking transformation. Texts/References 1)Selected papers and online reference material CPT653Quantum Cryptography 3-0-0 Finite Dimensional Hilbert Spaces – Tensor Products and Operators on Hilbert Space – Hermitian and Trace Operators - Basic Quantum Mechanics necessary for the course. Quantum Gates and operators and Measurement – Quantum Computational Model – Quantum Complexity – Schemes for Physical realization (Only peripheral treatment expected). Shor's Algorithm – Application to Integer Factorization – Grover's Algorithm – Quantum Cryptography: Encryption and decryption schemes. Texts/References 1)Nielsen M. A. and I. L. Chauang , Quantum Computation and Quantum Information , Cambridge University Press, 2002. 2)J. Gruska, Quantum Computing , McGraw Hill, 1999. 3)P. R. Halmos, Finite Dimensional Vector Spaces , Van Nostrand, 1958. 4)Selected papers and online material. CPT655Public Key Infrastructure and Trust Management 3-0-0 Public key infrastructure - components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross-certification. Repository, Certification Authority (CA) and Registration Authority (RA), trusted third party, digital certificates. PKI services – authentication, non-repudiation, privilege management, privacy, secure communication. Key management – certificate revocation list, root CA, attacks on CA, key backup. PKI standards – SSL, LDAP, IPSec, X.500, X.509, S/MIME Trust models – strict v/s loose hierarchy, four corner, distributed. Certificate path processing – path construction and path validation. Texts/References 1)Ashutosh Saxena, Public Key Infrastructure , Tata McGraw Hill 2)Carlisle Adams, Steve Lloyd. Understanding PKI: Concepts, Standards, and Deployment Considerations, Addison Wesley. 3)John R. Vacca. Public Key Infrastructure: Building Trusted Applications and Web Services , AUERBACH. 4)Messaoud Benantar, Introduction to the Public Key Infrastructure for the Internet , Pearson Education. CPT606Selected Topics in Cryptography 3-0-0 Elliptic Curve Cryptography Secret Sharing, Threhold cryptography – Robust ElGamal system Visual Cryptography Interactive zero knowledge proofs, witness hiding protocols. Group encryption, decryption. Group signatures, ring signatures. EV oting: requirements, issues and challenges, existing solutions, write-in ballots. Pair based cryptography – Weil and Tate pairing. Text & References: 1)Selected paper and online reference material. CPT612Robotics and Control 3-0-0 Robotics: Introduction to robotics, advantages, applications. Robotic kinematics and dynamics: Direct and inverse kinematics problem. Axis transformations; DH matrix; forward and reverse kinematics, trajectory planning. manipulators and their control. Robot sensors: Active and passive robot sensors, Construction of tactile, touch and vision sensors; interpretation of sensory information; vision processing; kinematic information from sensory data. Robot Intelligence: Robot learning, State space search, robotics in computer vision applications. Robotic end effectors: Stable grip; constraints; types of contact; mathematical representation of stable grip; use of screw twist, and wrench gripper design; tools as end effectors. Problems of implementation of automatic systems. Text & References: 1)Fu K, Gonzalez R and Lee C, Robotics - Control Sensing Vision & Intelligence , McGraw Hill. 2)Craig J J, Introduction to Robotics, Mechanics and Control , Addison Wesley, 1993. 3)McKerrow P J, Introduction to Robotics , Addison Wesley, 1993. 4)Selig M, Introductory Robotics , Prentice Hall, 1992. CPT614FPGA based System Design 3-0-0 Introduction to FPGA Architectures. FPGA design flow, partitioning, placement and routing algorithms. Technology mapping for FPGAs, case studies. Text/References: 1)Brown, Francis, Rose and Vranesic. Field programmable Gate arrays . Kluwer. 2)Betz, Rose, Marquardt, Architecture and CAD for Deep-submicron FPGAs . Kluwer. 3)Trimberger, FPGA Technology. Kluwer, 1992. 4)Oldfield, Dorf. FPGAs: Reconfigurable logic for rapid prototyping and implementation of digital systems. John Wiley. 5)Recent papers from conferences and journals. CPT616 Network Security 3-0-0 Review of wired/wireless network protocols, intrusion detection systems, malicious software. Review of cryptographic algorithms, protocols, cryptanalysis, authentication and signature protocols. Kerberos, PKI, real-time communication security, IPSec: AH, ESP, IKE . SSL/TLS, e-mail security, PEM and S/MIME, PGP, web security, network management security, wireless security. Threats in networks, network security controls, firewalls, intrusion detection, administering security Honeypots, password management, malicious software, viruses and countermeasures Text/References: 1)C. Kaufman, R. Perlman, Network Securit, Prentice Hall. 2)Kurose & Ross, Computer Networking , Pearson Education. 3)Schiller J., Mobile Communications , Pearson Education. 4)W. Stallings, Cryptography and Network Security Principles and practice , Pearson Education. CPT618Security in Computing 3-0-0 Computer security, threats, attacks, computer criminals, defense methods, information and network policies, cryptography, symmetric and public-key encryption, uses of encryption. Secure file systems and database security. Program security, secure programs, viruses and other malicious code, control against program threats, protection in general-purpose OS, protected resources and methods of protection, user authentication. Binding programs to machines. Language based security, Integrating security in compilers. Designing trusted OS, models of security, database security, security requirements, reliability and integrity, inference. Administering security, legal, privacy, and ethical issues in computer security. Texts/References 1)Pfleeger and Pfleeger, Security in Computing , Pearson Education. 2)M. Bishop and S. S. Venkatramanayya, Introduction to Computer Security , Pearson Education. 3)Stallings W., Cryptography and Network Security Principles and Practice , Pearson Education. 4)Stallings W., Network Security Essentials: Applications and Standards , Pearson Education. CPT620Intelligent Agents 3-0-0 Introduction to agent-based computing , Motivations for agent-based computing Key concepts and models, Agent architectures (deliberative, reactive, hybrid), Rational decision making (decision theoretic, belief-desire-intention) Mobile agents, Agent Interactions, Coordination (organisation models, social laws, social dependencies), Cooperation (team-oriented problem solving, coalition formation) Negotiation (mechanism design, heuristic models, argumentation) Computational markets (auctions, competition) Agent-Oriented Software Engineering, Benefits and Potential Drawbacks, Agent Methodologies, Application Case Studies (agent-mediated electronic commerce, business process management, telecommunications network management) Texts/References 1)M.J.Wooldridge, An introduction to multi-agent systems . Wiley (2002) CPT624Critical Systems 3-0-0 Introduction to time critical systems, Issues, Components, Classification and terminology. Misconceptions about Real-time computing. Real-time System requirements. Specification of timing constraints. Real-time scheduling: Requirements and Issues, Terminology, modeling, Introduction static and dynamic scheduling schemes, cyclic scheduling, priority driven scheduling of periodic tasks, schedulability tests, Aperiodic task scheduling: server/non-server based scheduling algorithms. Practical factors/overheads. Task Synchronization: Need and priority inversion problem, Priority Inheritance protocol, priority ceiling protocol and stack-based priority ceiling protocol. Introduction to multiprocessor real-time systems, problems and issues. An overview of an operating system Text & References: 1)J.W.S.Liu: Real-Time Systems, Pearson Education Asia 2)S.T.Lavi, A.K.Agrawala: Real-time system Design, McGraw Hill 3)Laplante: Real-time Systems Design and Analysis, An Engineer’s Handbook, IEEE Press 4)Laurence, K.Mauch: Real-time Microcomputer system design, An introduction, McGraw Hill CPT626Pattern Recognition 3-0-0 Introduction to statistical, syntactic and descriptive approaches, features and feature extraction. Bayes Decision theory- continuous case, 2-category classification, minimum error rate classification, discriminant functions and decision surfaces, discrete case. Parameter estimation, supervised learning-Maximum likelihood, Bayes, general bayesian learning. Nonparametric - density estimation, parzen windows, k-nearest Neighbor, estimation posterior probability. Linear discriminant functions- decision surfaces, generalized linear discriminant functions, 2- category linearly separable case, non-separable behavior, linear programming procedures, SVMs. Supervised learning: Feed forward Neural networks, Backpropagation algorithm, error surfaces. Clustering - data description and clustering, Hierarchical clustering, self organizing maps. Texts/References 1)Duda and Hart P.E, and David G Stork, Pattern classification , John Wiley & Sons. 2)Duda and Hart P.E, Pattern classification and scene analysis , John Wiley and sons.. 3)Earl Gose, Richard Johnsonbaugh, and Steve Jost; Pattern Recognition and Image Analysis, PHI. 4)Fu K.S., Syntactic Pattern recognition and applications , Prentice Hall.s CPT628Security Analysis of Protocols 3-0-0 Mathematical models of computer security – Abstract state machines, belief logics, provable security, spi-calculus, Communicating Sequential Processes (CSP). Needham Schroeder – public key, shared key, attacks; security analysis of Kerberos and Shoup Rupin protocol Time-stamping and its incorporation in modeling Authentication protocols, Access control – policies and mechanism , Nominal calculi for security and mobility, classification of security properties. Protocol verification – case studies. Texts/References 1)Peter Ryan, Steve Schneider, Michael Goldsmith, and Gavin Lowe. Modelling & Analysis of Security Protocols, Addison Wesley. 2)Giampaolo Bella. Formal Correctness of Security Protocols , Springer. 3)Riccardo Focardi and Roberto Gorrieri. Foundations of Security Analysis and Design: Tutorial Lectures, Springer. 4)Riccardo Focardi and Roberto Gorrieri. Foundations of Security Analysis and Design II , Springer. CPT691 Object Oriented Systems 3-0-0 Abstractions, Objects, Classes and Methods, Inheritance and Reuse, Replacement and Refinement, Contracts, Design by Contract, Reuse: code vs. design reuse, Design patterns – classification, pattern descriptions, Creational patterns: Singleton, Factory, Prototype, Structural patterns: Adapter, Proxy, Composite, Decorator, Facade, Behavioral patterns: Strategy, State, Observer, Template method, Iterator. Text/References: 1)Timothy Budd, An Introduction to Object-oriented Programming, Pearson Education. 2)Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, Design Patterns, Pearson Education. CPT693Data Compression 3-0-0 Compression: Need, Lossless v/s lossy compression, review of information theory, prefix codes, uniquely decodable code. Huffman coding – minimum variance, optimal, non-binary, extended, adaptive. Applications and limitations of Huffman codes. Run length encoding, Arithmetic coding, Predictive coding – Burrows-Wheeler transform, Delta modulation, Adaptive delta modulation Lossy Compression Techniques – JPEG and its application, MPEG Error detection and correction: Parity, 1,2,n dimensions, Hamming codes, p-out-of-q codes Dictionary based compression - Lempel-Ziv-Welch, LZ77 and LZ-78 Quantization – Scalar and Vector Quanitization. Video compression, Audio Compression, Fractal techniques. Texts/References: ■■Khalid Sayood, Introduction to Data Compression, Morgan Kauffman ■■Greg A. Harris, Darrel R. Hankerson, Peter D. Jr. Johnson, Introduction to Information Theory and Data Compression, Second Edition , Chapman and Hall. ■■Saloman, Data Compression, Springer Verlag. ■■Nelson, The Data Compression book, Hungry Minds. ■■Stephen Welstead, Fractal and wavelet Image Compression techniques , PHI, NewDelhi-1, 1999. CPT695Biometric Security 3-0-0 Biometrics: Need, Conventional techniques of authentication, challenges - legal and privacy issues. Biometrics: DNA, fingerprint, Iris, Face, hand geometry, ear. Behavioral: Human gait, speech, thermal imaging, infra-red spectrum, signature, keystroke dynamics Combining biometrics, scaling issues. Privacy, legal and ethical issues. Texts/References: 1)Julian D. M. Ashbourn, Biometrics: Advanced Identify Verification: The Complete Guide 2)Davide Maltoni (Editor), et al, Handbook of Fingerprint Recognition 3)L.C. Jain (Editor) et al, Intelligent Biometric Techniques in Fingerprint and Face Recognition 4)John Chirillo, Scott Blaul, Implementing Biometric Security 5)Nalini Ratha (Editor), Ruud Bolle 6)Authentication: From Passwords to Public Keys, Richard E. Smith CPT697 Digital Forensics 3-0-0 File System Forensics : Duplicating hard disks for "dead analysis", reading hidden data on a disk's Host Protected Area (HPA), Direct versus BIOS access, dead versus live acquisition, Disk partitions - DOS, Apple, and GPT partitions, BSD disk labels, Sun V olume; multiple disk volumes - RAID and disk spanning; Analyzing FAT, NTFS, Ext2, Ext3, UFS1, and UFS2 file systems, Finding evidence: File metadata, recovery of deleted files, Using The Sleuth Kit (TSK), Autopsy Forensic Browser, and related open source tools Web Forensics: network-based evidence in Windows and Unix environments, Reconstructing Web browsing, e-mail activity, Tracing domain name ownership and the source of e-mails System Forensics: Windows Registry changes, Duplicating and analyzing the contents of PDAs and flash memory devices Electronic document, computer image verification and authentication Texts/References: 1)Brian Carrier. File System Forensic Analysis , Addison Wesley. 2)Chris Prosise, Kevin Mandia. Incident Response and Computer Forensics , McGraw Hill. 3)Linda V olonino, Reynaldo Anzaldua, and Jana Godwin. Computer Forensics: Principles and Practices, Prentice Hall. 4)Keith J. Jones, Richard Bejtlich, and Curtis W. Rose. Real Digital Forensics: Computer Security and Incident Response , Addison Wesley 5)Vacca, John R., Computer Forensics Computer Crime Scene Investigation , Charles River Media. 6)Nelson, Phillips, Enfinger, Steuart. Guide to computer Forensics and Investigation , Course Technology. CPT692Semantic Web 3-0-0 Introduction to semantic web, architecture, langauages and tools for knowledge management. XML, RDF, OIL, DAML, OWL for semantic web. Semantic Web Technologies: Ontology-based Systems: Ontology based knowledge management; ontology construction; generating, storing, aligning and maintaining ontologies for semantic web; information retrieval from natural language based documents; ontology evolution; ontological indexing and searching techniques for Searching web Texts/References 1)John Davies, Rudi Studer, and Paul Warren. Semantic Web Technologies: Trends and Research in Ontology-based Systems, Wiley. 2)John Davies, Dieter Fensel, Frank van Harmelen, and Frank van Harmelen. Towards the Semantic Web: Ontology-Driven Knowledge Management, Wiley. CPT694Intrusion Detection 3-0-0 Introduction- Intrusion detection system (IDS), intrusion prevention system (IPS), Unauthorized access – buffer overflow, packet fragmentation, out-of-spec packets Review of Network protocol – TCP-/IP, Intrusiond detection through tcpdump. IDS and IPS – Architecture and internals. Malicious and non-malicious traffic, IP headers, TDP, UPD and ICMP protocols and header formats, Header information to detect intrusion, logs and their analysis, IDS through reaction and response Intrusion analysis – data correlation, tools, SNORT. Text & References: 1)Matt Fearnow, Stephen Northcutt, Karen Frederick, and Mark Cooper. Intrusion Signatures and Analysis, SAMS. 2)Carl Endorf, Gene Schultz, Jim Mellander, Intrusion Detection and Prevention , McGraw Hill. 3)Stephen Northcutt and Judy Novak. Network Intrusion Detection , SAMS. 4)Paul E. Proctor. The Practical Intrusion

Detection Handbook , Prentice Hall. CPT696Intellectual Property Rights 3-0-0 Introduction to Intellectual property, Patents, Trademark, Copyright Patents – process, patentable entities, scope of patent system, patents and free enterprise; cost considerations; antitrust law, patent institutions, infringement, limitations of patents Copyright – protection, eligibility, fair use; works and rights protection; limitations Trademark – history, concepts, scope, computer software copyrights, copyright in databases and electronic publishing. Design protection Computer contracts, liability for defective hardware and software, software contracts, web and hardware contracts, electronic contracts and torts, liabilities. Introduction to Cyber laws in India, IT Act 2000, data subjects' rights, ethical issues in computer security. Case studies. Texts/References 1)Robert P. Merges and Jane C. Ginsburg. Foundations of Intellectual Property, Foundation Press. 2)Tom Greaves. Intellectual Property Rights for Indigenous Peoples: A Source Book, 3)Susan K. Sell. Private Power, Public Law: The Globalization of Intellectual Property Rights, Cambridge University Press. 4)D. Bainbridge, Introduction to Computer Law, Pearson Education. 5)P. Duggal, Cyber law: the Indian Perspective, 2005 CPT698Internet Security 3-0-0 Security protocols: naming and addressing, IPv6, Network address translation, SNMP, remote login, file transfer protocol, RPC based protocol, peer-to-peer communication Web architecture and protocols, buffer overflow and hacking Internet threats – password stealing, Trojans, phishing, viruses, worms, DOS attack, backdoors, Botnets, port scanning, hacking techniques. Security mechanisms – passwords, one-time password – time based, Lamport's, authentication – smart card, biometrics, RADIUS, SASL framework, host to host authentication, PKI. Firewalls, VPNs, tunneling, Intrusion detection. Server and client security, Text & References: 1)John Chirillo. Hack attacks denied, Wiley. 2)McClure. Web Hacking, Pearson Education. 3)John R. Vacca. Practical Internet Security , Springer. 4)William R. Cheswick, Steven M. Bellovin, and Aviel D. Rubin. Firewalls and Internet Security: Repelling the Wily Hacker , Addison-Wesley. 5)Kenneth Einar Himma. Internet Security: Hacking, Counterhacking ,and Security , Jones & Bartlett Publishers CPT634Malware Analysis and Detection 3-0-0 Malware: Types – Virus, Worms, Trojans, Logic Bombs, etc., infection modes, payload and its delivery mechanisms. Analysis Tools and their design: Disassemblers, Unpackers, Scanners, Decompilers, Emulators, Virtualization techniques Anti-analysis techniques: Obfuscation techniques, Packing, Encryption, Polymorphism, metamorphism. Analysis Techniques: Signature based, Non-signature based, Static, dynamic, behavioral, anomaly detection. Case Study: Android Malware Text/Reference Books 1. Peter Szor: The Art of Computer Virus Research and Defense, Addison Wesley Professional. 2. Eric Filiol: Computer Viruses: from theory to applications, Springer. 3. Michael Sikorski and Andrew Honig: Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software, No Starch Press 4. Christopher Elisan: Advanced Malware Analysis, McGraw-Hill Osborne Media. 5. Michael Hale Ligh, Andrew Case: The Art of Memory Forensics: Detecting Malware, Wiley. 6. Bruce Dang, Alexandre Gazet: Practical Reverse Engineering, Wiley. CPT699 Modelling and Simulation 3-0-0 Analytical v/s simulation modeling, performance measurement and benchmarking, Workload modeling, random variables, commonly used distributions, Stochastic Processes, Performance evaluation methods, Evaluation Metrics Markov chains, Birth and Death Processes, Markov chain models of Computer systems, Steady- state and transient analysis Queuing models, M/M systems and their steady state analysis, Single server and multi-server queues, open and closed queuing networks Petri Net based Performance Modeling : Classical Petri Nets, Timed Petri Nets, Discrete Petri Nets, Modeling multiprocessor systems Discrete event simulation – Simulation languages, random number generation and testing, model verification and validation, analysis of simulation results, confidence intervals, variance reduction techniques, Case studies of analytical and simulation studies of computer systems Text/Reference Books 1. Law and Kelton, Simulation Modeling and Analysis, Mcgraw Hill 2. Raj Jain, The Art of Computer System Performance Analysis, John Wiley 3. K.S.Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, PHI 4. Kant, Introduction to Computer System Performance Evaluation, Mcgraw Hill MTech_2013_CS_PT.pdf Department of Computer Engineering Malaviya National Institute of Technology MTech Part-Time (Computer Engineering) (2012-13 onwards) I Semester (Autumn Semester) Course Title Credit LTP CWS PRS MTE ETE PRE 1CP-501Topics in Algorithms PC3300220-3050- 2 3CP-523Topics in Computing PC3300220-3050- 4 5CP-509Programming Lab – I PC3103-60--40 6 Total 9 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. II Semester (Spring Semester) Course Title** Credit LTP CWS PRS MTE ETE PRE 1Elective-I PE3300220-3050- 2Elective-II PE3300220-3050- 3 4 5 6Lab Elective-I PE3103-60--40 Total 9 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. ** Two Electives need to be taken from Department Elective List. 18S.NoCourse Code Subject AREA Exam DurationRelative Weightage* S.NoCourse Code Subject AREA Exam DurationRelative Weightage* TOTAL CREDITS (Sem I-II) Department of Computer Engineering Malaviya National Institute of Technology MTech Part-Time (Computer Engineering) (2012-13 onwards) III Semester (Autumn Semester) Course Title Credit LTP CWS PRS MTE ETE PRE 1 2CP-513Topics in Databases PC3300220-3050- 3 4CP-505System Design Lab PC3103-60--40 5 6CP-506Security in Computing PC3300220-3050- Total 9 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. IV Semester (Spring Semester) Course Title** Credit LTP CWS PRS MTE ETE PRE 1 2 3Elective-III PE3300220-3050- 4Elective-IV PE3300220-3050- 5Elective-V PE3300220-3050- 6 Total 9 * Typical distribution. Can be changed by Course Instructor/Coordinator by announcing at beginning of semester. ** Two Electives need to be taken from Department Elective List. 18S.NoCourse Code Subject AREA Exam DurationRelative Weightage* S.NoCourse Code Subject AREA Exam DurationRelative Weightage* TOTAL CREDITS (Sem III-IV) Department of Computer Engineering Malaviya National Institute of Technology MTech Part-Time (Computer Engineering) (2012-13 onwards) III Semester (Autumn Semester) Course Title Credit LTP CWS PRS MTE ETE PRE 1CP-600Seminar PC4-------100- 2CP-601Dissertation PC16--------- Total 20 IV Semester (Spring Semester) Course Title Credit LTP CWS PRS MTE ETE PRE 1CP-602Dissertation PC16-------- Total 16 36 72S.NoCourse Code Subject AREA Exam DurationRelative Weightage* S.NoCourse Code Subject

AREA Exam DurationRelative Weightage* TOTAL CREDITS (Sem III-IV) TOTAL CREDITS (Sem I-IV) CPT601 Topics in Algorithms 3-0-0 RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis - Advanced Data Structures: B-Trees, Binomial Heaps, Fibonacci Heaps, A VL trees, Red-black trees, B- trees, Splay trees. Disjoint set – union and path compression, Amortized analysis Recurrence equations. Time and space complexity, NP, NPC and NP-Hard problems, undecidability. Convex hull and V oronoi diagrams, line segments, Optimal polygon triangulation. Primality testing, Integer factorization, Randomized algorithms, Probabilistic algorithms. Dynamic programming: Longest common subsequence. Chain of matrix multiplication, Approximate Algorithms: Vertex-cover, set-covering problems, Travelling Salesman problem. Combinatorial algorithms, Randomized algorithms: Use of probabilistic inequalities in analysis, applications using examples. Graph algorithms: Matching and Flows. Parallel algorithms: Basic techniques for sorting, seraching, merging.. Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions. Texts/References: 1)Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India. 2)Horowitz and Sahani: Fundamental of Computer algorithms . 3)Aho A.V , J.D Ulman: Design and analysis of Algorithms , Addison Wesley 4)Brassard : Fundamental of Algorithmics , PHI. 5)Sara Baase: Computer Algorithms: Introduction to Design and Analysis , Pearson Education. 6)Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms and Complexity , PHI. 7)Motwani and Raghavan: Randomized Algorithms , Cambridge University Press 8)Joseph Ja'Ja': Introduction to Parallel Algorithms , Addison-Wesley 9)Vaizirani: Approximation Algorithms , Springer Verlag 10)N. Deo: Graph Theory with Application to Engineering and Computer Science , Prentice-Hall. 11)N. Deo: Combinatorial Algorithms: Theory and Practice , Prentice-Hall. CPT602Parallel and Distributed Computing 3-0-0 Introduction to parallel computing. Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O Parallel reduction, Prefix sums, List ranking, Preorder tree traversal, Merging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS Thread and process level parallel architectures: MIMD, multi-threaded architectures. Distributed and shared memory MIMD architectures. Dynamic interconnection networks. Mapping and scheduling: Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock. Parallel programming and parallel algorithms: Programming models, parallel programming on multiprocessors and multicomputers. Parallel algorithm structure, analyzing parallel algorithm. Elementary parallel algorithms, Matrix algorithms, sorting, Graph algorithms. Text & References: 1)Quinn, Parallel computing – theory and practice , Tata McGraw Hill. 2)Sima and Fountain, Advanced Computer Architectures , Pearson Education. 3)Mehdi R. Zargham, Computer Architectures single and parallel systems , PHI. 4)Ghosh, Moona and Gupta, Foundations of parallel processing , Narosa publishing. 5)Ed. Afonso Ferreira and Jose' D. P. Rolin, Parallel Algorithms for irregular problems - State of the art, Kluwer Academic Publishers. 6)Selim G. Akl, The Design and Analysis of Parallel

Algorithms , PH International. CPT603Selected Topics in Operating System 3-0-0 Introduction: Goals, Functions, Design issues of Distributed OS, Distributed v/s network operating system. Communication: Client Server, RPC Distributed OS: Issues, process management, inter-process communication, scheduling, deadlocks Design and implementation of distributed file systems, distributed shared memory Security: Concepts and Distributed Systems Distributed Concurrency, Transactions. Case study: Unix, Amoeba. Text/References: 1)Tanenbaum: Distributed Operating Systems, Pearson Education. 2)Bach, Design of Unix O/S. 3)Coulouris et al, Distributed Systems: Concepts and Design , Addison Wesley. 4)Mullender: Distributed Systems , Addison Wesley. 5)Tanenbaum and Steen: Distributed Systems: Principles and Paradigms , Pearson Education CPT627Information System Security 3-0-0 Number theory: Prime numbers, modular arithmetic, Fermat's theorem, Euler's theorem, Chinese remainder theorem, Discrete logarithms, Random number generation, factoring, prime number generation, one-way hash functions – MD5, SHA (Secure Hash Algorithm). Cryptography: Need, conventional techniques, stream ciphers, block cipher, steganography. Public v/s private key cryptography. Stream Ciphers: Caesar Cipher, mono-alphabetic and poly-alphabetic ciphers, Playfair Cipher, Hill Cipher, Rotor machines, One time pad,. Steganography: Visual, Textual, Cipher hiding, False errors. Private-key cryptography: Feistel structure, DES (Data encryption standard), design of S-boxes, AES, Triple DES, Public key cryptography: Key management, Key exchange – Diffie-Hellman, Authentication, Signatures, Deniability, RSA. Digital Signature: DSA and its variants, discrete logarithm based digital signatures. Cryptanalysis: Differential and linear cryptanalysis - cracking DES. Rabin, ElGamal, Goldwasser-Micali, Blum-Goldwaser cryptosystems. Digests: Message authentication, digital signature algorithms. Security handshake pitfalls, Strong password protocols. Text & References: 1.Stallings, Cryptography and Network Security , Pearson Education. 2.B Schneier, Applied Cryptography , Wiley. ISBN 0-471-11709-9 3.D Kahn. The Codebreakers, Sphere books. ISBN 0-7221-51497 4.A.J. Menezes, P.C. van Oorschot and S.A. Vanstone, Applied Cryptography , CRC Press. 5.D.R. Stinson, Cryptography - Theory and practice , CRC Press. CPT611Advanced Topics in Computer Graphics 3-0-0 Visibility: Polygon Meshes, Depth Sorting. Triangle decomposition, Geometric Sort, Warnock's Methods Hidden Lines and Surfaces : Special cases, Surfaces defined by a function y=f(x,y), Grid surfaces, visible surface determination . Colour in Computer Graphics : Color Vision, Measuring Color, Color Models, Color output, color usage. Object Lighting and Shading : Illumination and shading models, Local reflection models, shading surfaces, Texture and transparency, Forward & backward Ray-tracing Global Illumination and classical radiosity. Modeling natural phenomena : Fractals and chaos. Animation Techniques : Position, speed or orientation. Animation by hierarchic control, scenario-based systems, movement control. Shadows, Morphing, Texture mapping Text/ References: 1)J. Foley et al : Computer Graphics-Principles and Practice, Addison Wesley. 2)Alan Watt- 3D Computer Graphics . 3)A. Watt, M. Watt: Advanced Animation & Rendering Techniques , Addison-Wesley. 4)D. Rogers and Adams: Mathematical Elements of Computer Graphics , Mc Graw Hill. 5)Thomas Moller: Real-time Rendering , Eric Haines, A.K Peters Ltd CPT613Topics in Databases 3-0-0

Issues in Implementation of Database Systems, Query Processing, Query Optimization, Transaction Processing, Concurrency, Recovery Management. Database System Architectures, Distributed Databases, Distributed Transactions, Distributed Query Processing, Parallel Databases, Times in Databases, Multimedia Databases. Text/References 1)Silberschatz A, Korth HF, Sudarshan S, Database System Concepts, McGrall Hill. 2)Elmasri R and Navathe SB, Fundamentals of Database Systems, 3rd Edition, Addison Wesley,2000. This book covers most of the material on the course. 3)Ceri S, Pelagatti G, Distributed Databases – Principles and Systems, McGraw Hill. 4)Date CJ, An Introduction to Database Systems , 7th Edition, Addison Wesley. 5)Khashafian S and Baker AB, Multimedia and Imaging Databases , Morgan Kaufmann. CPT615Network Performance Modeling 3-0-0 Networking as resource sharing: current practices, Traffic Multiplexing, Traffic analysis, Stochastic Traffic Models, Multiple Access: Wireless Networks. Routing: Virtual path routing and Elastic Aggregates, Routing of Stream Type sessions, Routing in Ad-hoc and Sensor Networks. Introduction to High Performance Switching and Routing. QoS and Modeling issues of the Networks. Text & References: 1)Communication Networking: An Analytical Approach, Anurag Kumar, D.Manjunath, Joy Kuri, Elsevier 2)High Performance Communication Networks, Jean Walrand, P.Vaiya, Elsevier 3)Selected papers and online references. CPT617Software Testing and Validation 3-0-0 Basic software testing principles – Software Quality, Software testing and test management. Acceptance Testing: User acceptance testing, alpha and beta testing. Functional and Non-functional system testing Static and dynamic testing, Black-box or functional testing, structural, white box or glass box testing. Integration testing, component testing. Software testing tools. Software Validation: Issues and Challenges. Books/References: 1)Selected papers and online references. CPT619Topics in SOC Design 3-0-0 Methodologies and design flows of front end and back end designs. Introduction to intellectual property core types and their design issues. Integration issues of IPs on SOC designs. Low power design issues and methodologies. Testing standards and architecture of SOCs. Text/Reference: 1)Farzad Nekoogar , F .Nekooqar, From ASICs to SOCs: A Practical Approach, Pearson. 2)Steve B. Furber, ARM System-on-Chip Architecture (2nd Edition), AWL 3)Recent papers from conferences and journals. CPT621Advances in Compiler Design 3-0-0 A Tour of Compiler Design, LR Parsers, Lex and Yacc Tools, Control-flow Analysis, Control-flow Graphs, Basic Blocks, Data-flow Analysis, Dependence Analysis, Global Optimizations, Loop Optimizations, Peephole Optimization and Optimal Code Generation, Data Dependence Analysis in Loops, Loop Scheduling, Static Single Assignment, Just-In-Time (JIT) and Adaptive Compilation, Runtime System Architectures and Automatic Memory Management Techniques. Text/Reference: 1)Aho, Alfred V ., Sethi, Ravi, Ullman, Jeffrey D., Compilers: Principles, Techniques and Tools , Addison-Wesley. 2)Steven Muchnick, Advanced Compiler Design & Implementation , Morgan Kaufmann. 3)Keith Cooper and Linda Torczon, Engineering a Compiler , Morgan Kaufmann. CPT623Topics in Computing 3-0-0 Advanced Architectures relevant to Modern OS. Multi core architectures (Power performance issues, virtualisation etc.). GPU Architecture. Architecture for cloud computing. Advanced concepts for multi media OS and scheduling. Disk management. MLFQ scheduling, Linux kernel features, hardware abstraction layer, Completely fair scheduling. Virtualisation and Cloud computing. Mobile OS. DVM and ART. Comparative study of mobile and desktop OS. Advanced topics on Networking: flow control in Networks. Software Defined Networks. QoS issues at transport and application layer of networks. Special and emerging topics in different areas of CSE. Text and References: 1. Recent papers from Journals 2. Computer Networks: Peterson and Davie 3. Linux kernel Internals CPT625Wireless Sensor Networks 3-0-0 Wireless Sensor Networks: Introduction, Overview and Applications. Sensor node – Design issues, power consumption, operating environment, sensor examples. Architecture - Single node, Network, Single hop v/s multi-hop, Performance metrics, QoS Wireless communication – Fundamentals, spread spectrum techniques, CDMA Protocols – Physical layer, MAC, link layer, Routing, middleware. Network management, Topology, operating system. Security in sensor networks. Open issues and Chanllenges. Texts/References: 1)Holger Karl, Andreas Willig. Protocols and Architectures for Wireless Sensor Networks , Wiley Interscience. 2)Kazem Sohraby, Daniel Minoli, and Taieb Znati: Wireless Sensor Networks: Technology, Protocols, and Applications , Wiley Interscience. 3)Selected papers and online reference material. CPT641 Digital Image Analysis 3-0-0 Digital Image Fundamentals, Point operations. Smoothing, Sharpening, Crispening, Image Enhancement in Spatial Domain, Image Enhancement in Frequency Domain Image Transforms: Hotelling, Hit and Miss transform. Color Image Processing, Multiview Image Processing, Epipolar geometry Image Warping and Restoration. Image Segmentation, Representation and Description Morphological Operators, Erosion, Dilation, Medial Axis, Thining, Skeleton. Image Matching and Classification Texts/References: 1)Rafael C Gonzalez, Richard E Woods, Digital Image Processing , Addison-Wesley. 2)Milan Sonka, Vaclav Hlavac, Roger Boyale, Image Processing, Analysis and Machine Vision : PWS Publishing (ITP-International Thomson Publishing). 3)Anil K Jain: Fundamentals of Digital Image Processing , Printice Hall of India (PHI). CPT643 Data Mining and Data Warehousing 3-0-0 Introduction to Decision Support Systems, Data Warehouse and Online Analytical Processing. Data Warehouse Architecture: System Processes, Process Architecture: Load Warehouse, Query, Detailed and Summarized Information. Design: Data Base Schema Facts, Dimensions and Attributes. Data Base and Metadata. Data Mining : Introduction and need, Descriptive and Predicative Data Mining. Data Processing : Data Cleaning, Data Integration and Transformation, Data Reduction. Data Mining Primitives:, Language DMQL and its Preliminary Clauses. Data Mining Methods: Association – Single and Multilevel, Characterization and Comparison, Regression Analysis, Classification and Predication. Data Mining Algorithms: Clustering, Association, Regression, Decision Trees. Application and Trends in Data Mining. Data Warehouse Implementation. Text & References: 1)Data Warehousing in the Real World – Anahory and Murray, Pearson Education. 2)Data Mining – Concepts and Techniques – Jiawai Han and Micheline Kamber. 3)Building the Data Warehouse – WH Inmon, Wiley. CPT645Topics in High Speed Networking 3-0-0 Overview of Internet Technologies, Issues in next generation Internet - Routing, Multicasting, Packet Scheduling, Quality of Service etc. Admission control in Internet: Effective bandwidth, Differentiated services, Policy-based networking, Real time communications over Internet, Internet telephony, V oice over IP, Integrated services. Web QoS, Intelligent caching, Traffic measurement and characterization. Text/References: 1)Kurose: Computer Networking A Top Down Approach , Pearson. 2)Peterson and Davie: Computer Networks: A systems approach , Morgan Kaufman and Elsevier. 3)J.Walrand, High Performance Computer Networks , Elesevier 4)A.Kumar, D.Manjunath, Communication Network MKP. 5)Recent papers from conferences and journals. CPT647e-Commerce 3-0-0 Introduction and concepts: networks and commercial transactions, the Internet environment, online commerce solutions. A generic business model for e-commerce. Security technologies: Introduction to cryptography, key distribution and clarification. Architecture for e-commerce: online commerce environment, servers and commercial environments, strategies, techniques and tools. Electronic payment methods: Secure online transaction models, digital payment system, cyber cash, digital currencies, Smart cash, digital purse, anonymity and authentication. Protocol for the public transport of private information: security protocols, secure socket layer. Open issues: legal and technical issues. Text & References: 1)Pete Loshin, Paul A Murphy: Electronic e-commerce , Jaico book. 2)Paul May: The Business of e-commerce , Cambridge University Press. 3)Recent papers from conferences and journals CPT649High Level Synthesis of Digital Systems 3-0-0 Overview. Design methodologies. Abstractions and views. Review of basic concepts in algorithms and graph theory Design representation and modeling, Modeling languages, Abstract models Synthesis at higher levels of abstraction Scheduling, Resource sharing Structural synthesis: Module selection. Pipeline. Control Synthesis at lower levels of abstraction, Logic synthesis Text/Reference: 1)G. D. Micheli. Synthesis and optimization of digital systems . 2)N.D. Dutt, D. D. Gajski. High level synthesis, Kluwer, 2000. 3)T. H. Cormen, C. E. Leiserson and R. L. Rivest, “ Introduction to Algorithms ,” McGraw-Hill, 1990. 4)Recent papers from journals and conferences. CPT651Parallelizing Compiler 3-0-0 Motivation and overview, structure of a parallelizing compiler. Review of code optimization techniques in compilers for sequential machines. Parallelism detection - data dependence analysis, direction vectors, loop carried and loop independent dependences; tests for data dependence and their applicability, construction of data dependence graph. Control dependence and control dependence graph. Restructuring transformations and automatic extraction of parallelism; representation of iteration spaces of multiply nested loops; loop based transformations such as loop distribution, loop coalescing, loop inter-change and cycle shrinking transformation. Texts/References 1)Selected papers and online reference material CPT653Quantum Cryptography 3-0-0 Finite Dimensional Hilbert Spaces – Tensor Products and Operators on Hilbert Space – Hermitian and Trace Operators - Basic Quantum Mechanics necessary for the course. Quantum Gates and operators and Measurement – Quantum Computational Model – Quantum Complexity – Schemes for Physical realization (Only peripheral treatment expected). Shor's Algorithm – Application to Integer Factorization – Grover's Algorithm – Quantum Cryptography: Encryption and decryption schemes. Texts/References 1)Nielsen M. A. and I. L. Chauang , Quantum Computation and Quantum Information , Cambridge University Press, 2002. 2)J. Gruska, Quantum Computing , McGraw Hill, 1999. 3)P. R. Halmos, Finite Dimensional Vector Spaces , Van Nostrand, 1958. 4)Selected papers and online material. CPT655Public Key Infrastructure and Trust Management 3-0-0 Public key infrastructure - components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross-certification. Repository, Certification Authority (CA) and Registration Authority (RA), trusted third party, digital certificates. PKI services – authentication, non-repudiation, privilege management, privacy, secure communication. Key management – certificate revocation list, root CA, attacks on CA, key backup. PKI standards – SSL, LDAP, IPSec, X.500, X.509, S/MIME Trust models – strict v/s loose hierarchy, four corner, distributed. Certificate path processing – path construction and path validation. Texts/References 1)Ashutosh Saxena, Public Key Infrastructure , Tata McGraw Hill 2)Carlisle Adams, Steve Lloyd. Understanding PKI: Concepts, Standards, and Deployment Considerations, Addison Wesley. 3)John R. Vacca. Public Key Infrastructure: Building Trusted Applications and Web Services , AUERBACH. 4)Messaoud Benantar, Introduction to the Public Key Infrastructure for the Internet , Pearson Education. CPT606Selected Topics in Cryptography 3-0-0 Elliptic Curve Cryptography Secret Sharing, Threhold cryptography – Robust ElGamal system Visual Cryptography Interactive zero knowledge proofs, witness hiding protocols. Group encryption, decryption. Group signatures, ring signatures. EV oting: requirements, issues and challenges, existing solutions, write-in ballots. Pair based cryptography – Weil and Tate pairing. Text & References: 1)Selected paper and online reference material. CPT612Robotics and Control 3-0-0 Robotics: Introduction to robotics, advantages, applications. Robotic kinematics and dynamics: Direct and inverse kinematics problem. Axis transformations; DH matrix; forward and reverse kinematics, trajectory planning. manipulators and their control. Robot sensors: Active and passive robot sensors, Construction of tactile, touch and vision sensors; interpretation of sensory information; vision processing; kinematic information from sensory data. Robot Intelligence: Robot learning, State space search, robotics in computer vision applications. Robotic end effectors: Stable grip; constraints; types of contact; mathematical representation of stable grip; use of screw twist, and wrench gripper design; tools as end effectors. Problems of implementation of automatic systems. Text & References: 1)Fu K, Gonzalez R and Lee C, Robotics - Control Sensing Vision & Intelligence , McGraw Hill. 2)Craig J J, Introduction to Robotics, Mechanics and Control , Addison Wesley, 1993. 3)McKerrow P J, Introduction to Robotics , Addison Wesley, 1993. 4)Selig M, Introductory Robotics , Prentice Hall, 1992. CPT614FPGA based System Design 3-0-0 Introduction to FPGA Architectures. FPGA design flow, partitioning, placement and routing algorithms. Technology mapping for FPGAs, case studies. Text/References: 1)Brown, Francis, Rose and Vranesic. Field programmable Gate arrays . Kluwer. 2)Betz, Rose, Marquardt, Architecture and CAD for Deep-submicron FPGAs . Kluwer. 3)Trimberger, FPGA Technology. Kluwer, 1992. 4)Oldfield, Dorf. FPGAs: Reconfigurable logic for rapid prototyping and implementation of digital systems. John Wiley. 5)Recent papers from conferences and journals. CPT616 Network Security 3-0-0 Review of wired/wireless network protocols, intrusion detection systems, malicious software. Review of cryptographic algorithms, protocols, cryptanalysis, authentication and signature protocols. Kerberos, PKI, real-time communication security, IPSec: AH, ESP, IKE . SSL/TLS, e-mail security, PEM and S/MIME, PGP, web security, network management security, wireless security. Threats in networks, network security controls, firewalls, intrusion detection, administering security Honeypots, password management, malicious software, viruses and countermeasures Text/References: 1)C. Kaufman, R. Perlman, Network Securit, Prentice Hall. 2)Kurose & Ross, Computer Networking , Pearson Education. 3)Schiller J., Mobile Communications , Pearson Education. 4)W. Stallings, Cryptography and Network Security Principles and practice , Pearson Education. CPT618Security in Computing 3-0-0 Computer security, threats, attacks, computer criminals, defense methods, information and network policies, cryptography, symmetric and public-key encryption, uses of encryption. Secure file systems and database security. Program security, secure programs, viruses and other malicious code, control against program threats, protection in general-purpose OS, protected resources and methods of protection, user authentication. Binding programs to machines. Language based security, Integrating security in compilers. Designing trusted OS, models of security, database security, security requirements, reliability and integrity, inference. Administering security, legal, privacy, and ethical issues in computer security. Texts/References 1)Pfleeger and Pfleeger, Security in Computing , Pearson Education. 2)M. Bishop and S. S. Venkatramanayya, Introduction to Computer Security , Pearson Education. 3)Stallings W., Cryptography and Network Security Principles and Practice , Pearson Education. 4)Stallings W., Network Security Essentials: Applications and Standards , Pearson Education. CPT620Intelligent Agents 3-0-0 Introduction to agent-based computing , Motivations for agent-based computing Key concepts and models, Agent architectures (deliberative, reactive, hybrid), Rational decision making (decision theoretic, belief-desire-intention) Mobile agents, Agent Interactions, Coordination (organisation models, social laws, social dependencies), Cooperation (team-oriented problem solving, coalition formation) Negotiation (mechanism design, heuristic models, argumentation) Computational markets (auctions, competition) Agent-Oriented Software Engineering, Benefits and Potential Drawbacks, Agent Methodologies, Application Case Studies (agent-mediated electronic commerce, business process management, telecommunications network management) Texts/References 1)M.J.Wooldridge, An introduction to multi-agent systems . Wiley (2002) CPT624Critical Systems 3-0-0 Introduction to time critical systems, Issues, Components, Classification and terminology. Misconceptions about Real-time computing. Real-time System requirements. Specification of timing constraints. Real-time scheduling: Requirements and Issues, Terminology, modeling, Introduction static and dynamic scheduling schemes, cyclic scheduling, priority driven scheduling of periodic tasks, schedulability tests, Aperiodic task scheduling: server/non-server based scheduling algorithms. Practical factors/overheads. Task Synchronization: Need and priority inversion problem, Priority Inheritance protocol, priority ceiling protocol and stack-based priority ceiling protocol. Introduction to multiprocessor real-time systems, problems and issues. An overview of an operating system Text & References: 1)J.W.S.Liu: Real-Time Systems, Pearson Education Asia 2)S.T.Lavi, A.K.Agrawala: Real-time system Design, McGraw Hill 3)Laplante: Real-time Systems

Design and Analysis, An Engineer's Handbook, IEEE Press 4)Laurence, K.Mauch: Real-time Microcomputer system design, An introduction, McGraw Hill CPT626Pattern Recognition 3-0-0 Introduction to statistical, syntactic and descriptive approaches, features and feature extraction. Bayes Decision theory- continuous case, 2-category classification, minimum error rate classification, discriminant functions and decision surfaces, discrete case. Parameter estimation, supervised learning-Maximum likelihood, Bayes, general bayesian learning. Nonparametric - density estimation, parzen windows, k-nearest Neighbor, estimation posterior probability. Linear discriminant functions- decision surfaces, generalized linear discriminant functions, 2- category linearly separable case, non-separable behavior, linear programming procedures, SVMs. Supervised learning: Feed forward Neural networks, Backpropagation algorithm, error surfaces. Clustering - data description and clustering, Hierarchical clustering, self organizing maps. Texts/References 1)Duda and Hart P.E, and David G Stork, Pattern classification , John Wiley & Sons. 2)Duda and Hart P.E, Pattern classification and scene analysis , John Wiley and sons.. 3)Earl Gose, Richard Johnsonbaugh, and Steve Jost; Pattern Recognition and Image Analysis, PHI. 4)Fu K.S., Syntactic Pattern recognition and applications , Prentice Hall.s CPT628Security Analysis of Protocols 3-0-0 Mathematical models of computer security – Abstract state machines, belief logics, provable security, spi-calculus, Communicating Sequential Processes (CSP). Needham Schroeder – public key, shared key, attacks; security analysis of Kerberos and Shoup Rupin protocol Time-stamping and its incorporation in modeling Authentication protocols, Access control – policies and mechanism , Nominal calculi for security and mobility, classification of security properties. Protocol verification – case studies. Texts/References 1)Peter Ryan, Steve Schneider, Michael Goldsmith, and Gavin Lowe. Modelling & Analysis of Security Protocols, Addison Wesley. 2)Giampaolo Bella. Formal Correctness of Security Protocols , Springer. 3)Riccardo Focardi and Roberto Gorrieri. Foundations of Security Analysis and Design: Tutorial Lectures, Springer. 4)Riccardo Focardi and Roberto Gorrieri. Foundations of Security Analysis and Design II , Springer. CPT691 Object Oriented Systems 3-0-0 Abstractions, Objects, Classes and Methods, Inheritance and Reuse, Replacement and Refinement, Contracts, Design by Contract, Reuse: code vs. design reuse, Design patterns – classification, pattern descriptions, Creational patterns: Singleton, Factory, Prototype, Structural patterns: Adapter, Proxy, Composite, Decorator, Facade, Behavioral patterns: Strategy, State, Observer, Template method, Iterator. Text/References: 1)Timothy Budd, An Introduction to Object-oriented Programming, Pearson Education. 2)Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, Design Patterns, Pearson Education. CPT693Data Compression 3-0-0 Compression: Need, Lossless v/s lossy compression, review of information theory, prefix codes, uniquely decodable code. Huffman coding – minimum variance, optimal, non-binary, extended, adaptive. Applications and limitations of Huffman codes. Run length encoding, Arithmetic coding, Predictive coding – Burrows-Wheeler transform, Delta modulation, Adaptive delta modulation Lossy Compression Techniques – JPEG and its application, MPEG Error detection and correction: Parity, 1,2,n dimensions, Hamming codes, p-out-of-q codes Dictionary based compression - Lempel-Ziv-Welch, LZ77 and LZ-78 Quantization – Scalar and Vector Quanitization. Video compression, Audio Compression, Fractal techniques. Texts/References: ■■Khalid Sayood, Introduction to Data Compression, Morgan Kauffman ■■Greg A. Harris, Darrel R. Hankerson, Peter D. Jr. Johnson, Introduction to Information Theory and Data Compression, Second Edition , Chapman and Hall. ■■Saloman, Data Compression, Springer Verlag. ■■Nelson, The Data Compression book, Hungry Minds. ■■Stephen Welstead, Fractal and wavelet Image Compression techniques , PHI, NewDelhi-1, 1999. CPT695Biometric Security 3-0-0 Biometrics: Need, Conventional techniques of authentication, challenges - legal and privacy issues. Biometrics: DNA, fingerprint, Iris, Face, hand geometry, ear. Behavioral: Human gait, speech, thermal imaging, infra-red spectrum, signature, keystroke dynamics Combining biometrics, scaling issues. Privacy, legal and ethical issues. Texts/References: 1)Julian D. M. Ashbourn, Biometrics: Advanced Identify Verification: The Complete Guide 2)Davide Maltoni (Editor), et al, Handbook of Fingerprint Recognition 3)L.C. Jain (Editor) et al, Intelligent Biometric Techniques in Fingerprint and Face Recognition 4)John Chirillo, Scott Blaul, Implementing Biometric Security 5)Nalini Ratha (Editor), Ruud Bolle 6)Authentication: From Passwords to Public Keys, Richard E. Smith CPT697 Digital Forensics 3-0-0 File System Forensics : Duplicating hard disks for "dead analysis", reading hidden data on a disk's Host Protected Area (HPA), Direct versus BIOS access, dead versus live acquisition, Disk partitions - DOS, Apple, and GPT partitions, BSD disk labels, Sun V olume; multiple disk volumes - RAID and disk spanning; Analyzing FAT, NTFS, Ext2, Ext3, UFS1, and UFS2 file systems, Finding evidence: File metadata, recovery of deleted files, Using The Sleuth Kit (TSK), Autopsy Forensic Browser, and related open source tools Web Forensics: network-based evidence in Windows and Unix environments, Reconstructing Web browsing, e-mail activity, Tracing domain name ownership and the source of e-mails System Forensics: Windows Registry changes, Duplicating and analyzing the contents of PDAs and flash memory devices Electronic document, computer image verification and authentication Texts/References: 1)Brian Carrier. File System Forensic Analysis , Addison Wesley. 2)Chris Prosise, Kevin Mandia. Incident Response and Computer Forensics , McGraw Hill. 3)Linda V olonino, Reynaldo Anzaldua, and Jana Godwin. Computer Forensics: Principles and Practices, Prentice Hall. 4)Keith J. Jones, Richard Bejtlich, and Curtis W. Rose. Real Digital Forensics: Computer Security and Incident Response , Addison Wesley 5)Vacca, John R., Computer Forensics Computer Crime Scene Investigation , Charles River Media. 6)Nelson, Phillips, Enfinger, Steuart. Guide to computer Forensics and Investigation , Course Technology. CPT692Semantic Web 3-0-0 Introduction to semantic web, architecture, langauages and tools for knowledge management. XML, RDF, OIL, DAML, OWL for semantic web. Semantic Web Technologies: Ontology-based Systems: Ontology based knowledge management; ontology construction; generating, storing, aligning and maintaining ontologies for semantic web; information retrieval from natural language based documents; ontology evolution; ontological indexing and searching techniques for Searching web Texts/References 1)John Davies, Rudi Studer, and Paul Warren. Semantic Web Technologies: Trends and Research in Ontology-based Systems, Wiley. 2)John Davies, Dieter Fensel, Frank van Harmelen, and Frank van Harmelen. Towards the

Semantic Web: Ontology-Driven Knowledge Management, Wiley. CPT694Intrusion Detection 3-0-0 Introduction- Intrusion detection system (IDS), intrusion prevention system (IPS), Unauthorized access – buffer overflow, packet fragmentation, out-of-spec packets Review of Network protocol – TCP-/IP, Intrusiond detection through tcpdump. IDS and IPS – Architecture and internals. Malicious and non-malicious traffic, IP headers, TDP, UPD and ICMP protocols and header formats, Header information to detect intrusion, logs and their analysis, IDS through reaction and response Intrusion analysis – data correlation, tools, SNORT. Text & References: 1)Matt Fearnow, Stephen Northcutt, Karen Frederick, and Mark Cooper. Intrusion Signatures and Analysis, SAMS. 2)Carl Endorf, Gene Schultz, Jim Mellander, Intrusion Detection and Prevention , McGraw Hill. 3)Stephen Northcutt and Judy Novak. Network Intrusion Detection , SAMS. 4)Paul E. Proctor. The Practical Intrusion Detection Handbook , Prentice Hall. CPT696Intellectual Property Rights 3-0-0 Introduction to Intellectual property, Patents, Trademark, Copyright Patents – process, patentable entities, scope of patent system, patents and free enterprise; cost considerations; antitrust law, patent institutions, infringement, limitations of patents Copyright – protection, eligibility, fair use; works and rights protection; limitations Trademark – history, concepts, scope, computer software copyrights, copyright in databases and electronic publishing. Design protection Computer contracts, liability for defective hardware and software, software contracts, web and hardware contracts, electronic contracts and torts, liabilities. Introduction to Cyber laws in India, IT Act 2000, data subjects' rights, ethical issues in computer security. Case studies. Texts/References 1)Robert P. Merges and Jane C. Ginsburg. Foundations of Intellectual Property, Foundation Press. 2)Tom Greaves. Intellectual Property Rights for Indigenous Peoples: A Source Book, 3)Susan K. Sell. Private Power, Public Law: The Globalization of Intellectual Property Rights, Cambridge University Press. 4)D. Bainbridge, Introduction to Computer Law, Pearson Education. 5)P. Duggal, Cyber law: the Indian Perspective, 2005 CPT698Internet Security 3-0-0 Security protocols: naming and addressing, IPv6, Network address translation, SNMP, remote login, file transfer protocol, RPC based protocol, peer-to-peer communication Web architecture and protocols, buffer overflow and hacking Internet threats – password stealing, Trojans, phishing, viruses, worms, DOS attack, backdoors, Botnets, port scanning, hacking techniques. Security mechanisms – passwords, one-time password – time based, Lamport's, authentication – smart card, biometrics, RADIUS, SASL framework, host to host authentication, PKI. Firewalls, VPNs, tunneling, Intrusion detection. Server and client security, Text & References: 1)John Chirillo. Hack attacks denied, Wiley. 2)McClure. Web Hacking, Pearson Education. 3)John R. Vacca. Practical Internet Security , Springer. 4)William R. Cheswick, Steven M. Bellovin, and Aviel D. Rubin. Firewalls and Internet Security: Repelling the Wily Hacker , Addison-Wesley. 5)Kenneth Einar Himma. Internet Security: Hacking, Counterhacking ,and Security , Jones & Bartlett Publishers CPT634Malware Analysis and Detection 3-0-0 Malware: Types – Virus, Worms, Trojans, Logic Bombs, etc., infection modes, payload and its delivery mechanisms. Analysis Tools and their design: Disassemblers, Unpackers, Scanners, Decompilers, Emulators, Virtualization techniques Anti-analysis techniques: Obfuscation techniques, Packing, Encryption, Polymorphism, metamorphism. Analysis Techniques: Signature based, Non-signature based, Static, dynamic, behavioral, anomaly detection. Case Study: Android Malware Text/Reference Books 1. Peter Szor: The Art of Computer Virus Research and Defense, Addison Wesley Professional. 2. Eric Filiol: Computer Viruses: from theory to applications, Springer. 3. Michael Sikorski and Andrew Honig: Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software, No Starch Press 4. Christopher Elisan: Advanced Malware Analysis, McGraw-Hill Osborne Media. 5. Michael Hale Ligh, Andrew Case: The Art of Memory Forensics: Detecting Malware, Wiley. 6. Bruce Dang, Alexandre Gazet: Practical Reverse Engineering, Wiley. CPT699 Modelling and Simulation 3-0-0 Analytical v/s simulation modeling, performance measurement and benchmarking, Workload modeling, random variables, commonly used distributions, Stochastic Processes, Performance evaluation methods, Evaluation Metrics Markov chains, Birth and Death Processes, Markov chain models of Computer systems, Steady- state and transient analysis Queuing models, M/M systems and their steady state analysis, Single server and multi-server queues, open and closed queuing networks Petri Net based Performance Modeling : Classical Petri Nets, Timed Petri Nets, Discrete Petri Nets, Modeling multiprocessor systems Discrete event simulation – Simulation languages, random number generation and testing, model verification and validation, analysis of simulation results, confidence intervals, variance reduction techniques, Case studies of analytical and simulation studies of computer systems Text/Reference Books 1. Law and Kelton, Simulation Modeling and Analysis, Mcgraw Hill 2. Raj Jain, The Art of Computer System Performance Analysis, John Wiley 3. K.S.Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, PHI 4. Kant, Introduction to Computer System Performance Evaluation, Mcgraw Hill BTech_2013_CS.pdf Semester III S.No. Semester Course Code Course Name Category Type Credit L-T-P 1 III CST201 Logic in Computing PC Theory 3 3-0-0 2 III CST203 Data Structures and Algorithms PC Theory 4 3- 1-0 3 III CST205 Digital Logic Design PC Theory 4 3-1-0 4 III CST207 Programming Methodology PC Theory 3 3-0-0 5 III CST209 Introduction to Signals and Communication PC Theory 4 3-1-0 6 III HST201 Effective Communication PC Theory 3 2-1-0 1 III CSP211 Programming Lab PC Lab 2 0-0-4 2 III CSP213 Digital Logic Design Lab PC Lab 2 0-0-3 25 29 Cont act Hour s Semester IV S.No. Semester Course Code Course Name Category Type Credit L-T-P 1 IV CST202 Computer Organization and Microprocessors P C Theory 3 3-0-0 2 IV CST204 Discrete Structures PC Theory 4 3-0-0 3 IV CST206 Formal Languages and Automata Theory PC Theo ry 4 3-1-0 4 IV CST208 Design and Analysis of Algorithms PC Theory 4 3-1-0 5 IV CST210 Systems Programming PC Theory 3 3-0-0 6 IV HST202 Economic Environment PC Theory 3 2-1-0 1 IV CSP212 Assembly Language Programming Lab PC Lab 2 0-0 -3 2 IV CSP214 Algorithms Lab PC Lab 2 0-0-3 3 IV CSP216 System Programming Lab PC Lab 2 0-0-3 Department of Computer Engineering Curricular Structure (B.Tech Computer Engg.) 27 29 Cont act Hour s Semester V S.No. Semester Course Code Course Name Category Type Credit L-T-P 1 V CST301 Computer Architecture PC Theory 3 3-0-0 2 V CST303 Concurrent and Parallel Programming PC Theory 3 3-0-0 3 V CST305 DBMS PC Theory 4 3-1-0 4 V CST307 Computer Networks PC Theory 3 3-0-0 5 V CST309

Compiler Design PC Theory 3 3-0-0 6 V CST311 Software Engineering PC Theory 3 3-0-0 1 V CSP313 DBMS Lab PC Lab 2 0-0-3 2 V CSP315 Concurrent Programming Lab PC Lab 2 0-0-3 3 V CSP317 Computer Network Lab PC Lab 2 0-0-3 25 28 Cont act Hour s Semester VI S.No. Semester Course Code Course Name Category Type Credit L-T-P 1 VI CST302 Operating System PC Theory 3 3-0-0 2 VI CST304 Embedded Systems PC Theory 3 3-0-0 3 VI CST306 Object Oriented Analysis and Design PC Theor y 3 3-0-0 4 VI CST308 Computer and Network Security PC Theory 3 3-0- 0 5 VI CST310 Computer Graphics PC Theory 3 3-0-0 6 VI CST312 AI and Expert System PC Theory 3 3-0-0 1 VI CSP314 OS and Security Lab PC Lab 2 0-0-3 2 VI CSP316 Graphics Lab PC Lab 2 0-0-3 3 VI CSP318 Advanced Programming Lab PC Lab 2 0-0-3 4 VI CSP320 Embedded System Design Lab PC Lab 2 0-0-3 26 30 Cont act Hour s * Letter grades to be awarded. Semester VII S.No. Semester Course Code Course Name Category Type Credit L-T-P 1 VII CSS401 Training Seminar PC Theory 2 0-2-0 2 VII Management PC Theory 3 VII Open Elective I OE Theory 4 VII Open Elective II OE Theory 5 VII Program Elective I PE Theory 4 3-0-2 6 VII Program Elective II PE Theory 4 3-0-2 Semester VIII S.No. Semester Course Code Course Name Category Type Credit L-T-P 1 VIII Management PC Theory 2 VIII CSD402 Major Project Project Theory 3 VIII Open Elective III OE Theory 4 VIII Open Elective IV OE Theory 5 VIII Advanced Program Elective I AEC Theory 4 3-0-2 6 VIII Advanced Program Elective II AEC Theory 4 3-0-2 Advanced Elective Courses S.No. Course Code Course Name CST432 Topics in Data Strutures and Algorithms CST434 Parallel and Distributed Computing CST436 Selected Topics in Operating System CST438 Advanced Topics in Computer Graphics CST440 Advanced Topics in Databases CST442 Network Performance Modelling CST444 Software Testing and Validation CST446 Topics in SOC Design CST448 Advances in Compiler Design CST450 Wireless Sensor Networks CST452 Digital Image Analysis CST454 Data Mining and Data Warehousing CST456 Topics in High Speed Networking CST458 E-Commerce CST460 High Level Synthesis of Digital Systems CST462 Parallelizing Compiler CST464 Public Key Infrastructure and Trust Managemen t CST466 Selected Topics in Cryptography CST468 Robotics and Control CST470 FPGA based System Design CST472 Security in Computing CST474 Intelligent Agents CST476 Critical Systems CST478 Pattern Recognition CST480 Biometric Security CST482 Computer Forensics CST484 Semantic Web CST486 Intrusion Detection CST488 Internet Security CST490 Malware Analysis and Detection Program Electives S.No. Course Code Course Name CST433 Wireless Communications CST435 VHDL CST437 Neural Networks CST439 Speech Recognition CST441 Software Project Management CST443 Data Compression CST445 Natural Language Processing CST447 Wireless & Ad-hoc Networks CST449 Real Time Systems CST451 Cryptography CST453 VLSI Algorithms CST455 Digital Image Processing CST457 Evolving Architectures CST459 Topics in Computing CST461 Machine Learning CST463 Modelling and Simulation CST431 Programming in Java CST465 Python Programming CST467 Multimedia Technology CST469 Computer Human Interaction UG/PG Department: Course Code: Course Credit: L-T-P: Version: Approved on: Pre-requisite Course : Syllabus Books: Michael Huth, Mark Ryan: Logic in Computer Science : Modelling and Reasoning about Systems, Cambridge University Press .

DUGC Convener Curriculum committee Convener SUGB Chairman Date: 3 3-0-0 Logic: Introduction to Logic, Propositional Logic a nd Predicate Logic Propositional logic: Elements, Truth table, Declara tive sentences, Construction of Proposition, Converse and Contrapos itive, Reasoning with Propositions, Natural deduction – rules, Provable e quivalence, Semantics, logical connectives, Soundness and completeness of propositional logic, Normal forms, Identities of Propositions and Dual, Use of Identities, Implications, Reasoning with Propositions, Proof of Identities, Proof of Implications, Semantic equivalence, satisfiability and validity, Conjunctive normal forms. Predicate logic: Terms, Formulas - Well Formed Form ula (WFF) of Predicate Logic, Constructing Formulas; Free and bound varia bles, Reasoning with Predicate Logic, deduction rules, Quantifier, Seman tics , Undecidability of predicate logic, Expressiveness, second-order logic . Verification: Linear-time temporal (LTL) logic, Syn tax and Semantics, Model checking: systems, tools, properties, Branching-ti me temporal logic - Syntax and Semantics of CTL, Model-checking algorithms Program verification: Partial and total correctness , Proof calculus, Modal logic – syntax and semantics, Binary decision diagrams. B.Tech (Computer Engineering) - Semester III UG Computer Engineering CST201 Logic in Computing UG/PG Department: Course Code: Course Name: Credit: L-T-P: Version: Approved on: Pre-requisite Course : Syllabus Books: Date: Introduction to data structures, dynamic aspects of operations on data, analysis of algorithms. Creation and manipulation of data structures: array s, lists, stacks, queues, trees – binary, threaded, multiway; heaps, height balanced trees, graphs, hashing and hash tables, dictionaries, tries. Algorithm approaches: greedy, dynamic programming, divide and conquer, branch and bound, introduction to complexity analys is and measures. Algorithms: sorting and searching, merging, tree an d graph traversals, shortest path, minimum spanning tree, order statis tics, string matching. Selected topics: computational geometry, emerging a reas. 1. Kruse R.L., Data Structure and Program Design, P HI. 2. Rivest, Cormen, Introduction to Algorithms, MIT Press 3. Horowitz and Sahni: Data Structure in C++ , Glag otia 4. Ellis Horowitz, Sartaj Sahni, Fundamentals of Da ta Structures 5. Aaron M. Tenenbaum, Y. Langsam, Moshe J. Augenst ein, Data Structures Using C DUGC Convener Curriculum committee Convener SUGB Chairman UG Computer Engineering CST203 Data Structures and Algorithms 4 3-1-0 B.Tech (Computer Engineering) - Semester III UG/PG Department: Course Code: Course Name: Credit: L-T-P: Version: Approved on: Pre-requisite Course : Syllabus Books: 1.Digital Systems and Hardware and Firmware Algorit hms: M.Ercegovac and T. Lang, Pearson. 2.Hill & Peterson: Switching Theory and Logic Desig n, John Wiley 3.J.F.Wakerly: Digital Design, Principle and Practi ces, Pearson. 4 3-1-0 Boolean algebra: Binary connectives, Evaluation of truth functions, Duality, Simplification of Boolean expressions. Realisation of Logic Circuits: Minterm, Maxterm, Ka rnaugh maps, incompletely specified functions, simplification. Q uine-Mckluskey's tabular method, prime implicants, map and tabular minimizat ion of multiple output circuits. Combinational and Sequential circuits: Adders - Rip ple carry, Carry look ahead, Carry select, carry save; subtraction, encod er/decoder, multiplexer, demultiplexer, parity checker and generator. Latche s, Flip Flops : JK, SR, D Type and T type Flip Flops; Shift registers, Counte rs - Ripple, decade, up- down counters, Mod- n counters, Multiplication - Add and Shift method, Booth's Multiplier, m -Array Multiplier, Division - Restoring/Non restoring method.. Clock, pulse and level mode sequential circuits; An alysis and design of sequential circuit. Synthesis of state diagrams, fi nite memory circuits, equivalence relations, equivalent states and circui ts, simplification by implicant tables. Mealy and Moore machines, state a ssignment and memory element input equation, General pulse-mode circuits , clock input counters, extended state tables. Asynchronous Mode Circuits: Analysis of a fundament al mode circuits, Synthesis of flow tables, minimization, transition tables, excitation maps and output maps, Cycles and Races, Race free assignment s, Hazards in sequential circuits. Introduction to A/D and D/A converters. Sampling an d Quantization. B.Tech (Computer Engineering) - Semester III UG Computer Engineering CST205 Digital Logic Design UG/PG Department: Course Code: Course Name: Credit: L-T-P: Version: Approved on: Pre-requisite Course : Syllabus Introduction to flow charts, programming paradigms. Abstractions in programming languages. Declarations , variables and constants, data types, arithmetic expressions, stat ements, precedence and associativity of operators. User-defined data types , data abstraction, array, records, character string, variable size data struc ture, pointer and reference types, design and implementation uses of these type s, type checking and type conversion. Control constructs – branching and looping, relatio nal and boolean expressions, conditional execution and iteration, e xception handling. Sub-programs, procedures and functions, parameter p assing mechanism, scope and lifetime of variables, environment, activ ations, and allocation. Recursion and recursive functions, Co-routines and scheduled subprograms, task and concurrent exception. Name and referencing environments, static dynamic a nd block structures. Dynamic and static scope of shared data. Block stru cture, parameters and their transmission. Dynamic memory management. Storage management: Stat ic, Stack, Heap (Fixed/variable size), File processing, debugging s trategies. UG Computer Engineering CST207 Programming Methodology 3 3-0-0 DUGC Convener Curriculum committee Convener SUGB Chairman Date: B.Tech (Computer Engineering) - Semester III Books: UG/PG Department: Course Code: Course Name: Credit: L-T-P: Version: Approved on: Pre-requisite Course : 4 3-1-0 Date: B.Tech (Computer Engineering) - Semester III UG Computer Engineering CST209 Introduction to Signals and Communication Ghezzi and Jazayeri: Programming Language Concepts , . Sethi Ravi: Programming Language Concepts & Constr ucts, Addison Wesley Louden: Programming Languages- Priciples and Practi ce, Cengage Learning. Friedman and Wand: Essential of Programming Langua ges, PHI. Sebasta: Concept of programming language, Addison W esley Pratt: Programming language design and implementati on PHI. DUGC Convener Curriculum committee Convener SUGB Chairman Syllabus Books: UG/PG Department: Course Code: Course Name: Credit: L-T-P: B.Tech (Computer Engineering) - Semester III UG Computer Engineering HST201 Effective Communication 3 2-1-0 1. Oppenheim , Willsky: Signals and Systems , Prentice Hall. 2. Proakis: Digital Signal Processing , Maxwell Macmillan. 3. Oppenheim: Discrete-time Digital Signal Processing , PHI. 4. N K Sinha, Linear systems , John Wiley. 5. Haykins, Analog and Digital Communications, Wil ey Publications. 6. Forouzan, Data Communications and Networking, M cGraw Hill, . 7. B.P.Lathi : Modern Digital Communication, Oxfor d. 9. Taub: Introduction to

Communication Systems, Mcg raw Hill. 10. R.Coolen : Electronic Communication, PHI DUGC Convener Curriculum committee Convener SUGB Chairman Date: Signals: representation, Sampling and aliasing; qua ntization, Review of Fourier, Laplace and z-transform; Linear Time Inva riant System Filters: Transfer functions, FIR filters, IIR filters; Spect rograms; Spectral analysis: DFT for periodic and non-periodic signals, FFT. Analog Communication: Signal modulation, FM, PM, SS B, VSB. Frequency Division Multiplexing and Time Division M ultiplexing. Digital Communication: Pulse transmission over Band limited signals, sampling theory; Pulse Modulation - PAM, PCM, DPCM , DM, ADM, metrics - bit transmission, signaling rate, error probability , S/N ratio, bandwidth requirement. Modulation: PSK, FSK, QPSK (QAM), MSK. Transmission Media: Guided and Unguided Media, Tran smission Impairments, Multiplexing, Switching: Circuit, Mess age, Packet, Datagram, Virtual Networks, DSL. Fiber Optic Communication : Principles of light communication in fiber, losses in fiber, dispersion , light source and detectors, multiple access – TDMA, FDMA, CDMA. Codes : Information theory, Shannon’s theorem, Sour ce coding, error control coding, Block codes, Cyclic codes, Linear code, che cksum. Version: Approved on: Pre-requisite Course : Syllabus Books: UG/PG Department: Course Code: Course Credit: L-T-P: Version: Approved on: Pre-requisite Course : Syllabus Books: Programming assignments for conceptual understandin g of control constructs, scoping rules, functions, recursion, fi le handling, dynamic memory management. B.Tech (Computer Engineering) - Semester III UG Computer Engineering CSP211 Programming Lab 2 0-0-3 Importance of Effective Communication Principles to Increase Clarity of Communication Technical Report Writing Soft Skills for the first Job (Time Mgmt, attitude, responsibility, self- confidence and courage, teamwork, consistency, ethi cs ,integrity and values,etc.) Presentation skills (defining purpose, analysis of audience and locale, organizing contents, visual aids, and nuances of de livery) Resume’, Group discussions and Job Interviews Avoiding Errors; Active Listening; Condensation Reading Comprehension Effective Speaking Guidelines Vocabulary Building (Root Words, Prefixes and suffi xes, words often confused, and frequently used foreign phrases) 1.Technical Communication Principles and Practice : Raman and Sharma (Oxford) DUGC Convener Curriculum committee Convener SUGB Chairman Date: UG/PG Department: Course Code: Course Name: Credit: L-T-P: Version: Approved on: Pre-requisite Course : Syllabus Books: The following proposed coverage are broad guiding a reas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with concerned theory courses. 1. Design and test a 2-bit and 4-bit half adder. 2. Design and test a 2-bit and 4-bit adder (ripple, carry look ahead). 3. Design and test of encoder/decoder (binary-gray, self-complementing). 4. Design and test of parity generator and detector . 5. Design and test of one bit error detecting and c orrecting circuit. 6. Design and test of a 2-bit multiplier. 7. Design and test of n-bit comparator. 7. Design and test of flip flops – RS/JK/D/T. 8. Design and test of SISO and PIPO shift registers . 9. Design and test of counters. Programming Implementation and simplification of k-map (upto 3 variables. Implementation of Quine-Mckluskey's method. Design of a simulator. Text/Reference books for Digital Logic Design. Online reference material. UG Computer Engineering CSP213 Digital Logic Design Lab 2

0-0-3 Date: B.Tech (Computer Engineering) - Semester III DUGC Convener Curriculum committee Convener SUGB Chairman Date: DUGC Convener Curriculum committee Convener SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Computer Organization and Microprocessors Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman Organization of Computer Systems – CPU, Memory and I/O organization, Instruction encoding and addressing modes. Von-neum ann versus Harvard Architecture, RISC and CISC architectures. Introduction to microprocessors, control unit, and interrupt system design. Design of hardware and software for microprocessor applications. Assembly language programming. Microprocessor system case studies – x86, IA, ARM. 1. Patterson and Hennessy: Computer Organization an d Design, Morgan Kaufmann. 2. Hamacher and Zaky: Computer Organization, McGraw Hill. 3. Pal Chaudhuri: Computer Organization and Design, PHI. 4. Hayes: Computer Architecture and Organization, M cGraw Hill. 5. Barry B. Brey: The Intel microprocessors. Pearso n 6. Douglas V. Hall: Microprocessors and Interfacing , McGraw Hill. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester IV UG CST202 3 UG/PG Department: Computer Engineering Course Code: Course Name: Discrete Structures Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman 1. Kolman B., Busby R: Discrete Mathematical Struct ures for Compute Science, PHI. 2. Liu: Introduction to Discrete Mathemetics, McGra w-Hill. 3. Graham, Knuth, Pratshnik : Concrete Mathematics. 4. Grimaldi: Discrete Mathematical Structures. 5. Rosen, Discrete Mathematics and Its Applications , McGraw Hill. 6. Koshy, Discrete Mathematics with Applications, E lsevier. 7. Foulds: Graph Theory Applications, Narosa. 8. Harary: Graph Theory, Narosa. 9. N. Deo: Graph Theory, PHI. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester IV UG CST204 3 Mathematical Reasoning – Induction; Counting – Pige onhole principle, permutation, combination, probability Sets, relations, functions, operations, and equival ence Relations, relation of partial order, partitions, binary relations, Equivalence re lations. Recursion, Number-theoretic algorithms: Greatest Common Diviso r, Chinese Remainder Theorem, Primality testing, polynomial representati on of binary number, Galois fields, primitive roots, discrete logarithms. Graph Theory: Connectivity, Binary tree, Spanning t ree, tree enumeration, cycles, Planarity, cut-set, coverings, colourings, matroid.B.Tech (Computer Engineering) - Semester IV UG/PG Department: Computer Engineering Course Code: Course Name: Formal Languages and Auto mata Theory Credit: L-T-P: 3-1-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester IV CST206 4 Introduction to automata theory, finite automata an d regular languages, regular expressions, transition graphs. Non-determination, finite automata with output, reg ular languages, minimization of finite automata, pumping lemma for regular language s. Chomsky classification of languages, regular gramma rs, context free grammars, simplification of context free grammars, Normal for ms of context free grammars. Push Down Automata Theory: push down automata and l anguages, push down automata and context free grammars, pumping lemma for context free languages. Turing hypothesis, Turing machine, Minskey's theore m, TM variation and encoding, Post machines, computability and acceptab ility. Introduction to automata theory, finite automata an d regular languages, regular expressions, transition graphs. 1. Hopcroft, Motwani and Ullman: Introduction to Au tomata Theory, languages and Computation, Pearson Education. 2. Cohen: Introduction to Computer Theory, Addison Wesley. 3. Martin: Introduction to Languages and Theory of Computation, TMH. 4. Papadimitriou, Introduction to Theory of Computi ng, Prentice Hall. UG UG/PG Department: Computer Engineering Course Code: Course Name: Design and Analysis of Al gorithms Credit: L-T-P: 3-1-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering B.Tech (Computer Engineering) - Semester IV UG 4 Algorithm Analysis: Asymptotic notation, solution o f recurrence, model of computation, time and space complexities, average a nd worst case analysis, Amortized analysis. Algorithm Design Techniques: Gr eedy algorithm, dynamic programming, divide and conquer, backtracking, bran ch and bound. Graph Algorithms: Shortest path algorithms, Disjoin t set operations, minimum spanning tree algorithm, network flow, matching, co verings, applications of DFS:- bi-connectivity, Euler circuits, strongly connected components, topological sort, and articulation point. Matrix Algorithms – Strass en Matrix multiplication, LUP decomposition. Construction of codes: Shannon Fano and Huffman cod es. Dynamic Programming: Chained matrix multiplication, longest common subsequence. Divide and Conquer: Order Statistics – finding the median, exponentiation, matrix multiplication, LCS. Computa tional Geometry: Line segments, Optimal polygon triangulation. Approximat e Algorithm: Travelling Salesman Problem, vertex-cover problem. Primality testing, Integer factorization, Randomize d algorithms, Probabilistic algorithms. String Matching algorithms: Rabin Karp, KMP, Boyer Moore. Introduction to problem classes – NP, NPC, NP-Hard. 1.Cormen, Leiserson, Rivest: Introduction to Algori thms, Prentice Hall of India. 2.Horowitz and Sahani: Fundamental of Computer algo rithms. 3.Aho A.V , J.D Ulman: Design and analysis of Algor ithms, Addison Wesley 4.Brassard : Fundamental of Algorithmics, PHI. 5.W.W. Peterson and E. J. Weldon: Error correcting codes. 6.Sara Baase, Allen Van Gelder: Computer Algorithms : Introduction to Design and Analysis, Pearson Education DUGC Convener Curriculum committee Convener UG CST208 Course Code: Course Name: Systems Programming Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Economic Environment Credit: L-T-P: 2-1-0 Version: Approved on: Pre-requisite Course : B.Tech (Computer Engineering) - Semester IV UG HST202 3Overview Of Systems Software, Language Processors. Concept Of Machine And Assembly Language, Represen tation Of Instruction And Data, Macro Processor, Macros And Macro Program ming, Assemblers. Linker, Loader, Dynamic Link Library, relocation, Editors And Debuggers. Unix/ Linux Shell programming, Device Drivers, Kern el and Low Level Programming. 1. D. M. Dhamdhere ; Introduction to Systems Softwa re ,TMH 2. Beck L.L. : System Software-An Introduction to S ystems Programming, Addition Wesley 3. Rebecca Thomas : Adv. Programmer guide to Unix s ystem V. MH 4. Glingaert : Assemblers, Loaders and Compilers, P rentice Hall 5. John R. Levine : Linkers and Loaders, Harcourt I ndia 6. Kanetkar : Unix Shell Programming. DUGC Convener Curriculum committee Convener CST210 3 Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Assembly Language Program ming Lab Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : UG CSP212 2Economic growth & development; primary, secondary a nd tertiary sectors; structural changes & emerging sectors of the Indian economy. National Income; concepts & measurement; circular f lows of income. Review of five year plans in India, planning strate gy and objectives. Current trends in industrial growth, industrial and licensing policy, growth of private sector, problems of public sector units, po licy changes for industrial growth; environment for the SME sector. Design and strategy of economic reforms and liberal ization: India's growth post liberalization. Main trends in imports and exports, balance of paym ents in recent years, environment for foreign capital and investment. Intellectual property rights and R & D environment. Banking reforms and challenges; business opportunit ies in the rural sector. Monetary & Fiscal Policies; meaning, importance & i nstruments. Global economic environment and opportunities. 1) Ishwar C. Dhingra, "The Indian Economy: Environ ment and Policy", Sultan Chand, New Delhi 2) H. L. Ahuja, "Economic Environment of Business: Macroeconomic Analysis", Sultan Chand, New Delhi 3) Amartya Sen & Jean Dreze, "INDIA: Development a nd Participation", Oxford University Press, India 4) S. K. Mishra & Puri, "Development Issues of Ind ian Economy", Himalaya 5) Ahluwalia, I.J. & IMD Little, "India's Economic Reform and Development", Oxford University Press, India DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester IV Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Algorithms Lab Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: System Programming Lab DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester IV UG CSP216 CSP214 2 The following proposed are broad guiding areas lab. The instructor offering the course can adopt further variations. Implementation of graph algorithms – DFS, Shortest Path, MST, articulation point, topological sorting, Network Flow, matching, coveri ng; pattern matching algorithms; kth shortest number in a given sequence ; Dynamic programming; Approximation algorithms for NP problems; Randomize d algorithms implementation. Text/Reference books of "Design and Analysis of Alg orithms".. Text/Reference books of "Microprocessors and Comput er Organization" Online material on Assembly Language programming. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester IV UG Programming assignments on microprocessor kits (808 5, 8086), FPGA programming, Programs on ARM processor, mini-emulat or Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman 2 Programming lab assignments related to 1. Assemblers 2. Macro assembler 3. Loader 4. Linker 5. Editor 6. Interpreter 7. Device driver 8. Kernel mode programming Text books of "System Programming" DUGC Convener Curriculum committee Convener UG/PG Department: Computer Engineering Course Code: Course Name: Computer Architecture Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course :

Syllabus Books: SUGB Chairman Flynn Classification, Stack machines, subroutine ca lls, allocation and evaluation of data in stack machines. SIMD, SPMD and MIMD. CPU Organization: Addressing techniques, Instructio n formats: Instruction set design, Instruction types: example for zero address , one address, two address and three address machines, Stack, accumulator and general purpose register organization. Register Transfer Language: arithmeti c, logic and shift micro operations and their hardware implementations as a simple ALU. Control Unit, Hardwired and Micro programmed control unit design. Memory Organization: device characteristics, RAM or ganization: 1D and 2D organization, Virtual memory - Paging and Segmentat ion, High speed memories: Associative and Cache memory. Input-Output Design: IO interface, Bus structure, M odes of data transfer, Interrupts, Input Output Processor, Serial Communic ation Pipelining: Pipeline structure, Pipeline types - I nstruction and Arithmetic pipelines. Interleaved memory organization, instru ction prefetch, data buffers, pipeline performance measures. Array processors : R outing mechanisms, Static v/s dynamic network. Multiprocessor systems, data f low concepts. Parallel processing languages. 1. J.L. Hennessy and D.A. Patterson, Computer Archi tecture: A Quantitative Approach, 4th Edition Elsevier. 2. Flynn : Computer Architecture, Narosa 3. David Culler: Parallel Computer Architecture: A Hardware/Software Approach, Morgan Kaufmann. 4. Hwang and Briggs: Computer Architecture and Para llel Processing, McGraw- Hill. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester V UG CST301 3 UG/PG Department: Computer Engineering Course Code: Course Name: Concurrent and Parallel Programming Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman 1. Mordechai Ben-Ari. Principles of Concurrent and Distributed Programming, Prentice-Hall International. 2. Greg Andrews. Concurrent Programming: Principles and Practice, Addison Wesley. 3. Gadi Taubenfeld. Synchronization Algorithms and Concurrent Programming, Pearson. 4. M. Ben-Ari. Principles of Concurrent Programming , Prentice Hall. 5. Fred B. Schneider. On Concurrent Programming, Sp ringer. 6. Brinch Hansen. The Origins of Concurrent Program ming: From Semaphores to Remote Procedure Calls, 7. Introduction to Parallel Computing by Ananth Gra ma, Anshul Gupta, Geroge Karypis, Vipin Kumar – Pearson 8. CUDA Programming – David Kirk 9. Parallel Algorithms – Joseph Ja Ja 10. Heteregeneous Computing with OpenCL by Ben Gast er, Lee Howes et al (Morgan Kaufmann) DUGC Convener Curriculum committee Convener UG CST303 3 Concurrent versus sequential programming. Concurren t programming constructs and race condition. Synchronisation primitives. Pro cesses and threads. Interprocess communication. Livelock and deadlocks, starvation, and deadlock prevention. Issues and challenges in concurrent pro gramming paradigm and current trends. Parallel algorithms – sorting, ranking, searching, traversals, prefiix sum etc., Parallel programming paradigms – Data parallel, Tas k parallel, Shared memory and message passing, Parallel Architectures, GPGPU, pthreads, STM, OpenMP, OpenCL, Cilk++, Intel TBB, CUDA Heterogeneous Computing: C++AMP, OpenCL B.Tech (Computer Engineering) - Semester V UG/PG Department: Computer Engineering Course Code: Course Name: DBMS Credit: L-T-P: 3-1-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman DUGC Convener Curriculum committee Convener

CST305 4 Need, purpose and goal of DBMS, Three tier archite cture, ER Diagram, data models- Relational, Network, Hierarchical and Obje ct Oriented. Data Base Design: Conceptual data base design, Theo ry of Normalization, Primitive and Composite data types, concept of phys ical and logical databases, data abstraction and data independence, data aggreg ation, Relational Calculus. SQL : DDL and DML, Relational Algebra. Application Development using SQL : Host Language interface, embedded SQL programming, Stored procedures and triggers and views, Constraints assertions. Internal of RDBMS : Physical data organisation in s equential, indexed random and hashed files. Inverted and multilist structures , B trees, B+ trees, Query Optimisation, Join Algorithm, Statistics and Cost B ase optimisation. Transaction Processing, concurrency control, and re covery management. Transaction model properties and state serialisabil ity . Lock base protocols, two phase locking. 1. H.f. Korth and Silberschatz: Database Systems C oncepts, McGraw Hill 2. Almasri and S.B. Navathe: Fundamentals of Databa se Systems, 3. C.J. Date: Data Base Design, Addison Wesley 4. Hansen and Hansen : DBM and Design, PHI B.Tech (Computer Engineering) - Semester V UG UG/PG Department: Computer Engineering Course Code: Course Name: Computer Networks Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Compiler Design Credit: L-T-P: 3-0-0 Version: Approved on: Date: B.Tech (Computer Engineering) - Semester V UG CST309 33 Computer Network Architecture, Circuit switching, P acket And Massage Switching, Network Structure. OSI 7-layer architect ure. Physical Layer, Data Link Layer, Framing, Error det ection. Retransmission algorithms. Queueing models and introduction to Lit tle’s theorem, M/M/1 and M/M/m queues. Network of queues. Introduction to M/ G/1 queues, reservations and priority. Stability of queueing systems. Multip le access and Aloha. CSMA/CD and Ethernet. High Speed LANs and Token Ring. High speed switch scheduling. Broadcast routing and spanning trees. Shortest path routing. Distributed routing algorithms, optimal routing. Flow control – window/ credit schemes, rate control schemes. Transport layer and TCP/IP. Introduction t o ATM networks and Network Management And Interoperability. Performanc e Issues Of LAN And WAN. 1. Data Networks: Bertsekas and Gallagher, Phi. 2. Computer Networking A top down Approach: J.F.Kur ose, Pearson. 3. Data & Computer Communication : W. Stalling , Ph i 4. Computer Networks: L. Peterson and Davie, MKP 5. Computer Networks and Internet: D.E. Comer, Pear son DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester V UG CST307 Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Software Engineering Credit: L-T-P: 3-0-0 Version: Approved on: B.Tech (Computer Engineering) - Semester V UG CST311 3Translators: Introduction to compilers, translators , and interpreters, compilation process. Lexical Analysis: Finite automata, Regular expressi ons, Design & implementation of lexical analysers. Syntax Analysis: Context Free Grammars, Derivation and Parse trees, Bottom- up and Top-down Parsing. Ambiguity, Shift Reduce Pa rser, Operator Precedence Parser, Predictive Parsers, canonical co llection of items, LR parsers. Syntax directed translation: Syntax direct ed translation, Attributes, Intermediate codes, Three address codes. Symbol table organization: Hashing, linked list, tr ee structures. Memory allocation: Static and dynamic structure all ocation. Code optimization: Basic blocks, Flow graphs, DAG, Global data flow analysis – ud-chaining, available expressions, Loop optimizati on. Code generation: Compilation of expression and cont rol structures. Error detection and recovery. 1. Aho, Ullman and Sethi: Compilers – Principles, t echniques and tools, Pearson Education. 2. Tremblay, Sorenson: The Theory and Practice of C ompiler Writing, BSP. 3. Holub, Compiler Design in C, PHI. DUGC Convener Curriculum committee Convener Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: DBMS Lab Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman Text/Reference books for course on "DBMS" DUGC Convener Curriculum committee Convener UG CSP313 2 The following are broad guiding areas lab. The inst ructor offering the course can adopt further variations in tune with DBMS Conceptual designs using ER diagrams; Design and im plementation of small DBMS; SQL queries. Engineering paradigms. System analysis: Feasibility study requirement anal ysis, Cost benefit analysis, Planning systems, Analysis tools and techniques. System Design: design fundamentals, Modular Design, Data and procedural design, object oriented design. System Development: Code documentation, Program des ign paradigms. Verification, Validation and Testing: testing metho ds, Formal Program Verification, Testing Strategies. Software Maintena nce: Maintenance Characteristics, Maintainability, Maintenance tasks and side effects. 1. Pressman R.S: Software Engineering: A Practition er approach, McGraw Hill. 2. Sommerville I: Software Engineering, Addison Wes ley 3. Ghezzi C. Jazayeri M and Mandrioli: Fundamentals of Software Engg. , PHI. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester V UG/PG Department: Computer Engineering Course Code: Course Name: Concurrent and Parallel Programming Lab Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Computer Network Lab Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : 2DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester V UG CSP317 CSP315 2 Programming exercises to implement synchronization primitives – semaphores and monitors. Parallel algorithm implementation (CU DA and OpenMP) Implementing solutions for Producer-Consumer proble m – infinite buffer, bounded buffer; Reader – Writer problem; Sleeping B arber problem; Dining Philosopher problem lex(flex), yacc(bison) for lexical and parsing Design of a mini-compiler Text/Reference books for course on "Concurrent Prog ramming" B.Tech (Computer Engineering) - Semester V UG Syllabus Books: SUGB Chairman The following proposed coverage are broad guiding a reas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with CP-325. 1. Programming for data encoding, CRC detection and Correction. 2. Estimation of network delay through OS utilities . 3. Simulation and Emulation of Bus and Star topolog y, DLC, MAC protocols using Benchmark LAN trainer kits. 4. Packet measurement and observation using network sniffing tools. 5. Use of sniffers for protocol dynamics. 6. Introduction to Socket programming and applicati on development for internet. 7. ns-3 based assignments 1.Computer Networks and Internet: D.E. Comer, Pears on 2.TCP/IP Illustrated, W. Stevens, Vol 1-2, Pearson Eds DUGC Convener Curriculum committee Convener UG/PG Department: Computer Engineering Course Code: Course Name: Operating System Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman Operating System and its evolution, batch, multipro gramming, time sharing systems, real time systems. Processes and processor management: process concept , Process scheduling, interprocess communication and synchron ization, race condition, mutual exclusion, semaphores, monitors, messages. Deadlocks prevention , avoidance, detection and recovery. Pro cesses and Threads, Concurrency control. Memory Management: Contiguous, partitioned – fixed and variable partitioning, Non contiguous allocation – Paging, s egmentation. Virtual memory, page replacement, cache coherence. File management: disk space management directory st ructure, shared files, file system performance. File servers, secur ity, protection mechanism, Directory and File structure, File shari ng, NFS, Storage management. Input/Output Management: Device drivers , disk scheduling. Distributed OS: Issues, process management, inter-p rocess communication, scheduling, deadlocks Design and imp lementation of distributed file systems, distributed shared memory , Distributed Concurrency, Transactions. Design issues of Distrib uted OS, Distributed v/s network operating system. 1. Silberschatz,Galvin: Operating System Concepts, AddisonWesley. 2. Tanenbaum, Modern Operating Systems, Prentice Ha ll. 3. W. Stallings, Operasting Systems, Prentice Hall . 4. Tanenbaum: Operating Systems: Design and Impleme ntation. PHI. 5. Deitel, An introduction to operating systems. Ad dison-Wesley. 6. Sinha: Distributed Operating Systems: Concepts a nd Design, IEEE 7. Crowley: Operating System A Design Approach-, TM H. 8. Tanenbaum: Distributed Operating Systems, Pearso n Education. 9. Bach, Design of Unix O/S. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VI UG CST302 3 UG/PG Department: Computer Engineering Course Code: Course Name: Embedded Systems Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Object Oriented Analysis and Design Credit: L-T-P: 3-0-0 Version: Approved on: CST306 31.Denial D. Gajski , Frank Vahid: Specification and design of embedded systems, PH 2.Jonathan W. Valvano: Embedded Microcomputer Syste ms, Thomson Learning 3.Myke Predko: Programming and Customizing the 8051 Micro Controller, TMH 4.Ayala : 8051 Micro controllers, Penram Press DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VI UG UG CST304 3 Introduction to embedded systems., design represent ations, level of abstractions, design methodologies. Models and architectures, Taxonomy of models and ar chitectures, Brief descriptions of specification languages, Spec ification requirement for embedded systems, Spec Chart and Spec Chart Descrip tion. Design challenges & issues, hardware and software d esign, co-design of software and hardware, ASIC. Design quality estimation : Quality matrix, softwar e and hardware estimation.Introduction Sample design Specification of Answering machine/ Microcontroller 8051. B.Tech (Computer Engineering) - Semester VI Pre-requisite Course : Syllabus Books: SUGB Chairman

UG/PG Department: Computer Engineering Course Code: Course Name: Computer and Network Secu rity Credit: L-T-P: 3-0-0 3DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VI UG CST308 Object Oriented Programming and Design: Review of a bstraction, objects and other basics, Encapsulation, Information hiding , method, Signature, Classes and Instances, Polymorphism and inheritance . C++ Programming Basics: Fundamentals, variables and assignments, Input and Output, Data types and expressions, flow of control, subprograms, top-down design, predefined functions, user defined functions, procedural abstractions, local variables , overloading function names, operator overloading, parameter passing, thi s pointer, destructors, copy constructor, overloading the assignment operat or, virtual functions, function calling functions, friend functions, recur sive functions, recursive member functions. Static member function. C++ Object oriented concepts: Objects and classes, use of file for I/O, formatting output with stream functions, Character I/O, inheritance, structures for diverse data, structures as function arguments, initializing structures, defining classes and member functions, public and private members, constructors for initialization, standard C++ classes, derived classes, flow of control, use of Boolean expression s, multiway branches, use and design of loops. Friend function and friend class. C++ Data structures and Advanced Topics: Arrays – p rogramming with arrays, arrays of classes, arrays as function argum ents, strings, Multidimensional arrays, Arrays of strings, pointer s Dynamic arrays, Classes and dynamic arrays, Base classes, access co ntrol, Templates- generic classes and functions, namespaces. Standard Template Library. 1. Balaguruswamy: Object-oriented Programming with C++. 2. Robert Lafore: C++ Programming 3. Ashok N. Kamthane : Object Oriented with C++, Pe arson Education Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering B.Tech (Computer Engineering) - Semester VI UG Computer Security: Threats and Countermeasures; Mal ware taxonomy, infection and propagation mechanisms, Countermeasur es – Scanning, Anomaly detection, behavioural analysis; static and dynamic analysis Review of wired/wireless network protocols, intrusi on detection systems, malicious software. Review of cryptographic algorit hms, protocols, cryptanalysis, authentication and signature protoco ls. Kerberos, PKI, real-time communication security, IP Sec: AH, ESP, IKE. SSL/TLS, e-mail security, PEM and S/MIME, PGP, web security, network management security, wireless security. Threats in networks, network security controls, fir ewalls, intrusion detection, administering security Honeypots, password management, malicious software, viruses and countermeasures 1) C. Kaufman, R. Perlman, Network Security, Prenti ce Hall. 2) Kurose & Ross, Computer Networking, Pearson Educ ation. 3) Schiller J., Mobile Communications, Pearson Educ ation. 4) W. Stallings, Cryptography and Network Security Principles and practice, Pearson Education. DUGC Convener Curriculum committee Convener Course Code: Course Name: Computer Graphics Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: AI and Expert Systems Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : B.Tech (Computer Engineering) - Semester VI UG CST312 3Basic raster and vector graphics. Scan conversion a lgorithms for line, circle, and ellipse. Filling: seed fill and polygon filling. Clipping lines and polygons. Geometrical transformations: 2D and 3D tr ansformations, homogeneous coordinates, composition of transformat ions, the Window-to- Viewport transformation. matrix representation of t ransformations. Projections: mathematics of planar geometric projec tions, implementation of planar geometric projections. Visible surface de termination: object space and image space techniques for visible surfac e detection, algorithms, z-buffer, list priority, scan line, are a subdivision, back face removal, BSP tree and ray tracing algorithms. Illum ination and shading: illumination models, shading for polygons, constant , Gouraud and Phong shading models. Curves: parametric cubic curves, He rmite, Bezier and B-spline curves. 1. Computer Graphics, principles and practice, Fol ey, VanDam, Feiner, Hughes, Addison Wesley. 2. Computer Graphics, Hearn and Baker, PHI 3. Mathematical Elements for Computer Graphics, Dav id F. Rogers, Adams, McGraw Hill. 4. Procedural Elements for Computer Graphics, David F. Rogers, McGraw Hill. DUGC Convener Curriculum committee Convener CST310 3 Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: OS and Security Lab Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : Syllabus UG CSP314 2 This lab shall cater to programming assignments in area of Operating System and Security. Overview of AI, Problems, Problem space and searchi ng techniques, Definition production system, Control strategies, H euristic search techniques. Introduction to AI languages: PROLOG an d LISP. Knowledge representation, Representation, mappings, approaches and issues, Predicate logic, prepositional logic, Resol ution, Procedural and declarative knowledge, forward and backward reasoni ng, Matching, Logic Frames and Semantic Nets etc. Domain Exploration Kn owledge elicitation, conceptualization, methods of knowledge acquisition , formalization Learning and learning systems: Introduction to Hopf ield networks, introduction to neural networks, learning in neural networks, applications of neural networks, Recurrent network. Natural Language Processing, Perceptions and action s. Expert Systems: Introduction, Definition types, Com ponent, development process. Learning Planning and Explanation in Expert Systems . Implementation Tools : Prolog, Study of existing expert systems, M YCIN & AM. 1. Artificial Intelligence: Elaine Rich, Kevin Knig ht, Mc-Graw Hill. 2. Introduction to AI & Expert System: Dan W. Patte rson, PHI. 3. Patterson : Introduction to AI Expert Systems, P HI 4. Jackson : Building Expert Systems, John Wiley DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VI Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Graphics Lab Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Advanced Programming Lab Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : 2DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VI UG CSP318 CSP316 2 This lab shall cater to programming assignments in area of Computer Graphics. Text/Reference material as suggested in “Operating System” and “Computer Graphics” Text/Reference material as suggested in “Operating System” and “Computer and Network Security” DUGC Convener Curriculum committee Convener

B.Tech (Computer Engineering) - Semester VI UG Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Embedded System Design La b Credit: L-T-P: 0-0-3 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman The topics selection covering the latest and releva nt topics related to the emerging areas in “Embedded System” Text/Reference material as suggested in “Embedded S ystems” DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VI UG CSP320 2Programming exercises from the different paradigms mainly include Procedure-oriented Programming, Object-Oriented Pro gramming, Aspect- Oriented Programming, and Functional programming (A I and expert system related assignments) Text/Reference material as suggested in “Object Ori neted Analysis and Design” and “AI and Expert Systems” DUGC Convener Curriculum committee Convener UG/PG Department: Computer Engineering Course Code: Course Name: Seminar Credit: L-T-P: Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Program Elective I Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Program Elective II Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus 3DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VII UG UG 3DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VII B.Tech (Computer Engineering) - Semester VII UG CSS401 3 Books: SUGB Chairman DUGC Convener Curriculum committee Convener UG/PG Department: Computer Engineering Course Code: Course Name: Project Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Advanced Elective Course I Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Advanced Elective Course II Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman DUGC Convener Curriculum committee Convener 3DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VIII UG UG 3DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VIII B.Tech (Computer Engineering) - Semester VIII UG CSD402 3 UG/PG Department: Computer Engineering Course Code: Course Name: Program Elective III Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Program Elective IV Credit: L-T-P: 3-0-0 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VIII UG 33 DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Semester VIII UG UG/PG Department: Computer Engineering Course Code: Course Name: Wireless Communications Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: VHDL Credit: L-T-P: 3-0-2 Version: Approved on: UG CST435

4History of wireless communication, and future trend s. Wireless Generations and Standards. Cellular Concept and Cel lular System Fundamentals .Trunking Cell Splitting and Sectoring . Mobile Radio signal propagation, path loss and channel models. Large Sc ale Path Loss. Small Scale Path Loss - Rayleigh and Rician Fading. Analog Modulation Schemes for Wirele ss Communication - AM/FM. Digital Modulation Techniques for Wireless C ommunication Preliminaries. Baseband Modulation Schemes Bandpass Modulation Techniques. Fading Counteraction – Diversity, Codin g and Interleaving. Source and Channel Coding. Speech Coding for Wirele ss Communications. Adaptive Equalization. Multipath Pr opagation, Doppler. Multiplexing and Multiple Access techniques. TDMA, FDMA , ALOHA - Packet Radio, Spread Spectrum-CDMA ,Frequency Hoppe d Spread Spectrum, Inter-Symbol Interference (ISI), ISI miti gation; Equalization, Random Access Protocols. Wireless Networking, Wirel ess Standard. Third generation systems and advanced topics Wideband-CDM A, MCCDMA. OFDM principles: Comparison of OFDM and CDMA. WLAN and Bluetooth 1. Wireless Communications: Principles and Practice , 2nd edition, T. Rappaport, Prentice Hall, 2002 2. K. Pahlavan & P. Krishnamurthy, Principles of Wi reless Networks, Prentice Hall: 3. Wireless Communications Systems, A. Goldsmith, C ambridge. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective B.Tech (Computer Engineering) - Program Elective UG CST433 4 Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Neural Networks Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus CST437 4 Neural Architecture: Neuron model, transfer functio n, hamming and Hopfield network, perceptron, learning rule, recurr ent networks. Back propagation: generalized delta rule, limitatio ns, modifications – momentum, variable learning rate, conjugate gradien t. Learning: Supervised, associative, competitive, uns upervised learning. Unsupervised learning: Self-organizing maps, Adapti ve Resonance Theory. Neural network applications: Pattern classification , function approximation . Peter J. Ashenden ,” The Designer's Guide to VHDL ", published by Morgan Kaufmann” Kaufmann Pub. 1.SS Limaye,” Digital Design with VHDL”, CMR 2.Douglas Parry, “ VHDL Programming by Example”, MG H 3.Xilinx, “ Programmable Logic Design Quick Start H and Book II ed. 4.Xilinx,” A CPLD VHDL Introduction Application Not es” DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG 1. Overview of VHDL, fundamentals of VHDL, Lexical elements Data types and objects 2. Data Flow style: Conditional and selected Concur rent assignment, block assignment If and wait statement, Design for synthe sizability 3. Structural style: Instantiation and component de claration, statement configuration declaration, generate statement, exam ples of structural design 4. Behavioural Style : Signal assignment, statement like case, process and wait loop, exit etc., concurrent signal assignment statements, function and procedures, file I/O operations and Testbenches. Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Speech Recognition Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus 4 Overview of Speech Recognition; What is Speech; Why is it important; Applications and issues. Speech Production; Mechani sm of speech production;

Categories of sounds; Sound units in in dian languages. Nature of Speech Signal; Source-system characteristics; Se gmental and suprasegmental features; Temporal and spectral para meters for sound units in indian languages. Basics of Digital Signal Processing; Signals and systems; Discrete fourier transform; Digital filter ing; Stochastic processes. Speech Signal Processing Methods: Short-time spectr um analysis; Spectrograms; Linear prediction analysis; Cepstrum analysis. Speech Recognition; Isolated word recognition; Connected w ord recognition Continuous Speech Recognition; Speech recognition p roblem; Hidden markov models. Other Applications: Word spotting; S peaker recognition; Speech enhancement; Speech synthesis; Practical iss ues in speech Recognition. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG CST439 1.Simon Haykin: Neural Networks: A Comprehensive Fo undation (2nd Edition) 2.Christopher M. Bishop: Neural Networks for Patter n Recognition 3.James A. Freeman, David M. Skapura: Neural Networ ks, Pearson Education. 4.Martin T. Hagan: Neural Network Design, Thomson L earning. Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Software Project Management Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: Software Project Management Concept: The Management Spectrum, People, Product, Process & Project. Software Proces s & Project Matrix: Software Measurement, Size Oriented Matrices, Funct ion Oriented Matrices. Software Project Planning: Objectives, Decompositio n Techniques and Empirical Estimation Model. Risk Analyses and Manag ement: Risk Identification, Projection, Risk Identification, Pr ojection, Risk Refinement, Risk Monitoring and Management. Project Scheduling & Tracking, Software Quality Ass urance, Software Configuration Management 1.R. S. Pressman, Software Engineering 2.P. Jalote, Software Project Management in Practic e. 3.B. Hughest & M. Cotterell, Software Project Manag ement. B.Tech (Computer Engineering) - Program Elective UG CST441 41. Spoken Language Processing: A Guide to Theory, A lgorithm and System Development by Xuedong Huang, Alex Acero, Hs iao-Wuen Hon, Raj Reddy Prentice Hall PTR; ISBN: 0130226165 2. Speech Communications : Human & Machine by Dougl as O'Shaughnessy, IEEE Press, Hardcover 2nd edition, 1 999; ISBN: 0780334493. 3. Digital Processing of Speech Signals, Rabiner an d Schafer, Prentice Hall, 1978. 4. Fundamentals of Speech Recognition, Rabiner and Juang, Prentice Hall, 1994. 5. Speech and Audio Signal Processing : Processing and Perception of Speech and Music by Nelson Morgan and Ben Gold, Jul y 1999, John Wiley & Sons, ISBN: 0471351547 6. Discrete-Time Speech Signal Processing: Principl es and Practice by Thomas F. Quatieri Publisher: Prentice Hall; ISBN: 013242942X; 1st edition (October 29, 2001) 7. Speech Processing and Synthesis Toolboxes by Don ald G. Childers, John Wiley & Sons, September 1999; ISBN: 0471349593 DUGC Convener Curriculum committee Convener SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Data Compression Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Natural Language Processing UG CST445 Compression: Need, Lossless v/s lossy compression, review of information theory, prefix codes, uniquely decodable code. Lossless Compression:

Huffman coding – minimum vari ance, optimal, non- binary, extended, adaptive. Applications and limita tions of Huffman codes, Run length encoding, Arithmetic coding, Predictive coding – Burrows- Wheeler transform, Delta modulation, Adaptive delta modulation Dictionary based compression - Lempel-Ziv-Welch, LZ 77 and LZ-78 Lossy Compression Techniques – JPEG and its applica tion Error detection and correction: Parity, 1,2,n dimen sions, Hamming codes, p-out-of-q codes Quantization: Scalar and Vector Qu antization. 1. Khalid Sayood, Introduction to Data Compression, Morgan Kauffman 2. Greg A. Harris, Darrel R. Hankerson, Peter D. Jr . Johnson, Introduction to Information Theory and Data Compression, Second Edition, Chapman and Hall. 3. Saloman, Data Compression, Springer Verlag. 4. Nelson, The Data Compression book, Hungry Minds DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective B.Tech (Computer Engineering) - Program Elective UG CST443 4DUGC Convener Curriculum committee Convener Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Wireless & Ad-hoc Networks Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : CST447 41. Allen James, Natural Language Understanding, Sec ond Edition, Benjamin/Cumming, 1995. Grosz, Sparck-Jones Webber 2. Readings in Natural Lnaguage Processing, Morgan Kaufmann, 1986. Winograd T. 3. Language as a Cognitive Process, Addison Wesley, 1972. Marcus M. 4. A Theory of Synactic Recognition for Natural Lan guage, MIT Press, 1980. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG 4 Introduction; Goals of Natural Language Processing and Computational Linguistics. Finite State Automata and Transducers, Morphology. Parsing: Context Free Grammars, Generalized Phrase Structure Grammar, Earley Parsing ALgorithm. Transformational Grammar, Comput ational Models and Knowledge Representation. Semantics; Interpretation , time, tense and lexical semantics. Machine Translation, Natural Lan guage Interfaces, Natural Language Generation. Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Real Time Systems Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : 4DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG CST449 Fundamentals of Wireless Communication Technology T he Electromagnetic Spectrum – Radio Propagation Mechan isms Characteristics of the Wireless Channel - IEEE 802. 11a,b Standard Origin Of Ad hoc: Packet Radio Networks , Technical Challe nges, Driving Applications, Components of Packet Radios What Is a n Ad Hoc Network? Types of Ad hoc Mobile Communications. Key definiti ons of ad-hoc, Advantages of ad-hoc/sensor networks, Unique constr aints and challenges, Driving Applications, Media Access Cont rol (MAC) Protocols, Issues in designing MAC protocols, Classifications of MAC protocols, MAC protocols Routing Protocol: Global State Routing (G SR), Dynamic State Routing (DSR), Fisheye State Routing (FSR), Ad hoc On-Demand Distance Vector (AODV), Destination Sequenced Dista nce – Vector Routing (DSDV). Transport Layer, Security Protocols :Introduction Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks - Design Goals of a Transport Layer Protocol for Ad H oc Wireless Networks - Classification of Transport Layer Solutions, securi ty in Ad Hoc Wireless Networks –

Network Security Requirements - Issues a nd Challenges in Security Provisioning -Network Security Attacks. 1. C. Siva Ram Murthy and B.S. Manoj “Ad Hoc Wirele ss Networks: 2. C.K. Toh, Ad Hoc Mobile Wireless Networks: Proto cols and Systems, Prentice Hall PTR ,2001 Charles E. Perkins, Ad Hoc Networking, Addison Wesley, 2000 3. Wireless Communications: Principles and Practice , 2nd edition, T. Rappaport, Prentice Hall, 2002 4. K. Pahlavan & P. Krishnamurthy, Principles of Wi reless Networks, Prentice Hall Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Cryptography Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : B.Tech (Computer Engineering) - Program Elective UG CST451 4Introduction to Real-time systems, Issues in Real-t ime Systems, Real-time System Components, Classification of Real-time syst ems and Real-time tasks. Misconceptions about Real-time computing. Re al-time System requirements: Speed, Predictability, reliability, a daptability. Specification of timing constraints. Real-time scheduling: Requirements and Issues, Term inology, modeling, Introduction static and dynamic scheduling schemes, cyclic scheduling, priority driven scheduling of periodic tasks, sched ulability tests, Aperiodic task scheduling: fixed priority server/non-server b ased scheduling algorithms. Practical factors/overheads. Task Synchronization: Need and priority inversion p roblem, Priority Inheritance protocol, priority ceiling protocol and stack-based priority ceiling protocol for fixed priority preemptive system. Intr oduction to multiprocessor real-time systems, problems and issues. An overview of a real-time operating system 1. J.W.S.Liu: Real-Time Systems, Pearson Education Asia 2. S.T.Lavi, A.K.Agrawala: Real-time system Design, McGraw Hill 3. P.A.Laplante: Real-time Systems Design and Analy sis, An Engineer’s Handbook, IEEE Press 4. P.D.Laurence, K.Mauch: Real-time Microcomputer S ystem Design, An Introduction, McGraw Hill DUGC Convener Curriculum committee Convener Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: VLSI Algorithms Credit: L-T-P: 3-0-2 Version: Approved on: B.Tech (Computer Engineering) - Program Elective UG CST453 4Review of Number theory: Prime numbers, modular ari thmetic, Fermat’s theorem, Euler’s theorem, Chinese remainder theorem, Discrete logarithms, Ran dom number generation, factoring, prime number generation. Cryptography: Need, conventional techniques, stream ciphers, block cipher, steganography. Public v/s private key crypt ography. Stream Ciphers: Caesar Cipher, mono-alphabetic and poly-alphabetic ciphers, Playfair Cipher, Hill Cipher, Rotor machin es, One time pad,. Random Number Generation: Pseudo Random Number, PRN G, LFSR, Blum-Blum Shub generator Private-key cryptography: Feistel structure, DES (Data encryption standard), design of S-boxes, AES, Triple DES. Public key cryptography: Key management, Key exchan ge – Diffie- Hellman, El-Gamal, Merkle's Puzzle, Authentication, Signatures, Deniability, RSA. Threshold Cryprography: Sharing Secrets. Digital Signature: DSA and its variants, discrete l ogarithm based digital signatures. One-way hash functions – MD5, SHA (Secure Hash Algo rithm). Cryptanalysis: Differential and linear cryptanalysi s - cracking DES. 1. Stallings, Cryptography and Network Security: Pr inciples and Practice, Pearson Education Asia. ISBN 981-403-589-0. 2. B Schneier, Applied Cryptography, Wiley. ISBN 0-471-11709-9 3. D Kahn. The Codebreakers, Sphere books. ISBN 0-7 221-51497 4. P

Wayner, Disappearing Cryptography, Academic Pr ess. ISBN 0-12- 738671-8 5. Cracking DES, Electronic Frontier Foundation. IS BN 1-56592-520-3 6. A.J. Menezes, P.C. van Oorschot and S.A. Vanston e, Applied Cryptography, CRC Press, ISBN 0-8493-8523-7, 1997 7. D.R. Stinson, Cryptography - Theory and practice , CRC Press, ISBN 0- 8493-8521-0, 1995 DUGC Convener Curriculum committee Convener Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Digital Image Processing Credit: L-T-P: 3-0-2 UG CST455 41. Introduction of VLSI Technology, VLSI design cyc le, design styles, basic Layout rules and circuit abstraction, introduction to standard Cell, Gate array, FPGA 2. Overview of basic graph algorithms, Graph algori thms for physical Design 3. Partitioning: Classification of partitioning alg orithms, Karnighan-Lin Algorithm, FM Algorithm, Ratio cut algorithm 4. Floor-planning: Rectangular dual graph approach of floor-planning, hierarchical tree based approach, Integer programmi ng based floor- planning. 5. Placement: placement by simulated annealing and force directed method 6. Routing: classification of routing algorithms, G lobal routing: Maze routing algorithms, line probe algorithms, Steiner tree bas ed algorithms, Detailed Routing: Single layer and two layer routing algorit hms, routing in FPGAs 1. Naveed Shervawani, " Algorithms for VLSI physica l Design Automation " III Ed Springer 2. Sarrafzadeh and Wong " An introduction to VLSI P hysical design " MGH 3. Sze: VLSI Technology 4. Weste and Eshranghan, " Introduction toVLSI Desi gn". Pearson Edu. 5. Sadiq M. Sait, Habib Youssef, "VLSI Physical Des ign Automation: Theory and Practice", World Scientific Publishing C ompany; 0. Cormen Leiserson, Rivest, " Introduction to Algo rithms", Pearson Edu. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Evolving Architectures Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus CST457 4 Special, and emerging advanced topics in different areas of Computer Engineering will be covered under this course. 1.Gonzalez and Woods. Digital Image Processing, Add ison Wesley. 2.Castleman. Digital Image Processing. Prentice Hal l. 3.Duda and Hart. Pattern Classification. John Wiley . DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG Digital Image Fundamentals: Image Model, Sampling, Quantization, Neighborhood, connectivity of pixels, Labelling of connected components, Distance measures Image Transforms: Fourier Transform, Discrete Fouri er Transform, Properties of 2D Discrete Fourier Transform, The fa st Fourier Transform and its algorithm, number of operations, the invers e FFT. Discrete Cosine Transform and its applications, KL Transform, Convo lution and correlation Image Enhancement: Enhancement by point processing, spatial filtering, enhancement in frequency domain, generation of spat ial masks from frequency domain specifications Image Segmentation: Detection of discontinuities, e dge linking and boundary detection, thresholding, region oriented s egmentation Representation and Description: Representation sche mes, boundary descriptors, regional descriptors. Morphology: Dila tion, erosion, opening, closing, Hit-or-Miss Transform, some basic morpholo gical algorithms like pruning, thinning and thickening Books: SUGB Chairman UG/PG

Department: Computer Engineering Course Code: Course Name: Topics in Computing Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman 4 Autonomic and Fault Tolerant Computing: Fault Toler ance Strategies - Fault detection, masking, containment, location, re configuration, self-repairing, self-healing and recovery. Fault Toleran t Design Techniques - Hardware redundancy, software, redundancy, time red undancy, and information redundancy. Parallel and Distributed Computing: Concepts and is sues in parallel and distributed computing. Concepts and issues in quant um computing, Trusted Computing, Grid Computing, Multi-core and G PGPU computing Introduction to Cloud computing Any other contemporary and relevant issues. 1. P. Jalote, Fault Tolerance in Distributed System s, Prentice-Hall Inc., 1994 2. D. K. Pradhan (editor), Fault-Tolerant Computing , Theory and Techniques, Prentice-Hall, 1998. 3. Los Alamitos, CA, "Fault-tolerant Software Syste ms: Techniques and Applications", IEEE Computer Society Press, 1992. 4. Design and Analysis of Fault Tolerant Digital Sy stems, Barry W. Johnson, Addison Wesley, 1989 (Chapters 1-5). 5. A.K. Somani and N.H. Vaidya, ■Understanding fault-tolerance and reliability," IEEE Computer, vol.30, no.4, pp.45-50 , Apr. 1997. 6. Research papers and internet resources. DUGC Convener Curriculum committee Convener DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG CST459 .1. Research reports and papers from journals UG/PG Department: Computer Engineering Course Code: Course Name: Machine Learning Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Introduction: Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. Ind uctive Classification: The concept learning task. Concept learning as sear ch through a hypothesis space. General-to-specific ordering of h ypotheses. Finding maximally specific hypotheses. Version spaces and t he candidate elimination algorithm. Learning conjunctive concept s. The importance of inductive bias.Decision Tree Learning: Representing concepts as decision trees. Recursive induction of decision trees. Overf itting, noisy data, and pruning.Ensemble Learning Using committees of multi ple hypotheses. Bagging, boosting, and DECORATE. Active learning wi th ensembles.Experimental Evaluation of Learning Algor ithms: Measuring the accuracy of learned hypotheses. Comparing learn ing algorithms: cross- validation, learning curves, and statistical hypoth esis testing. Rule Learning: Propositional and First-Order: Translatin g decision trees into rules. Heuristic rule induction using separate and conquer and information gain. First-order Horn-clause induction (Inductive Logic Programming) and Foil. Learning recursive rules. Inverse resolution. Artificial Neural Networks: Neurons and biological motivation. Linear threshold units. Perceptrons: representational limi tation and gradient descent training. Multilayer networks and back prop agation. Hidden layers and constructing intermediate, distributed represen tations. Overfitting, learning network structure, recurrent networks. Bayesian Learning: Probability theory and Bayes rul e. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Marko v nets for representing dependencies.Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific e xamples. k-Nearest- neighbor algorithm. Case-based learning. B.Tech (Computer Engineering) - Program Elective UG CST461 4 Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Modelling and Simulation Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite : Course B.Tech (Computer Engineering) - Program Elective UG CST463 41. Bishop, C. (2006) Mitchell, T. M. (1997) Machine Learning. McGraw-Hill 2. Pattern Recognition and Machine Learning. Berlin : Springer-Verlag. 3. Richard O. Duda, Peter E. Hart and David G. Stor k. Pattern Classi_cation. Wiley-Interscience,second edition, 2 001. 4. Thomas Mitchell. Machine Learning. McGraw Hill H igher Education, First edition, 1997. 5. Stuart Russell and Peter Norvig. Articial Intell igence: A Modern Approach. Prentice Hall,second edition, 2003. (Mach ine-learning related chapters.) 0. Information Theory, Inference and Learning Algor ithms by David MacKay. DUGC Convener Curriculum committee Convener Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Programming in Java Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : UG CST431 4Analytical v/s simulation modeling, performance mea surement and benchmarking, Workload modeling, random variables, commonly used distributions, Stochastic Processes, Performance ev aluation methods, Evaluation Metrics' Markov chains, Birth and Death Processes, Markov ch ain models of Computer systems, Steady-state and transient analys is Queuing models, M/M systems and their steady state analysis, Single server and multi-server queues, open and closed que uing networks Petri Net based Performance Modeling : Classical Pe tri Nets, Timed Petri Nets, Discrete Petri Nets, Modeling multiprocessor systems Discrete event simulation – Simulation languages, r andom number generation and testing, model verification and vali dation, analysis of simulation results, confidence intervals, variance reduction techniques, Case studies of analytical and simulation studies o f computer systems 1. Law and Kelton, Simulation Modeling and Analysis , Mcgraw Hill 2. Raj Jain, The Art of Computer System Performance Analysis, John Wiley 3. K.S.Trivedi, Probability and Statistics with Rel iability, Queuing and Computer Science Applications, PHI 4. Kant, Introduction to Computer System Performanc e Evaluation, Mcgraw Hill DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Python Programming Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : CST465 44.Herbert Schildt: JAVA 2 - The Complete Reference, TMH, Delhi 5.U.K. Chakraborty and D.G. Dastidar: Software and Systems - An Introduction, Wheeler Publishing, Delhi. 6.Joseph O'Neil and Herb Schildt: Teach Yourself JA VA, TMH, Delhi. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG Introduction: Internet, Java as a tool for interne t applications, Byte Code and its advantages. Object Oriented Programming and Design: Review of A bstraction, Objects and other basics, Encapsulation, Information hiding , Method, Signature, Classes and Instances, Polymorphism, Inheritance, E xceptions and Exception Handling with reference to object modelin g, Coupling and Cohesion in object oriented software. Object Orient ed Design – Process, Exploration and Analysis. Java Programming Basics: Fundamentals: Variables an d assignments, Input and Output, Data Types and Expressions, Flow of control, Local variables, Overloading Parameter passing, this poin ter, Java Object Oriented Concepts: Objects and Classes: Use of file for I/O, Formatting output with stream functions, Character I/O, Inheritance, Public and private members, Constructors for initializatio ns, Derived classes, Flow of Control Java Data Structures and Advanced Topics Arrays – Programming with arrays, arrays of classes , arrays as function arguments, Strings, Multidimensional arrays, Arrays of strings, vectors, Base classes. Introduction to Java Applets Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Multimedia Technology Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus 4 Introduction to Multimedia, Graphics and Image data representations, Color in image and video CIE, RGB, CMY, HSL color m odels Fundamental concepts in video, NTSC, PAL and Digita l video Compression methods: Lossy and Loss less compressio n techniques.: Huffman coding, Arithmetic coding, LZW Image compression standards: DCT Transform and Four ier transforms, JPEG coding Video representation and compression te chniques Motion vector search: sequential, 2D logarithmic se arch. I, P and B frames, MPEG Video coding, MPEG-1, MPEG- 2 and MPEG-3: video coding and decoding Basic Audio compression: Fletcher- Munson curves, Critical Bands, Psychoacoustic phenomenon, MPEG Layer 3 (MP3) Audio DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG CST467 Introduction to Python: Data types, variables, expr essions, operators. Sequence, set, dictionary, print statement, control -flow statements, functions. Objects and classes, metaclasses. Decorators, speci al methods. Exception handling. Modules sys, os, etc. Strings a nd regular expressions. File operations. Working with processes and threads. Pipes and signa ls Graphical user interface design in Python (includin g the Tkinter module), Widgets and basic components, Layout options, Event handling Network scripting (sockets, FTP, and e-mail clients), Server-side scripting Databases and persistence in Python (including pick led objects and shelf files) Custom and built-in data structures in Python C integration with Python (including the SWIG modul e), Embedding Python calls within C 1. Programming Python by Mark Lutz, O'Reilly. 2. Learning Python, 3rd Edition by Mark Lutz, O'Rei lly 3. Python in a Nutshell by Alex Martelli, O'Reilly. 4. An Introduction to Python by Guido van Rossum an d Jr. Fred L. Drake, Network Theory Ltd. Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Computer Human Interaction Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: GUI Programming Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : B.Tech (Computer Engineering) - Program Elective UG CST471 4Human factors issues in the development of software , use of database systems, and design of user interfaces for interact ive systems. Science base (theories, models, usability studies, and cont rolled experimentation), and software engineering with user interface develo pment environments. Issues include: command languages, menus, forms, an d direct manipulation, graphical user interfaces, computer s upported cooperative work, information search and visualization, World W ide Web design, input/output devices, and display design. 1. B. Shneiderman, Designing the User Interface, 3r d Edition, Addison- Wesley, (1998) 2. Interaction Design by Jenny Preece, Yvonne Roger s, and

Helen Sharp. John Wiley & Sons: New York, 2002. ISBN: 0471492787 . 3. User Centered Web Site Design, by D.D. McCracken and R.J. Wolfe. Pearson Prentice Hall: Upper Saddle River, NJ, 2004 . ISBN: 013041161-2. 4. The Web Wizard's guide to Web Design, J.G. Lenge l, Addison-Wesley, 2002. ISBN: 0201745623. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG CST469 41. J H McClellan, R W Schafer & M A Yoder, DSP Firs t: a Multimedia Approach, Prentice-Hall International 1998 DUGC Convener Curriculum committee Convener Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Wireless and Mobile Computing Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus UG CST473 4 Wireless communication fundamentals: Introduction, wireless transmission, frequencies for radio transmission,si gnals, antennas, signal propagation, multiplexing, modulations, spread spec trum, MAC, SDMA, FDMA, TDMA, CDMA, cellular wireless networks. Telecommunication networks: Telecommunication syste ms :GSM,GPRS, DECT, UMTS, IMT-2000, Satellite networks - basics – parameters and configurations – capacity allocation: FAMA and DAMA . Wirless LAN: IEEE-802.11, architecture, services, MAC, physical laye r, IEEE 802.11a, 802.11b standards, HIPERLAN, BLUE TOOTH. Mobile network layer: mobile ip, dynamic host confi guration protocol,routing,DSDV,DSR . Transport and applicati on layers : traditional TCP, classical TCP improvements – WAP, WAP 2.0. Issues and Challenges in GUI design. Overview of in telligent interface design. Graphics versus web interface. Principles o f good interface. System Menu and Navigation schemes. Interaction dev ices. Screen based controls. Usability, testing, design for web, human s. Colors. 1. Wilbert O. Galitz. The Essential Guide to User Interface Design. Wiley. 2. Susan Weinschenk, Pamela Jamar, Sarah C. Yeo. G UI Design Essentials (Paperback) 3. Jenifer Tidwell. Designing Interfaces: Patterns for Effective Interaction Design, O’Reilly. 4. B. Shneiderman, Designing the User Interface, 3 rd Edition, Addison- Wesley. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Implementation of Data Bases Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman DUGC Convener Curriculum committee Convener CST479 4 Issues in Implementation of Centralized Database Sy stems - Query Processing, Query Optimization, Transaction Process ing, Concurrency, Recovery Management. Database System Architectures – Centralized and Cli ent-Server architecture, Parallel Systems, Distributed Databas e Systems. Implementation of Distributed Database Systems- Dis tributed Data Storage, Distributed Transactions, Concurrency cont rol in Distributed Database Systems, Distributed Query Processing. 1. Silberschatz A, Korth HF, Sudarshan S, Database System Concepts, McGrall Hill. 2. Elmasri R and Navathe SB, Fundamentals of Datab ase Systems, 3rd Edition, Addison Wesley,2000. 3. Ceri S, Pelagatti G, Distributed Databases – Pri nciples and Systems, McGraw Hill. 1. Jochen Schiller, “Mobile Communications”, PHI/Pe arson Education, Second Edition, 2003. 2. William Stallings, “Wireless Communications and Networks”, PHI/Pearson Education, 2002. 3. Kaveh Pahlavan, Prasanth Krishnamoorthy, “Princi ples of Wireless Networks”, PHI/Pearson Education, 2003. 4.

Uwe Hansmann, Lothar Merk, Martin S. Nicklons an d Thomas Stober, “Principles of Mobile Computing”, Springer, New Yor k, 2003. 5. Hazysztof Wesolowshi, “Mobile Communication Syst ems”, John Wiley and Sons Ltd, 2002 DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG UG/PG Department: Computer Engineering Course Code: Course Name: Information Retrieval Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Digital Watermarking Credit: L-T-P: 3-0-2 Version: Approved on: B.Tech (Computer Engineering) - Program Elective UG CST483 44 INTRODUCTION- Information storage and retrieval sys tems, Data Structures and Algorithms Related to Information Re trieval RETRIEVAL STRATEGIES - Vector Space Model, Probabil istic Retrieval Strategies, Language Models, Inference Network, Ext ended Boolean retrieval, Latent Semantic Indexing RETRIEVAL UTILITIES - Relevance Feedback , Clusteri ng, Passage- Based Retrieval, N-grams, Regression Analysis, Thes auri, Stemming, Semantic Networks, Parsing, Ranking EFFICIENCY- Inverted Index, Query Processing, Signa ture Files, Duplicate Document Detection INTEGRATING STRUCTURED DATA AND TEXT - Review of the Relation Model, A Historic Pro gression, Information Retrieval as a Relational Application, Semi-Structu red Search using a Relational Schema, Multi-dimensional Data Model 1. Information Retrieval Data Structures & Algorith ms by William B. Frakes, Ricardo Baeza-Yates 2. Information retrieval- by D A Grossman , Ophir F rieder, Springer International Edition DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG CST481 Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Multi-Core Architectures Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman Multiple core programming models. GPGPU programming and streaming data processing. Issues related with coherency, lan guages and communication overheads in multi-core programming Art of Multiprocessor Programming: Nir Shavit, Else vier DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Program Elective UG CST475 4Watermarking: Applications, technqiues, models, det ection techniques. Visible and invisible watermarks. Embedding. Robust watermarking, watermark security. Steganography – Least Bit, DCT, Spread spectrum. Au dio seganography. Steganalysis techniques. 1. Ingemar Cox, Matthew Miller, Jeffrey Bloom, and Jessica Fridrich . Digital Watermarking and Steganography, 2nd Ed, (Th e Morgan Kaufmann Series in Multimedia Information and Syste ms). 2. Frank Y. Shih. Digital Watermarking and Stegano graphy: Fundamentals and Techniques, CRC Press. 3. Stefan Katzenbeisser, Fabien, and A.P. Petitcol as. Information Hiding Techniques for Steganography and Digital Watermarki ng, Artech House. 4. Neil F. Johnson; Zoran Duric; Sushil Jajodia. I nformation Hiding: Steganography and Watermarking - Attacks and Counte rmeasures, Springer. 5. Gregory Kipper. Investigator's Guide to Steganog raphy, Auerbach Publications. DUGC Convener Curriculum committee Convener UG/PG Department: Computer Engineering Course Code: Course Name: Distributed Systems Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus

Books: SUGB Chairman 1. Distributed Systems: Concepts and Design, 4rd e d by Coulouris, G, Dollimore, J., and Kindberg, T., Addison-Wesley, 20 06. ISBN: 0321263545 2. Distributed Systems: Principles and Paradigms, 2nd ed by Tanenbaum, A. and van Steen, M., Prentice Hall, 200 7. ISBN: 0132392275. DUGC Convener Curriculum committee Convener UG CST477 4 Introduction to distributed system: characteristics . Advantages, Disadvantages. Design goals. Issues, Models of dist ributed systems. Communication in Distributed Systems: Message passi ng, client/server model. Remote Procedure Call. Group Communication. Time in distributed systems. Logical clocks. Vector clocks. Causal ordering of messages. Global state and state recording. Distributed Mutual Exclusion: Non-token based algo rithms. Token based algorithms. Distributed elections. Transaction and concurrency control, Nested transactions, Locks, Timestamp ordering. Con currency control in distributed transactions, Distributed deadlocks. Tr ansaction recovery Replication: Motivation, Consistency and ordering. Total and causal ordering. Update protocols and voting; Distributed File Systems: Recovery and Fault Tolerance: Transaction recovery. Checkpointing and recovery. Fault tolerance in distributed systems. H ardware and software redundancy. Byzantine agreement. B.Tech (Computer Engineering) - Program Elective UG/PG Department: Computer Engineering Course Code: Course Name: Topics in Data Structures and Algorithms Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman RAM model – Notations, Recurrence analysis - Maste r's theorem and its proof - Amortized analysis - Advanced Data Structur es: B-Trees, Binomial Heaps, Fibonacci Heaps, AVL trees, Red-black trees , B-trees, Splay trees. Disjoint set – union and path compression, Amortize d analysis Recurrence equations. Time and space complexity, NP , NPC and NP-Hard problems, undecidability. Convex hull and Voronoi diagrams, line segments, Op timal polygon triangulation. Primality testing, Integer factorization, Randomize d algorithms, Probabilistic algorithms. Dynamic programming: Longest common subsequence. Ch ain of matrix multiplication, Approximate Algorithms: Vertex-cover, set-covering problems, Travelling Salesman problem. Combinatorial algorithms, Randomized algorithms: Use of probabilistic inequal ities in analysis, applications using examples. Graph algorithms: Matc hing and Flows. Parallel algorithms: Basic techniques for sorting, seraching, merging.. Complexity classes - NP-Hard and NP-complete Proble ms - Cook's theorem NP completeness reductions. 1) Cormen, Leiserson, Rivest: Introduction to Algor ithms, PHI. 2) Horowitz and Sahani: Fundamental of Computer alg orithms. 3) Aho, Ulman: Design and analysis of Algorithms, A ddison Wesley 4) Brassard : Fundamental of Algorithmics, PHI. 5) Sara Baase: Computer Algorithms, Pearson Educati on. 6) Papadimitriou, Steiglitz: Combinatorial Optimiza tion: Algorithms and Complexity, PHI. 7) Motwani: Randomized Algorithms, Cambridge Univer sity Press 8) Joseph Ja'Ja': Introduction to Parallel Algorit hms, Addison-Wesley 9) Vaizirani: Approximation Algorithms, Springer Ve rlag 10) N. Deo: Graph Theory with Application to Engine ering and Computer Science, PHI. 11) N. Deo: Combinatorial Algorithms: Theory and Pr actice, PHI. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST432 4 UG/PG Department: Computer Engineering Course Code: Course Name: Parallel and Distributed

Computing Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman 1) Quinn, Parallel computing – theory and practice, Tata McGraw Hill. 2) Sima and Fountain, Advanced Computer Architectur es, Pearson Education. 3) Mehdi R. Zargham, Computer Architectures single and parallel systems, PHI. 4) Ghosh, Moona and Gupta, Foundations of parallel processing, Narosa publishing. 5) Ed. Afonso Ferreira and Jose' D. P. Rolin, Paral lel Algorithms for irregular problems - State of the art, Kluwer Acade mic Publishers. 6) Selim G. Akl, The Design and Analysis of Paralle l Algorithms, PH International. DUGC Convener Curriculum committee Convener UG CST434 4 Introduction to parallel computing. Parallel proces sing terminology, Pipelining Vs Data parallelism, Control parallelism , Scalability, Control parallel approach, Data parallel approach, Data par allel approach with I/O Parallel reduction, Prefix sums, List ranking, Preo rder tree traversal, Merging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAM S Thread and process level parallel architectures: MI MD, multi-threaded architectures. Distributed and shared memory MIMD a rchitectures. Dynamic interconnection networks. Mapping and scheduling: Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multi computers, Static scheduling on UMA multiprocessors, Deadlock. Parallel programming and parallel algorithms: Progr amming models, parallel programming on multiprocessors and multico mputers. Parallel algorithm structure, analyzing parallel algorithm. Elementary parallel algorithms, Matrix algorithms, sorting, Graph algor ithms. B.Tech (Computer Engineering) - Advanced Elective C ourse UG/PG Department: Computer Engineering Course Code: Course Name: Selected Topics in Operating System Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Advanced Topics in Computer Graphics Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : 4DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST438 CST436 4 Introduction: Goals, Functions, Design issues of Di stributed OS, Distributed v/s network operating system. Communication: Client Server, RPC Distributed OS: Issues, process management, inter-p rocess communication, scheduling, deadlocks Design and implementation of distributed file syste ms, distributed shared memory Security: Concepts and Distributed Systems Distributed Concurrency, Transactions. Case study: Unix, Amoeba. 1) Tanenbaum: Distributed Operating Systems, Pearso n Education. 2) Bach, Design of Unix O/S. 3) Coulouris et al, Distributed Systems: Concepts a nd Design, Addison Wesley. 4) Mullender: Distributed Systems, Addison Wesley. 5) Tanenbaum and Steen: Distributed Systems: Princi ples and Paradigms, Pearson Education B.Tech (Computer Engineering) - Advanced Elective C ourse UG Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Advanced Topics in Databases Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Issues in Implementation of Database Systems, Query Processing, Query Optimization, Transaction Processing, Concurrency, Recovery Management. Database System Architectures, Distribu ted Databases, Distributed Transactions, Distributed Query Process ing, Parallel Databases, Times in Databases, Multimedia

DatabasesB.Tech (Computer Engineering) - Advanced Elective C ourse UG CST440 4Visibility: Polygon Meshes, Depth Sorting. Triangle decomposition, Geometric Sort, Warnock's Methods Hidden Lines and Surfaces: Special cases, Surfaces defined by a function y=f(x,y), Grid surfaces, visible surface determinat ion . Colour in Computer Graphics: Color Vision, Measurin g Color, Color Models, Color output, color usage. Object Lighting and Shading: Illumination and shadi ng models, Local reflection models, shading surfaces, Texture and tr ansparency, Forward & backward Ray-tracing Global Illumination and classical radiosity. Modeling natural phenomena: Fractals and chaos. Animation Techniques: Position, speed or orientatio n. Animation by hierarchic control, scenario-based systems, movemen t control. Shadows, Morphing, Texture mapping 1) J. Foley et al : Computer Graphics-Principles an d Practice, Addison Wesley. 2) Alan Watt- 3D Computer Graphics. 3) A. Watt, M. Watt: Advanced Animation & Rendering Techniques, Addison-Wesley. 4) D. Rogers and Adams: Mathematical Elements of Co mputer Graphics, Mc Graw Hill. 5) Thomas Moller: Real-time Rendering, Eric Haines, A.K Peters Ltd DUGC Convener Curriculum committee Convener Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Network Performance Modeling Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Software Testing and Validation Credit: L-T-P: 0-0-3 Version: Approved on: UG CST444 2Networking as resource sharing: current practices, Traffic Multiplexing, Traffic analysis, Stochastic Traffic Models, Multip le Access: Wireless Networks. Routing: Virtual path routing and Elasti c Aggregates, Routing of Stream Type sessions, Routing in Ad-hoc and Sensor Networks. Introduction to High Performance Switching and Rout ing. QoS and Modeling issues of the Networks. 1) Communication Networking: An Analytical Approach , Anurag Kumar, D.Manjunath, Joy Kuri, Elsevier 2) High Performance Communication Networks, Jean Wa lrand, P.Vaiya, Elsevier 3) Selected papers and online references. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST442 41) Silberschatz A, Korth HF, Sudarshan S, Database System Concepts, McGrall Hill. 2) Elmasri R and Navathe SB, Fundamentals of Databa se Systems, 3rd Edition, Addison Wesley,2000. This book covers most of the material on the course. 3) Ceri S, Pelagatti G, Distributed Databases – Pri nciples and Systems, McGraw Hill. 4) Date CJ, An Introduction to Database Systems, 7t h Edition, Addison Wesley. 5) Khashafian S and Baker AB, Multimedia and Imagin g Databases, Morgan Kaufmann. DUGC Convener Curriculum committee Convener Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Topics in SOC Design Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST446 4 Methodologies and design flows of front end and bac k end designs. Introduction to intellectual property core types an d their design issues. Integration issues of IPs on SOC designs. Low power design issues and methodologies. Testing standards and architecture o f SOCs. 1)

Farzad Nekoogar , F.Nekooqar,From ASICs to SOCs: A Practical Approach, Pearson. 2) Steve B. Furber, ARM System-on-Chip Architecture (2nd Edition), AWL 3) Recent papers from conferences and journals. 1) Selected papers and online references. . DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG Basic software testing principles – Software Qualit y, Software testing and test management. Acceptance Testing: User acceptance testing, alpha and beta testing. Functional and Non-functional system testing Static and dynamic testing, Black-box or functional testing, structural, white box or glass box testing. Integration testing, component testing. Software testing tools. Software Validation: Issues and Challenges. Course Code: Course Name: Advances in Compiler Design Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Wireless Sensor Networks Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Wireless Sensor Networks: Introduction, Overview an d Applications. Sensor node – Design issues, power consumption, ope rating environment, sensor examples. Architecture - Single node, Network, Single hop v/s multi-hop, Performance metrics, QoS Wireless communication – Fundamentals, spread spect rum techniques, CDMA Protocols – Physical layer, MAC, link layer, Routin g, middleware. Network management, Topology, operating system. Security in sensor networks. Open issues and Chanllenges. B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST450 44 A Tour of Compiler Design, LR Parsers, Lex and Yacc Tools, Control-flow Analysis, Control-flow Graphs, Basic Blocks, Data-f low Analysis, Dependence Analysis, Global Optimizations, Loop Opt imizations, Peephole Optimization and Optimal Code Generation, Data Depe ndence Analysis in Loops, Loop Scheduling, Static Single Assignment, Just-In-Time (JIT) and Adaptive Compilation, Runtime System Architectures and Automatic Memory Management Techniques. 1) Aho, Alfred V., Sethi, Ravi, Ullman, Jeffrey D., Compilers: Principles, Techniques and Tools, Addison-Wesley. 2) Steven Muchnick, Advanced Compiler Design & Impl ementation, Morgan Kaufmann. 3) Keith Cooper and Linda Torczon, Engineering a Co mpiler, Morgan Kaufmann. DUGC Convener Curriculum committee Convener CST448 Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Digital Image Analysis Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Data Mining and Data Warehousing Credit: L-T-P: 3-0-2 UG CST454 4Digital Image Fundamentals, Point operations. Smoothing, Sharpening, Crispening, Image Enhancemen t in Spatial Domain, Image Enhancement in Frequency Domain Image Transforms: Hotelling, Hit and Miss transform . Color Image Processing, Multiview Image Processing, Epipolar geometry Image Warping and Restoration. Image Segmentation, Representation and Description Morphological Operators, Erosion, Dilation, Medial Axis, Thining, Skeleton. Image Matching and Classification 1) Rafael C Gonzalez, Richard E Woods, Digital Imag e Processing, Addison-Wesley. 2) Milan Sonka, Vaclav Hlavac, Roger Boyale, Image Processing, Analysis and Machine Vision: PWS Publishing (ITP-Internation al Thomson Publishing). 3) Anil K Jain: Fundamentals of Digital Image Proce ssing, Printice Hall of India (PHI). DUGC

Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST452 41) Holger Karl, Andreas Willig. Protocols and Archi tectures for Wireless Sensor Networks, Wiley Interscience. 2) Kazem Sohraby, Daniel Minoli, and Taieb Znati: W ireless Sensor Networks: Technology, Protocols, and Applications, Wiley Interscience. 3) Selected papers and online reference material. DUGC Convener Curriculum committee Convener Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Topics in High Speed Networking Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus CST456 4 Overview of Internet Technologies, Issues in next g eneration Internet - Routing, Multicasting, Packet Scheduling, Quality o f Service etc. Admission control in Internet: Effective bandwidth, Different iated services, Policy- based networking, Real time communications over Int ernet, Internet telephony, Voice over IP, Integrated services. Web QoS, Intelligent caching, Traffic measurement and characterization. 1) Data Warehousing in the Real World – Anahory and Murray, Pearson Education. 2) Data Mining – Concepts and Techniques – Jiawai H an and Micheline Kamber. 3) Building the Data Warehouse – WH Inmon, Wiley. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG Introduction to Decision Support Systems, Data Ware house and Online Analytical Processing. Data Warehouse Architecture: System Processes, Process Architecture: Load Warehouse, Query, Detail ed and Summarized Information. Design: Data Base Schema Facts, Dimensions and Attr ibutes. Data Base and Metadata. Data Mining : Introduction and need, Descriptive an d Predicative Data Mining. Data Processing : Data Cleaning, Data Integration a nd Transformation, Data Reduction. Data Mining Primitives:, Language DMQL and its Prel iminary Clauses. Data Mining Methods: Association – Single and Multi level, Characterization and Comparison, Regression Analysis, Classification and Predication. Data Mining Algorithms: Clustering, Association, Re gression, Decision Trees. Application and Trends in Data Mining. Data Warehou se Implementation. Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: e-Commerce Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman B.Tech (Computer Engineering) - Advanced Elective C ourse 4 Introduction and concepts: networks and commercial transactions, the Internet environment, online commerce solutions. A generic business model for e-commerce. Security technologies: Introduction to cryptography , key distribution and clarification. Architecture for e-commerce: online commerce enviro nment, servers and commercial environments, strategies, techniques and tools. Electronic payment methods: Secure online transacti on models, digital payment system, cyber cash, digital currencies, Sma rt cash, digital purse, anonymity and authentication. Protocol for the public transport of private inform ation: security protocols, secure socket layer. Open issues: legal and technical issues. 1) Pete Loshin, Paul A Murphy: Electronic e-commerc e, Jaico book. 2) Paul May: The Business of e-commerce, Cambridge University Press. 3) Recent papers from conferences and journals DUGC Convener Curriculum committee Convener DUGC Convener Curriculum committee Convener B.Tech

(Computer Engineering) - Advanced Elective C ourse UG CST458 1) Kurose: Computer Networking A Top Down Approach, Pearson. 2) Peterson and Davie: Computer Networks: A systems approach, Morgan Kaufman and Elsevier. 3) J.Walrand, High Performance Computer Networks, E lesevier 4) A.Kumar, D.Manjunath, Communication Network MKP. 5) Recent papers from conferences and journals UG/PG Department: Computer Engineering Course Code: Course Name: High Level Synthesis of Digital Systems Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Parallelizing Compiler Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Motivation and overview, structure of a parallelizi ng compiler. Review of code optimization techniques in compilers for seque ntial machines. Parallelism detection - data dependence analysis, d irection vectors, loop carried and loop independent dependences; tests for data dependence and their applicability, construction of data dependenc e graph. Control dependence and control dependence graph. Restructur ing transformations and automatic extraction of parallelism; representa tion of iteration spaces of multiply nested loops; loop based transformation s such as loop distribution, loop coalescing, loop inter-change an d cycle shrinking transformation. B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST462 4Overview. Design methodologies. Abstractions and vi ews. Review of basic concepts in algorithms and graph th eory Design representation and modeling, Modeling langua ges, Abstract models Synthesis at higher levels of abstraction Scheduling, Resource sharing Structural synthesis: Module selection. Pipeline. C ontrol Synthesis at lower levels of abstraction, Logic syn thesis 1) G. D. Micheli. Synthesis and optimization of dig ital systems. 2) N.D. Dutt, D. D. Gajski. High level synthesis, K luwer, 2000. 3) T. H. Cormen, C. E. Leiserson and R. L. Rivest, “Introduction to Algorithms,” McGraw-Hill, 1990. 4) Recent papers from journals and conferences. DUGC Convener Curriculum committee Convener UG CST460 4 Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Public Key Infrastructure and Trust Management Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Selected Topics in Cryptography Credit: L-T-P: 3-0-2 CST466 41) Ashutosh Saxena, Public Key Infrastructure, Tata McGraw Hill 2) Carlisle Adams, Steve Lloyd. Understanding PKI: Concepts, Standards, and Deployment Considerations, Addison Wesley. 3) John R. Vacca. Public Key Infrastructure: Buildi ng Trusted Applications and Web Services, AUERBACH. 4) Messaoud Benantar, Introduction to the Public Ke y Infrastructure for the Internet, Pearson Education. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG UG CST464 4 Public key infrastructure - components and architec ture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, rev ocation, authentication, cross-certification. Repository, Certification Authority (CA) and Regist ration Authority (RA), trusted third party, digital certificates. PKI services – authentication, non-repudiation, pri vilege management, privacy, secure communication. Key management – certificate revocation list, root CA, attacks on CA, key backup. PKI standards – SSL, LDAP, IPSec, X.500, X.509, S/M IME Trust models – strict v/s loose hierarchy, four cor ner, distributed. Certificate path processing – path construction and path validation. 1) Selected papers and online reference material DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Robotics and Control Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: 4 Robotics: Introduction to robotics, advantages, app lications. Robotic kinematics and dynamics: Direct and inverse kinematics problem. Axis transformations; DH matrix; forward and revers e kinematics, trajectory planning. manipulators and their control. Robot sensors: Active and passive robot sensors, Co nstruction of tactile, touch and vision sensors; interpretation of sensory information; vision processing; kinematic information from sensory data . Robot Intelligence: Robot learning, State space sea rch, robotics in computer vision applications. Robotic end effectors: Stable grip; constraints; ty pes of contact; mathematical representation of stable grip; use of screw twist, and wrench gripper design; tools as end effectors. Problems of implementation of automatic systems. 1) Fu K, Gonzalez R and Lee C, Robotics - Control S ensing Vision & Intelligence, McGraw Hill. 2) Craig J J, Introduction to Robotics, Mechanics a nd Control, Addison Wesley, 1993. 3) McKerrow P J, Introduction to Robotics, Addison Wesley, 1993. 4) Selig M, Introductory Robotics, Prentice Hall, 1 992. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST468 Elliptic Curve Cryptography Secret Sharing, Threhold cryptography – Robust ElGa mal system Visual Cryptography Interactive zero knowledge proofs, witness hiding p rotocols. Group encryption, decryption. Group signatures, rin g signatures. EVoting: requirements, issues and challenges, exist ing solutions, write-in ballots. Pair based cryptography – Weil and Tate pairing. 1) Selected paper and online reference material. SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: FPGA based System Design Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Security in Computing Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST472 4Introduction to FPGA Architectures. FPGA design flo w, partitioning, placement and routing algorithms. Technology mappin g for FPGAs, case studies. 1) Brown, Francis, Rose and Vranesic. Field program mable Gate arrays. Kluwer. 2) Betz, Rose, Marquardt, Architecture and CAD for Deep-submicron FPGAs. Kluwer. 3) Trimberger, FPGA Technology. Kluwer, 1992. 4) Oldfield, Dorf. FPGAs: Reconfigurable logic for rapid prototyping and implementation of digital systems. John Wiley. 5) Recent papers from conferences and journals. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST470 4DUGC Convener Curriculum committee Convener Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Intelligent Agents Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : UG CST474 4Computer security, threats, attacks, computer crimi nals, defense methods, information and network policies, cryptography, sym metric and public-key encryption, uses of encryption. Secure file systems and database security. Program security, secure programs, viruses and othe r malicious code, control against program threats, protection in gene ral-purpose OS, protected resources and methods of protection, user authentication. Binding programs to machines. Language based security, Integrating security in co mpilers. Designing trusted OS, models of security, database security, security requirements, reliability and integrity, inference. Administering security, legal, privacy, and ethical issues in computer security. 1) Pfleeger and Pfleeger, Security in Computing, P earson Education. 2) M. Bishop and S. S. Venkatramanayya, Introductio n to Computer Security, Pearson Education. 3) Stallings W., Cryptography and Network Security Principles and Practice, Pearson Education. 4) Stallings W., Network Security Essentials: Appli cations and Standards, Pearson Education. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Critical Systems Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus CST476 4 Introduction to time critical systems, Issues, Comp onents, Classification and terminology. Misconceptions about Real-time co mputing. Real-time System requirements. Specification of timing constr aints. Real-time scheduling: Requirements and Issues, Term inology, modeling, Introduction static and dynamic scheduling schemes, cyclic scheduling, priority driven scheduling of periodic tasks, sched ulability tests, Aperiodic task scheduling: server/non-server based scheduling algorithms. Practical factors/overheads. Task Synchronization: Need and priority inversion p roblem, Priority Inheritance protocol, priority ceiling protocol and stack-based priority ceiling protocol. Introduction to multiprocessor real-time systems, p roblems and issues. An overview of an operating system 1) M.J.Wooldridge, An introduction to multi-agent s ystems. Wiley DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG Introduction to agent-based computing , Motivations for agent-based computing Key concepts and models, Agent architectures (delib erative, reactive, hybrid), Rational decision making (decision theoret ic, belief-desire- intention) Mobile agents, Agent Interactions, Coordination (or ganisation models, social laws, social dependencies), Cooperation (tea m-oriented problem solving, coalition formation) Negotiation (mechanis m design, heuristic models, argumentation) Computational markets (auctions, competition) Agent-Oriented Software Engineering, Benefits and P otential Drawbacks, Agent Methodologies, Application Case Studies (agen t-mediated electronic commerce, business process management, telecommunic ations network management) Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Pattern Recognition Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman 4 Introduction to statistical, syntactic and descript ive approaches, features and feature extraction. Bayes Decision theory- continuous case, 2-category classification, minimum error rate classification, discriminant fun ctions and decision surfaces, discrete case. Parameter estimation, supervised learning- Maximum likelihood, Bayes, general bayesian learning. Nonparametric - density estimation, parzen windows, k-nearest Neighbor, estimation posterior probability. Linear discriminant functions- decision surfaces, g eneralized linear discriminant functions, 2-category linearly separab le case, non-separable behavior, linear programming procedures, SVMs. Supervised learning: Feed forward Neural networks, Backpropagation algorithm, error surfaces. Clustering - data description and clustering, Hiera rchical clustering, self organizing maps. 1) Duda and Hart P.E, and David G Stork, Pattern cl assification , John Wiley & Sons. 2) Duda and Hart P.E, Pattern classification and sc ene analysis, John Wiley and sons.. 3) Earl Gose, Richard Johnsonbaugh, and Steve Jost; Pattern Recognition and Image Analysis, PHI. 4) Fu K.S., Syntactic Pattern recognition and appli cations, Prentice Hall.s DUGC Convener Curriculum committee Convener DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST478 1) J.W.S.Liu: Real-Time Systems, Pearson Education Asia 2) S.T.Lavi, A.K.Agrawala: Real-time system Design, McGraw Hill 3) Laplante: Real-time Systems Design and Analysis, An Engineer’s Handbook, IEEE Press 4) Laurence, K.Mauch: Real-time Microcomputer syste m design, An introduction, McGraw Hill UG/PG Department: Computer Engineering Course Code: Course Name: Biometric Security Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Computer Forensics Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST482 4Biometrics: Need, Conventional techniques of authen tication, challenges - legal and privacy issues. Biometrics: DNA, fingerprint, Iris, Face, hand geom etry, ear. Behavioral: Human gait, speech, thermal imaging, in fra-red spectrum, signature, keystroke dynamics Combining biometrics, scaling issues. Privacy, legal and ethical issues. 1) Julian D. M. Ashbourn, Biometrics: Advanced Iden tify Verification: The Complete Guide 2) Davide Maltoni (Editor), et al, Handbook of Fing erprint Recognition 3) L.C. Jain (Editor) et al, Intelligent Biometric Techniques in Fingerprint and Face Recognition 4) John Chirillo, Scott Blaul, Implementing Biometr ic Security 5) Nalini Ratha (Editor), Ruud Bolle 6) Authentication: From Passwords to Public Keys, R ichard E. Smith DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST480 4 Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Semantic Web Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : UG CST484 4File System Forensics: Duplicating hard disks for " dead analysis”, reading hidden data on a disk's Host Protected Area (HPA), Direct versus BIOS access, dead versus live acquisition, Disk partitio ns - DOS, Apple, and GPT partitions, BSD disk labels, Sun Volume; multiple d isk volumes - RAID and disk spanning; Analyzing FAT, NTFS, Ext2, Ext3, UFS 1, and UFS2 file systems, Finding evidence: File metadata, recovery of deleted files, Using The Sleuth Kit (TSK), Autopsy Forensic Browser, and related open source tools Web Forensics: network-based evidence in Windows an d Unix environments, Reconstructing Web browsing, e-mail a ctivity, Tracing domain name ownership and the source of e-mails System Forensics: Windows Registry changes, Duplica ting and analyzing the contents of PDAs and flash memory devices Electronic document, computer image verification an d authentication 1) Brian Carrier. File System Forensic Analysis, Ad dison Wesley. 2) Chris Prosise, Kevin Mandia. Incident Response a nd Computer Forensics, McGraw Hill. 3) Linda Volonino, Reynaldo Anzaldua, and Jana Godw in. Computer Forensics: Principles and Practices, Prentice Hall. 4) Keith J. Jones, Richard Bejtlich, and Curtis W. Rose. Real Digital Forensics: Computer Security and Incident Response, Addison Wesley 5) Vacca, John R., Computer Forensics Computer Crim e Scene Investigation, Charles River Media. 6) Nelson, Phillips, Enfinger, Steuart. Guide to co mputer Forensics and Investigation, Course Technology. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Intrusion Detection Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus CST486 4 Introduction- Intrusion detection system (IDS), int rusion prevention system (IPS), Unauthorized access – buffer overflow, packet fragm entation, out-of-spec packets Review of Network protocol – TCP-/IP, Intrusiond detection through tcpdump. IDS and IPS – Architecture and internals. Malicious and non-malicious traffic, IP headers, TD P, UPD and ICMP protocols and header formats, Header information to detect intrusion, logs and their analysis, IDS through reaction and response Intrusion analysis – data correlation, tools, SNORT1) John Davies, Rudi Studer, and Paul Warren. Seman tic Web Technologies: Trends and Research in Ontology-based Systems, Wiley. 2) John Davies, Dieter Fensel, Frank van Harmelen, and Frank van Harmelen. Towards the Semantic Web: Ontology-Driven Knowledge Management, Wiley. DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG Introduction to semantic web, architecture, langaua ges and tools for knowledge management. XML, RDF, OIL, DAML, OWL for semantic web. Semantic Web Technologies: Ontology-based Systems: Ontology based knowledge ma nagement; ontology construction; generating, storing, alignin g and maintaining ontologies for semantic web; information retrieval from natural language based documents; ontology evolution; ontological in dexing and searching techniques for Searching web Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Internet Security Credit: L-T-P: 3-0-2 Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman UG/PG Department: Computer Engineering Course Code: Course Name: Malware Analysis and Detection Credit: L-T-P: 3-0-2 B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST490 44 Security protocols: naming and addressing, IPv6, Ne twork address translation, SNMP, remote login, file transfer prot ocol, RPC based protocol, peer-to-peer communication Web architecture and protocols, buffer overflow and hacking Internet threats – password stealing, Trojans, phis hing, viruses, worms, DOS attack, backdoors, Botnets, port scanning, hack ing techniques. Security mechanisms – passwords, one-time password – time based, Lamport’s, authentication – smart card, biometrics, RADIUS, SASL framework, host to host authentication, PKI. Firewalls, VPNs, tunneling, Intrusion detection. Server and client security, 1) John Chirillo. Hack attacks denied, Wiley. 2) McClure. Web Hacking, Pearson Education. 3) John R. Vacca. Practical Internet Security, Spri nger. 4) William R. Cheswick, Steven M. Bellovin, and Avi el D. Rubin. Firewalls and Internet Security: Repelling the Wily Hacker, A ddison-Wesley. 5) Kenneth Einar Himma.

Internet Security: Hacking, Counterhacking ,and Security, Jones & Bartlett Publishers DUGC Convener Curriculum committee Convener DUGC Convener Curriculum committee Convener B.Tech (Computer Engineering) - Advanced Elective C ourse UG CST488 1) Matt Fearnow, Stephen Northcutt, Karen Frederick , and Mark Cooper. Intrusion Signatures and Analysis, SAMS. 2) Carl Endorf, Gene Schultz, Jim Mellander, Intrus ion Detection and Prevention, McGraw Hill. 3) Stephen Northcutt and Judy Novak. Network Intrus ion Detection, SAMS. 4) Paul E. Proctor. The Practical Intrusion Detecti on Handbook, Prentice Hall. Version: Approved on: Pre-requisite Course : Syllabus Books: SUGB Chairman Malware Taxonomy, Infection and Propagation mechani sms, Payload delivery, obfuscation, Detection mechanisms: scanni ng, anomaly detection, behavioural analysis; polymorphic and metamorphic malware, signature, static and dynamic analysis, generic decryptor, dis infection, system vulnerabilities and exploits. 1) Peter Szor. The Art of Computer Virus Research a nd Defense, Addison Wesley. 2) Eric Filliol: Computer Viruses from Theory to Ap plications, Springer. 3) M. Sikorski and A. Honig: Practical Malware Anal ysis, No Starch Press. DUGC Convener Curriculum committee Convener BTech_CSE.pdf CP Page 1B.Tech (Computer Engineering) Semester12345678CreditsCHICPCPEOETotal I & II 4545451HS-200CP-221CP-223CP-225CP-227CP-251CP-253 III Data Structures Abstract AlgebraLSD Lab 22216422 (3-0-0)(3-0-0)(3-0-0)(3-0-0)(0-0-3)(0-0-3)233332 24CP-222CP-224CP-226CP-228CP-250CP-252 IVDBMS DBMS Lab Discipline23217423 (3-0-0)(3-0-0)(3-0-0)(3-1-0)(0-0-3)(0-0-3) 333422411CP-321CP-323CP-325CP-351CP-353CP-355 VCompiler Design OS Lab 23154423 (3-0-0)(3-0-0)(3-0-0)(0-0-3)(0-0-3)(0-0-3)33322244CP-322CP-324CP-350 CP-352CP-354 VI Algorithms LabSeminar Discipline231144423 (3-0-0)(3-0-0)(0-1-3)(0-0-3)(0-3-0) 3332344 1CP-451 CP-453 VII Design Elective 25318425 (0-3-0) 344464CP-452 VIIIProject Discipline191108019 1044 1 Total Credits 18051753420180Discipline /NSS Social Science and EconomicsLogic System DesignProbability and StatisticsData Structure LabOpen Elective I Microprocessor and MicrocontrollersComputer ArchitectureTheory of ComputationAssembly Language Programming LabOpen Elective II Creative Arts/ Sports/ NSS/ Hindi Operating SystemComputer NetworkSystem Programming LabNetwork Programming LabProgram Elective IOpen Elective III Software Engg. Design and Analysis of AlgorithmsFree and Open Source LabProgram Elective IIOpen Elective IV Industrial TrainingProgram Elective IIIProgram Elective IVProgram Elective VOpen Elective V Program Elective VIProgram Elective VII CP Page 2Program Elective I CP-371Object Oriented Programming CP-373Logical and Functional Programming CP-375Programming in Java CP-377Concurrent Programming Program Elective II CP-372Digital Signal Processing CP-374Wireless Communications CP-376VHDL CP-378Neural Networks Program Elective III Program Elective IV Program Elective V CP-471Computer Graphics CP-481Advances in Compiler Design CP-491Cryptography CP-473Speech Recognition CP-483Natural Language Processing CP-493Embedded Systems CP-475Mobile Computing CP-485Programming Paradigms CP-495Data Mining CP-477Software Project Management CP-487 CP-497VLSI Algorithms CP-479Data Compression CP-489Real

Time Systems Program Elective VI Program Elective VII CP-470Network Security CP-480Evolving Architectures CP-472Biometrics CP-482Topics in Advanced Computing CP-474High Level Synthesis of Digital Systems CP-484Software Testing and Validation CP-476Selected Topics in Cryptography CP-486Machine Learning CP-478Digital Image Processing CP-488Wireless & Ad-hoc Networks Modelling and Simulation B.Tech (Computer Engineering) Semester III HF-201 Humanities and Social Sciences (X-X-X)2 Please refer to Department of Humanities and Social Sciences. CP-221 Logic System Design (3-0-0)3 Introduction to Boolean algebra : Binary connectives, Evaluation of truth functions, Truth – function calculus as Boolean Algebra, Duality, Fundamental theorems of Boolean Algebra and simplification of Boolean expressions. Realisation of Logic Circuits : Standard forms of Boolean Functions, Minterm and Maxterm, designation of functions. Simplification of functions on Karnaugh maps, incompletely specified functions. Combinational circuits : Adder, subtract, encoder, decoder, multiplexer, demultiplexer, parity checker and generator.Cubical representation of Boolean functions and determination of prime implicants. Selection of an optimal set of prime implicants, multiple output circuits and map minimization of multiple output circuits. Tabular determination of multiple output prime implicants. Latches, Flip Flops : JK, SR, D Type and T type Flip Flops and their working principals. Counters and shift registers: Ripple, decade, up-down counters, Mod-n counters and series, parallel registers. General characteristic of sequential circuits, clock, pulse and level mode sequential circuits. Analysis and design of sequential circuit. Synthesis of state diagrams, finite memory circuits, equivalence relations, equivalent states and circuits, determination of classes of in distinguishable states and simplification by implicant tables. Mealy and Moore machines, state assignment and memory element input equation, Partitioning and state assignment. General pulse-mode circuits, clock input counters, extended state tables. Asynchronous Mode Circuits : Analysis of a fundamental mode circuits, Synthesis of flow tables, minimization, transition tables, excitation maps and output maps, Cycles and Races, Race free assignments, Hazards in sequential circuits. Introduction to A/D and D/A converters. Text/References: 1.Digital Systems and Hardware and Firmware Algorithms: M.Ercegovac and T. Lang, Pearson. 2.Morris-Mano : Logic System and Design, McGraw Hill 3.Hill & Peterson: Switching Theory and Logic Design, John Wiley 4.J.F.Wakerly: Digital Design, Principle and Practices, Pearson. 5.Malvino leech: Digital Electronics CP-223 Data Structures (3-0-0)3 Introduction to Data structures. Arrays: Representation – row-major, column-major, sparse matrix –implementation, addition, multiplication; polynomial – Representation, addition, evaluation and multiplication. Strings: Representation, operations, string matching - Brute force or naïve, Robin-Karp, Knuth-Morris- Pratt. Linked List: Static and dynamic implementation, single, double, circular, multiple linked list. Stack: Static and dynamic implementation, expression evaluation, prefix (polish), infix, postfix (inverse polish) expressions, application, multiple stacks, recursion. Queues: Static and dynamic implementation, applications, circular queue, multiple queue. Tree: Binary tree, binary search tree, static and dynamic implementation, tree operations - insertion, deletion and search, tree traversal, Binary heaps. Introduction to A VL trees and B trees. Sorting: Insertion sort, selection sort, Bubble sort, quick sort, merge sort, heap-sort, radix sort (bucket sort). Searching: Linear and binary search, hashing. Graph: Representation of graphs, BFS, DFS, topological sort. Text/References: 1.Aho A.V ., J.E. Hop croft, J.D. Ullman, Data Structures and algorithms, Addison Wesley. 2.Kruse R.L., Data Structure and Program Design, PHI. 3.Horowitz and Sahni: Data Structure in C++ , Glagotia 4.Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures 5.Aaron M. Tenenbaum, Y . Langsam, Moshe J. Augenstein, Data Structures Using C 6.Niklaus Wirth, Algorithms + Data Structures = Programs (Prentice-Hall Series in Automatic Computation) 7.Sartaj Sahni, Data Structures, Algorithms, and Applications in C++ 8.Mark Allen Weiss, Data Structures and Algorithm Analysis in C++ (2nd Edition) CP-225 Probability and Statistics (3-0-0)3 Probability Theorem : Properties of probability, Conditional probability, Independence, Bayes theorem Discrete Distributions : Probability distribution functions and cumulative distribution functions Mean and variance; moment-generating functions, Marginal and conditional probability distributions, Some specific discrete distributions Continuous Distributions : Probability density functions and cumulative distribution functions, Mean and variance; moment generating functions, Marginal and conditional probability distributions, Some specific continuous distributions Functions of Random Variables : Distribution function technique, Transformation technique, Moment- generating function techniques Text/References: 1.DeGroot, Morris H., and Mark J. Schervish. Probability and Statistics. 3rd ed. Boston, MA: Addison-Wesley, 2002. ISBN: 0201524880. 2.Feller, William. An Introduction to Probability Theory and Its Applications. 3rd ed., rev. printing. New York, NY: Wiley, 1968. ISBN: 0471257087. 3.Freund, W.J., Mathematical Statistics, 5th Ed., Prentice-Hall, Inc., Englewood Cliffs, N.J., 1994. 4.Hoel, P.G., Mathematical Statistics, 5th Ed., John Wiley & Sons, Inc., NewYork, 1984. 5.Hogg, R.V ., & Craig, A.T., Introduction to Mathematical Statistics, 5th Ed.,Prentice-Hall, Inc., Englewood Cliffs, N.J., 1995. 6.Mood, A.M., Graybill, F.A., Boes, D.C., Introduction to the Theory of Statistics, 3rd Ed. McGraw Hill, Inc., New York, 1974. CP-227 Abstract Algebra (3-0-0)3 Number Systems: Natural numbers. Counting. Cardinality of finite sets. Laws, Mathematical induction. Prime numbers. Fundamental theorem of arithmetic. Well-ordering principle. Number bases. Modulo arithmetic. Greatest Common Divisor, Euler's extended algorithm, Chinese Remainder Theorem, Primality testing, Integers. Laws of arithmetic. Integer powers and logarithms. Recurrence relations. Number sieves. Group Theory: Groups, Semi groups and Monoids, Cyclic semi graphs and sub monoids, Subgroups and cosets, Congruence relations on Semi groups, Factor groups and homomorphisms, Morphisms Normal sub groups. Structure of cyclic groups, Permutation groups, dihedral groups, Sylow theorems, abelian groups; solvable groups, Nilpotent groups; groups of small order, elementary applications in coding theory. Rings: Rings, Subrings, Morphism of rings, ideal and quotient rings, Euclidean domains, Commutative rings; integral domains, noncommutative examples, Structure of Noncommutative Rings, Ideal Theory of Commutative Rings Field Theory: Integral domains and Fields, polynomial representation of binary number, Galois fields, primitive roots, discrete logarithms, split search algorithm. Modules: Sums and products; chain conditions, Composition series; tensor products. Text/ References: 1.John Fraleigh. First Course in Abstract Algebra , Pearson Education. 2.Michael

Artin. Algebra, Pearson Education. 3.John A. Beachy and William D. Blair. Abstract Algebra, Second Edition, Waveland Press. 4.John A. Beachy. Abstract Algebra II, Cambridge University Press, London Mathematical Society Student Texts #47, 1999. CP-251 LSD Lab (0-0-3)2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with CP-221. 1.Truth table verification – NAND gate, NOR gate, OR gate, AND gate, NOT gate. 2.Verifying if NAND gate is a universal gate. 3.Constructing XOR gate using NOR gate only. 4.Realizing given truth table using SOP form. 5.Realizing given truth table using POS form. 6.Design of combinational circuits – half adder, full adder, multiplier. 7.Design of binary-gray encoder. 8.Design of parity generator and detector. 9.Design of one bit error detecting and correcting circuit. 10.Design of flip flops – RS, JK, D and T flip flops. 11.Design of sequential circuits – counters. Text/References: 1.Digital Systems and Hardware and Firmware Algorithms: M.Ercegovac and T. Lang, Pearson. 2.Morris-Mano : Logic System and Design, Mc Graw Hill 3.Hill & Peterson: Switching Theory and Logic Design, John Wiley 4.J.F.Wakerly: Digital Design, Principle and Practices, Pearson. 5.Malvino leech: Digital Electronics CP-253 Data Structure Lab (0-0-3)2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with CP-223. Programs in C or C++ for following: 1.Sorting programs: Bubble sort, Merge sort, Insertion sort, Selection sort, and Quick sort. 2.Searching programs: Linear Search, Binary Search. 3.Array implementation of Stack, Queue, Circular Queue, Linked List. 4.Implementation of Stack, Queue, Circular Queue, dynamic memory allocation. 5.Infix to postfix (prefix) conversion. 6.Program for expression evaluation. 7.Implementation of Binary tree. Program for Tree Traversals (preorder, inorder, postorder). 8.Program for graph traversal (BFS, DFS). 9.Program for minimum cost spanning tree, shortest path. Text/References: 1.Aho A.V ., J.E. Hop croft, J.D. Ullman, Data Structures and algorithms, Addison Wesley. 2.Kruse R.L., Data Structure and Program Design, PHI. 3.Horowitz and Sahni: Data Structure in C++ , Glagotia 4.Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures 5.Aaron M. Tenenbaum, Y . Langsam, Moshe J. Augenstein, Data Structures Using C 6.Niklaus Wirth, Algorithms + Data Structures = Programs (Prentice-Hall Series in Automatic Computation) 7.Sartaj Sahni, Data Structures, Algorithms, and Applications in C++ 8.Mark Allen Weiss, Data Structures and Algorithm Analysis in C++ (2nd Edition) Open Elective I (X-X-X)3/4 Please refer to concerned Department. B.Tech (Computer Engineering) Semester IV CP-222 Data Base Management System (3-0-0)3 Need, purpose and goal of DBMS, Three tier architecture, ER Diagram, data models-Relational, Network, Hierarchical and Object Oriented. Data Base Design: Conceptual data base design, Theory of Normalization Primitive and Composite data types, concept of physical and logical databases, data abstraction and data independence, data aggregation, Relational Calculus. SQL : DDL and DML, Relational Algebra. Application Development using SQL : Host Language interface, embedded SQL programming, Stored procedures and triggers and views, Constraints assertions. Internal of RDBMS : Physical data organisation in sequential, indexed random and hashed files. Inverted and multilist structures, B trees, B+ trees, Query Optimisation, Join Algorithm, Statistics and Cost Base optimisation. Transaction Processing, concurrency control, and recovery management. Transaction model properties and state serialisability . Lock base protocols, two phase locking. Text/References: 1.H.f. Korth and Silberschatz: Database Systems Concepts , McGraw Hill 2.Almasri and S.B. Navathe: Fundamentals of Database Systems , 3.C.J. Date: Data Base Design, Addison Wesley 4.Hansen and Hansen : DBM and Design, PHI CP-224 Microprocessor and Microcontrollers (3-0-0)3 Introduction to 8085 microprocessor: CPU Architecture, CPU Specifications, CPU Pin Description, System Timing Diagrams, Instructions, Interrupts etc. Introduction to 8086/88 microprocessor: CPU Architecture, 8086 CPU Specifications, CPU Pin Description, System Timing Diagrams, Bus Standards, 8086 Address & Data Buses, Segmentation and Paging, Addressing Modes, Accessing Memory, RAM & Direct Memory Access, Memory Mapped I/O, Processor Registers, Data Organization. Software Architecture: Introduction to Assembly Language Programming, Instruction and timing: instruction classification, instruction formats, addressing modes, instruction timings and status, interrupts. I/O System Design: 8255 Programmable Peripheral Interface, 8259 Programmable Interrupt Controller, Direct Memory Access: basic concepts of DMA techniques, Description and interfacing of DMA controller 8257. Introduction to Microcontrollers. Text/References: 1.Douglas V . Hall : Microprocessors and Interfacing, McGraw Hill 2.Gaonkar ; 8085 Architecture, Programming and interfaces, Penram Press 3.John Uffenbeck : The 8086/8088 Family -Design, Programming & Interfacing, Prentice Hall of India Private Limited. 4.Brey : Intel Microprocessor, The 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium & Pentium Pro Processor: Architecture, Programming, and Interfacing, PHI. CP-226 Computer Architecture (3-0-0)3 Introduction to computer architecture and organization: Digital components, V on Neumann Machine Architecture, Flynn Classification Register Transfer Language : Micro operations - data transfer operations, arithmetic, logic and shift micro operations and their hardware implementations as a simple Arithmetic and logic unit. CPU Organization: Addressing techniques - Immediate, direct, indirect, register, register indirect, index, relative and stack addressing techniques. Instruction formats : Instruction set design, Instruction types: example for zero address, one address, two address and three address machines, Stack, accumulator and general purpose register organization Arithmetic Algorithms : Arithmetic and Logic Unit, Adders - Full adder, Ripple carry adder, Carry look ahead adder, Carry select adder, carry save adder, Multiplication - Add and Shift method, Booth's Multiplier, m -Array Multiplier, Division - Restoring and Non restoring method. Pipelining: Pipeline structure, pipeline performance measures, Pipeline types - Instruction and Arithmetic pipelines. Memory Organization: Memory device characteristics, RAM organization: 1D and 2D organization, Virtual memory - Paging and Segmentation, High speed memories: Associative and Cache memory Control Unit Design, Hardwired and Micro programmed control unit design implementation techniques. Memory hierarchies. Input-Output Design: IO interface, Bus structure, Modes of data transfer, Interrupts, Input Output Processor, Serial Communication Text/References: 1. Computer Architecture: A Quantitative Approach, J.L. Hennessy and D.A. Patterson, 4th Edition Elsevier. CP-228 Theory of Computation (3-1-0)4 Introduction to automata theory, formal languages, recursive definitions, regular expressions, finite automata, transition graphs and Kleen's theorem. Non-determination, finite automata with output, regular languages, minimization of finite automata, pumping lemma for regular languages. Chomsky classification of languages, regular grammars, context free grammars, simplification of context free grammars, Normal forms of context free grammars. Push Down Automata Theory: push down automata and languages, push down automata and context free grammars, pumping lemma for context free languages. Turing hypothesis, Turing machine, Minskey's theorem, TM variation and encoding, Post machines, computability and acceptability. Elements of prepositional logic and predicate calculus. Text/ References: 1.Hopcroft, Motwani and Ullman: Introduction to Automata Theory, Languages and Computation , Pearson Education. 2.Cohen: Introduction to Computer Theory , Addison Wesley. 3.Martin: Introduction to Languages and Theory of Computation, TMH. 4.Papadimitriou, Introduction to Theory of Computing , Prentice Hall. 5.K.Krishnamurthy: Theory of Computation . CP-252 DBMS Lab (0-0-3)2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with CP-222. 1. Conceptual designs using ER diagrams. 2. Design of databases. Based on templates, files and relational basis. 3. Development and implementation of DB system from the fundamentals. 4. Experiments on SQL queries. CP-254 Assembly Language Programming Lab (0-0-3)2GS The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with CP-224. Programming the 8085: 8085 instruction set, data transfer instruction, arithmetic, logic & branch operations. Rotate and compare. Instruction related to stack operations. Programming Techniques: looping, counting and indexing, counters and time delays, subroutines. Interfacing microprocessors with the additional devices like ADC/DAC and plotting them onto CRO. Programming the 8086: Instruction types: Data Transfer, String, Arithmetic, Logical, Bit Manipulation, Program Transfer and Processor Control, the Processor Flags. Interfacing microprocessors with the additional devices like ADC/DAC and plotting them onto CRO. Stepper motor controller and PPI usages. Text/References: 1.Gaonkar ; 8085 Architecture, Programming and interfaces, Penram Press 2.John Uffenbeck : The 8086/8088 Family -Design, Programming & Interfacing, Prentice Hall of India Private Limited. Open Elective II (X-X-X)3/4 Please refer to concerned Department. B.Tech (Computer Engineering) Semester V CP-321 Operating System (3-0-0)3 Introduction: Need of Operating System, its evolution, types of operating systems, batch, multiprogramming, time sharing systems, real time systems. Processes and processor management : process concept, systems programmers view of processes, operating systems view of processes, Process scheduling, Schedulers, interprocess communication and synchronization, race condition, mutual exclusion, semaphores, monitors, messages. Deadlocks prevention , avoidance, detection and recovery. Memory Management : Contiguous allocation-partitioned memory allocation – fixed and variable partitioning, memory management with bit maps – swapping – relocation- protection and sharing. Non contiguous allocation – Paging – principles , page allocation, segmentation. Virtual memory concepts, address translation, management of virtual memory, page replacement policies, protection and sharing, working set model, hardware support. File management: Command language users view of file system, file system design, disk space management directory structure, shared files, file system performance. File servers, security, protection mechanism. Input/Output Management : Device drivers, disk scheduling. Introduction to loaders, linkers and relocating loaders. Case study: UNIX/LINUX, Windows. Text/References: 1.Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts. Sixth edition. Addison-Wesley (2003). 2.Andrew Tanenbaum, Modern Operating Systems, Prentice Hall. 3.William Stallings, Operasting Systems, Prentice Hall. 4.Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation. Prentice-Hall. 5.Harvey M. Deitel, An introduction to operating systems. Addison-Wesley. CP-323 Compiler Design (3-0-0)3 Translators: Introduction to compilers, translators, and interpreters, compilation process. Lexical Analysis: Finite automata, Regular expressions, Design & implementation of lexical analysers. Syntax Analysis: Context Free Grammars, Derivation and Parse trees, Bottom-up and Top-down Parsing. Ambiguity, Shift Reduce Parser, Operator Precedence Parser, Predictive Parsers, canonical collection of items, LR parsers. Syntax directed translation: Syntax directed translation, Attributes, Intermediate codes, Three address codes. Symbol table organization: Hashing, linked list, tree structures. Memory allocation: Static and dynamic structure allocation. Code optimization: Basic blocks, Flow graphs, DAG, Global data flow analysis – ud-chaining, available expressions, Loop optimization. Code generation: Compilation of expression and control structures. Error detection and recovery. Text/References: 1.Aho, Ullman and Sethi: Compilers – Principles, techniques and tools, Pearson Education. 2.Tremblay, Sorenson: The Theory and Practice of Compiler Writing, BSP. 3.Holub, Compiler Design in C, PHI. CP-325 Computer Network (3-0-0)3 1.Computer network architecture, Physical layer: Hardware, topology, data encoding, 2.Data Link Layer: Logical link Control: Error detection and Correction, ARQ protocols, Framing protocols(HDLC, LLC) Medium Access Control: Multiple access protocols, Channel Allocation, contention, reservation, round robin with Examples. 3.Network Inter connection: Generic switches, switch design issues, switching mechanism : virtual Circuit switching, datagram switching, source route switching, Bridge and bridge learning , Global Addressing scheme, fragmentation and reassembly, Address translation: ARP, RARP, ICMP, IP Scalability Issues, sub netting and super netting (CIDR) , IP Routing, EGP, BGP protocols 4.End to End protocols: End to end issues, UDP and TCP segment formats, connection establishment and termination, state transition sliding window protocol, TCP Flow control, Silly window syndrome, TCP retransmission, RTT Estimation, TCP Congestion Control and congestion avoidance protocols 5.Internet applications : Client server paradigm, DNS, SMTP, RPC, NFS and General network security issues. Text/References: 1.Data Networks: Bertsekas and Gallagher, Phi. 2.Computer Networking A Top down Approach: J.F.Kurose, Pearson. 3.Computer Networks A Systems Approach: L. Peterson and B. Davie, Elsevier 4.Computer Networks and Internet: D.E. Comer, Pearson CP-351 OS Lab (0-0-3)2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with CP-321. 1.Simple Unix-C programs: Programs using system calls, library function calls to display and write strings 2.Concurrent Programming concepts using fork, semaphore and pipes. 3.Programs for error reporting using errno,perror() function. 4.Programs to simulate process scheduling like FCFS,shortest Jobs First and Round Robin. 5.Programs to simulate page replacement algorithms like FIFO, Optimal and LRU. 6.Programs to simulate Free space management. 7.Programs to simulate virtual memory. 8.Programs to simulate deadlock detection. 9.Any other as per curriculum. Text/References: 1.Unix concepts and applicaions by Sumitbha Das,TMH applications. 2.Unix Programming by stevens, Pearsons Education. 3.Shell Programming by Yashwant Kanetkar. 4.Operating System concepts by silberschatz, and Peter Galvin. CP-353 System Programming Lab (0-0-3)2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations. Programming exercises to implement typical lexical analyzers, parsers, intermediate code generation. Assignments using LEX and YACC tools. Programming exercises to implement assemblers, editors, debuggers etc. Text/References: 1.Aho, Ullman and Sethi: Compilers, Pearson Education. 2.Levine, Mason and Brown: Lex and Yacc, O'Reilly. CP-355 Network Programming Lab (0-0-3) 2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with CP-325. 1.Programming for data encoding, CRC detection and Correction. 2.Estimation of network delay through OS utilities. 3.Simulation and Emulation of Bus and Star topology, DLC, MAC protocols using Benchmark LAN trainer kits. 4.Packet measurement and observation using network sniffing tools. 5.Use of sniffers for protocol dynamics. 6.Introduction to Socket programming and application development for internet. Text/References: 1. Computer Networks and Internet: D.E. Comer, Pearson 2. TCP/IP Illustrated, W. Stevens, V ol 1-2, Pearson Eds. Program Elective I (3-0-2)4 One/More of the following courses as offered by Department. CP-371 Object Oriented Programming CP-373 Logical and Functional Programming CP-375 Programming in Java CP-377 Concurrent Programming Open Elective III (X-X-X)3/4 Please refer to concerned Department. B.Tech (Computer Engineering) Semester VI CP-322 Software Engg. (3-0-0)3 Introductory Concepts : Historical perspective, System Definition, Software Life Cycle, Software Engineering paradigms. System analysis: Feasibility study requirement analysis, Cost benefit analysis, Planning systems, Analysis tools and techniques. System Design: design fundamentals, Modular Design, Data and procedural design, object oriented design. System Development : Code documentation, Program design paradigms. Verification, Validation and Testing: testing methods, Formal Program Verification, Testing Strategies. Software Maintenance : Maintenance Characteristics, Maintainability, Maintenance tasks and side effects. Text/References: 1.Pressman R.S: Software Engineering: A Practitioner approach, McGraw Hill. 2.Sommerville I: Software Engineering, Addison Wesley 3.Ghezzi C. Jazayeri M and Mandrioli: Fundamentals of Software Engg. , PHI. CP-324 Design and Analysis of Algorithms (3-0-0)3 Algorithm Analysis : Asymptotic notation, solution of recurrence, model of computation, time and space complexities, average and worst case analysis, Amortized analysis. Algorithm Design Techniques : Greedy algorithm, dynamic programming, divide and conquer, backtracking, branch and bound. Graph Algorithms: Shortest path algorithms, Disjoint set operations, minimum spanning tree algorithm, network flow, matching, coverings, applications of DFS:- bi-connectivity, Euler circuits, strongly connected components, topological sort, and articulation point. Dynamic Programming : Chained matrix multiplication, longest common subsequence. Divide and Conquer : Order Statistics – finding the median, exponentiation, matrix multiplication, LCS. Computational Geometry: Line segments, Optimal polygon triangulation. Approximate Algorithm : Travelling Salesman Problem, vertex-cover problem. Primality testing, Integer factorization, Randomized algorithms, Probabilistic algorithms. String Matching algorithms : Rabin Karp, KMP, Boyer Moore. Matrix Algorithms – Strassen Matrix multiplication, LUP decomposition. Construction of codes: Shannon Fano and Huffman codes. Introduction to problem classes – NP, NPC, NP-Hard. Text/References: 1.Cormen, Leiserson, Rivest: Introduction to Algorithms , Prentice Hall of India. 2.Horowitz and Sahani: Fundamental of Computer algorithms . 3.Aho A.V , J.D Ulman: Design and analysis of Algorithms , Addison Wesley 4.Brassard : Fundamental of Algorithmics , PHI. 5.W.W. Peterson and E. J. Weldon: Error correcting codes . 6.Sara Baase, Allen Van Gelder: Computer Algorithms: Introduction to Design and Analysis , Pearson Education. CP-352 Algorithms Lab (0-0-3)2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations. 1.Implementation of graph algorithms – DFS, Shortest Path, MST, articulation point, topological sorting. 2.Implementation of Network Flow, matching, covering. 3.Implementation of pattern matching algorithms. 4.Determination of kth shortest number in a given sequence. 5.Dynamic programming – Applications to problem solving. 6.Approximation algorithms for NP problems. 7.Randomized algorithms implementation. Text/References: 1.Cormen, Leiserson, Rivest: Introduction to Algorithms , Prentice Hall of India. 2.Horowitz and Sahani: Fundamental of Computer algorithms . 3.Aho A.V , J.D Ulman: Design and analysis of Algorithms , Addison Wesley 4.Brassard : Fundamental of Algorithmics , PHI. 5.W.W. Peterson and E. J. Weldon: Error correcting codes . 6.Sara Baase, Allen Van Gelder: Computer Algorithms: Introduction to Design and Analysis , Pearson Education. CP-354 Seminar (0-2-0)2 The topics selection covering the latest and relevant topics related to the emerging areas. Ideally, some recent reputed journal papers abstraction and presentation shall be encouraged for presentation. The evaluation shall be continuous and through components evaluation viz. content, coverage, depth, presentation, response to the queries, and seminar report. In case of unsatisfactory performance, an X grade can be awarded for extension work during summer term. Program Elective II (3-0-2)4 One/More of the following courses as offered by Department. CP-372 Digital Signal Processing CP-374 Wireless Communications CP-376 VHDL CP-378 Neural Networks Open Elective IV (X-X-X)3/4 Please refer to concerned Department. Open Elective V (X-X-X)3/4 Please refer to concerned Department. B.Tech (Computer Engineering) Semester VII CP-451 Industrial Training (0-2-0)2 The evaluation shall be continuous and through components evaluation viz. content, coverage, depth, presentation, demonstration, response to the queries, and training report. In case of unsatisfactory performance, and failure extra credit course from the department equivalent to CP-451 can be permitted through consent of DUGC. CP-453 Free and Open Source Lab (0-0-3)2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations. 1.Linux basics and installation and management of the Linux. 2.Different types of software development environment (Eclipse) 3.make and other software construction utilities on Linux. 4.Version control and managing project in open source. 5.Managing large software development through wiki or alike project management tools. 6.Introduction to scripting for system management. Program Elective III (3-0-2)4 One/More of the following courses as offered by Department. CP-471 Computer Graphics CP-473 Speech Recognition CP-475 Mobile Computing CP-477 Software Project Management CP-479 Data Compression Program Elective IV (3-0-2)4 One/More of the following courses as offered by Department. CP-481 Advances in Compiler Design CP-483 Natural Language Processing CP-485 Programming Paradigms CP-487 Wireless and Ad hoc Networks CP-489 Real Time Systems Program Elective V (3-0-2)4 One/More of the following courses as offered by Department. CP-491 Cryptography CP-493 Embedded Systems CP-495 Data Mining CP-497 VLSI Algorithms CP-455 Project Lab (0-2-3)5 Objective of this elective is to facilitate transfer of knowledge acquired by a student to a field of his own choice for application to solving a problem. Student is expected to collect and study relevant material under mentorship of a faculty member working in similar area; identify a suitable problem and propose methodology towards its solution. Alternately a student can explore hardware implementation of existing solution(s). This elective shall act as prequel to project work for next semester. The project coordinator(s) from the department for continuity shall coordinate this course. Grouping and division shall be applicable as defined in the major project of final semester. Open Elective VI (X-X-X)3/4 Please refer to concerned Department. B.Tech (Computer Engineering) Semester VIII CP-452 Major Project (0-10-0)10 The major project covers lab component of the final semester work. The evaluation of project shall be continuous and will be done through project coordinator(s). The evaluation mechanism shall be evolved based on the existing practices through DUGC rectified from time to time. Ideally the project should comprise with group size of two students shall be limited to maximum 4 students and the groups shall be evenly distributed among faculty through coordinator(s). Internal and external components shall not exceed 40% each of the overall marks. CP-454 Group Discussions (0-0-3)2 This lab will remain only if Industrial training is given weightage of 02 credits. Program Elective VI (3-0-2)4 One/More of the following courses as offered by Department. CP-470 Network Security CP-472 Biometrics CP-474 High Level Synthesis of Digital Systems CP-476 Selected Topics in Cryptography CP-478 Digital Image Processing Program Elective VII (3-0-2)4 One/More of the following courses as offered by Department. CP-480 Evolving Architectures CP-482 Topics in Advanced Computing CP-484 Software Testing and Validation CP-486 Machine Learning CP-488 Modeling and Simulation Open Elective VII (X-X-X)3/4 Please refer to concerned Department. Program Elective I (Semester V) CP-371 Object Oriented Programming (3-0-2)4 Object Oriented Programming and Design : Review of abstraction, objects and other basics, Encapsulation, Information hiding, method, Signature, Classes and Instances, Polymorphism and inheritance. C++ Programming Basics : Fundamentals, variables and assignments, Input and Output, Data types and expressions, flow of control, subprograms, top-down design, predefined functions, user defined functions, procedural abstractions, local variables, overloading function names, operator overloading, parameter passing, this pointer, destructors, copy constructor, overloading the assignment operator, virtual functions, function calling functions, friend functions, recursive functions, recursive member functions. Static member function. C++ Object oriented concepts : Objects and classes, use of file for I/O, formatting output with stream functions, Character I/O, inheritance, structures for diverse data, structures as function arguments, initializing structures, defining classes and member functions, public and private members, constructors for initialization, standard C++ classes, derived classes, flow of control, use of Boolean expressions, multiway branches, use and design of loops. Friend function and friend class. C++ Data structures and Advanced Topics : Arrays – programming with arrays, arrays of classes, arrays as function arguments, strings, Multidimensional arrays, Arrays of strings, pointers Dynamic arrays, Classes and dynamic arrays, Base classes, access control, Templates- generic classes and functions, namespaces. Standard Template Library. Text/References: 1.Balaguruswamy: Object-oriented Programming with C++. 2.Robert Lafore: C++ Programming 3.Ashok N. Kamthane : Object Oriented with C++, Pearson Education CP-373 Logical and Functional Programming (3-0-2)4 Introduction to logic programming, Prolog - Lists, cut operator, and sorting, Data structures, text strings, operators - extensions of SWI Prolog, Searching state space, clause management, and parsing in Prolog Introduction to functional programming, lambda calculus, Programming language Haskell - introduction, lists, User-defined data types, type classes, and arrays in Haskell. Input/Ouput in Haskell - type classes IO and Monad, Simple applications/programs in Haskell. Text/References: 1.Nilsson, Maluszynski: Logic, Programming and Prolog, John Wiley. 2.Thompson: Haskell, The Craft of Functional Programming, Addison-Wesley. CP-375 Programming in Java (3-0-2)4 Introduction: Internet, Java as a tool for internet applications, Byte Code and its advantages. Object Oriented Programming and Design: Review of Abstraction, Objects and other basics, Encapsulation, Information hiding, Method, Signature, Classes and Instances, Polymorphism, Inheritance, Exceptions and Exception Handling with reference to object modeling, Coupling and Cohesion in object oriented software. Object Oriented Design – Process, Exploration and Analysis. Java Programming Basics: Fundamentals: Variables and assignments, Input and Output, Data Types and Expressions, Flow of control, Local variables, Overloading Parameter passing, this pointer, Java Object Oriented Concepts: Objects and Classes: Use of file for I/O, Formatting output with stream functions, Character I/O, Inheritance, Public and private members, Constructors for initializations, Derived classes, Flow of Control Java Data Structures and Advanced Topics Arrays – Programming with arrays, arrays of classes, arrays as function arguments, Strings, Multidimensional arrays, Arrays of strings, vectors, Base classes. Introduction to Java Applets Text/References: 1.Herbert Schildt: JA V A 2 - The Complete Reference, TMH, Delhi 2.U.K. Chakraborty and D.G. Dastidar: Software and Systems - An Introduction, Wheeler Publishing, Delhi. 3.Joseph O’Neil and Herb Schildt: Teach Yourself JA VA, TMH, Delhi. CP-377 Concurrent Programming (3-0-2)4 Concurrent versus sequential programming. Concurrent programming constructs and race condition. Synchronisation primitives. Processes and threads. Interprocess communication. Livelock and deadlocks, starvation, and deadlock prevention. Issues and challenges in concurrent programming paradigm and current trends. Text/References: 1.Mordechai Ben-Ari. Principles of Concurrent and Distributed Programming , Prentice-Hall International. 2.Greg Andrews. Concurrent Programming: Principles and Practice , Addison Wesley. 3.Gadi Taubenfeld. Synchronization Algorithms and Concurrent Programming, Pearson. 4.M. Ben-Ari. Principles of Concurrent Programming, Prentice Hall. 5.Fred B. Schneider. On Concurrent Programming, Springer. 6.Brinch Hansen. The Origins of Concurrent Programming: From Semaphores to Remote Procedure Calls, Program Elective II (Semester VI) CP-372 Digital Signal Processing (3-0-2)4 Introduction to Continuous time Systems ,idea about Linear Time Invariant System LTI systems. Fourier Transforms. Discrete Time Systems: Sampling and aliasing, LTIs , Representation of Sequences by Fourier Transform and properties of Fourier Transform. Z-Transform, Structures for discrete system, DFT, Computation of DFT. FIR Filters, frequency response of FIR filters. IIR Filters, spectrum analysis. FFT Algorithms Text/References: 1.Discrete Time Signal Processing by Alan V Oppenheim, Ronald W Schafer.- PHI 2.Digital Signal Processing Primer : K.Steiglitz, Pearson. 3.Signal and Systems: S.Haykin and Veen, Wiley 4.DSP First: A Multimedia Approach : J.F.McClellan, Schafer and Yodar, Pearson. CP-374 Wireless Communications (3-0-2)4 History of wireless communication, and future trends. Wireless Generations and Standards. Cellular Concept and Cellular System Fundamentals .Trunking Cell Splitting and Sectoring. Mobile Radio signal propagation, path loss and channel models. Large Scale Path Loss. Small Scale Path Loss - Rayleigh and Rician Fading. Analog Modulation Schemes for Wireless Communication - AM/FM. Digital Modulation Techniques for Wireless Communication Preliminaries. Baseband Modulation Schemes Bandpass Modulation Techniques. Fading Counteraction – Diversity, Coding and Interleaving. Source and Channel Coding. Speech Coding for Wireless Communications. Adaptive Equalization. Multipath Propagation, Doppler. Multiplexing and Multiple Access techniques. TDMA, FDMA , ALOHA - Packet Radio, Spread Spectrum-CDMA ,Frequency Hopped Spread Spectrum, Inter-Symbol Interference (ISI) , ISI mitigation; Equalization, Random Access Protocols. Wireless Networking, Wireless Standard. Third generation systems and advanced topics Wideband-CDMA, MCCDMA. OFDM principles: Comparison of OFDM and CDMA. WLAN and Bluetooth. Text/References: 1.Wireless Communications: Principles and Practice, 2nd edition, T. Rappaport, Prentice Hall, 2002 2.K. Pahlavan & P. Krishnamurthy, Principles of Wireless Networks, Prentice Hall: 3.Wireless Communications Systems, A. Goldsmith, Cambridge, 2005 4. CP-376 VHDL (3-0-2)4 1.Overview of VHDL, fundamentals of VHDL, Lexical elements Data types and objects 2. Data Flow style: Conditional and selected Concurrent assignment, block assignment If and wait statement, Design for synthesizability 3.Structural style: Instantiation and component declaration, statement configuration declaration, generate statement, examples of structural design 4.Behavioural Style : Signal assignment, statement like case, process and wait loop, exit etc., concurrent signal assignment statements, function and procedures, file I/O operations and Testbenches. Text/References: 1. Peter J. Ashenden ,” The Designer's Guide to VHDL", published by Morgan Kaufmann” Kaufmann Pub. 1.SS Limaye,” Digital Design with VHDL”, CMR 2.Douglas Parry, “ VHDL Programming by Example”, MGH 3.Xilinx, “ Programmable Logic Design Quick Start Hand Book II ed. 4.Xilinx,” A CPLD VHDL Introduction Application Notes” CP-378 Neural Networks (3-0-2)4 Neural Architecture : Neuron model, transfer function, hamming and Hopfield network, perceptron, learning rule, recurrent networks. Back propagation: generalized delta rule, limitations, modifications – momentum, variable learning rate, conjugate gradient. Learning: Supervised, associative, competitive, unsupervised learning. Unsupervised learning : Self-organizing maps, Adaptive Resonance Theory. Neural network applications : Pattern classification, function approximation. Text/ References: 1.Simon Haykin: Neural Networks: A Comprehensive Foundation (2nd Edition) 2.Christopher M. Bishop: Neural Networks for Pattern Recognition 3.James A. Freeman, David M. Skapura: Neural Networks, Pearson Education. 4.Martin T. Hagan: Neural Network Design, Thomson Learning. Program Elective III (Semester VII) CP-471 Computer Graphics (3-0-2)4 Introduction to computer graphics : Vector and Raster graphics, Graphic primitives and attributes. Computer graphics devices - CRT, plasma, LCD, plotters, Scan conversion of line, circle and ellipse. Viewing Transformations : Coordinate system - world, device and normalized device coordinates, Window and Viewport and viewing transformations Filling and Clipping - Flood fill and seed fill algorithms and scan line polygon filling algorithms, Cohen Sutherland clipping algorithms for Polygon Geometric transformations - 2D and 3D transformations: Translation, Scaling, rotation, Shearing, reflection etc., Transformations about an arbitrary axis Projections: Parallel - Orthographic, Plans and Elevations, Axonometric - Isometric, Diametric, trimetric, Perspective - One point, two point, three point. Hidden surface removal : Object space and image space algorithms, Back space removal, Z-buffer, scan line, area subdivision, painters, BSP tree, Floating horizon and ray tracing methods Curves: Spline representations, Curve representation techniques, Continuity constraints, Hermite Interpolation, Bezier curves, B-Spline curves Text/References: 1.Foley, Van Dam. Computer Graphics: Principles and Practic. Addison Wesley. 2.Hearn and Baker. Computer Graphics. PHI. 3.Rogers and Adams. Mathematical Elements of Computer Graphics. McGraw Hill. 4.Rogers and Adams. Procedural Elements of Computer Graphics. McGraw Hill. CP-473 Speech Recognition (3-0-2)4 Overview of Speech Recognition; What is Speech; Why is it important; Applications and issues. Speech Production; Mechanism of speech production; Categories of sounds; Sound units in indian languages. Nature of Speech Signal; Source-system characteristics; Segmental and suprasegmental features; Temporal and spectral parameters for sound units in indian languages. Basics of Digital Signal Processing; Signals and systems; Discrete fourier transform; Digital filtering; Stochastic processes. Speech Signal Processing Methods: Short-time spectrum analysis; Spectrograms; Linear prediction analysis; Cepstrum analysis. Speech Recognition; Isolated word recognition; Connected word recognition Continuous Speech Recognition; Speech recognition problem; Hidden markov models. Other Applications: Word spotting; Speaker recognition; Speech enhancement; Speech synthesis; Practical issues in speech Recognition. Text/References: 1.Spoken Language Processing: A Guide to Theory, Algorithm and System Development by Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, Raj Reddy Prentice Hall PTR; ISBN: 0130226165 2.Speech Communications : Human & Machine by Douglas O'Shaughnessy, IEEE Press, Hardcover 2nd edition, 1999; ISBN: 0780334493. 3.Digital Processing of Speech Signals, Rabiner and Schafer, Prentice Hall, 1978. 4.Fundamentals of Speech Recognition, Rabiner and Juang, Prentice Hall, 1994. 5.Speech and Audio Signal Processing : Processing and Perception of Speech and Music by Nelson Morgan and Ben Gold, July 1999, John Wiley & Sons, ISBN: 0471351547 6.Discrete-Time Speech Signal Processing: Principles and Practice by Thomas F. Quatieri Publisher: Prentice Hall; ISBN: 013242942X; 1st edition (October 29, 2001) 7.Speech Processing and Synthesis Toolboxes by Donald G. Childers, John Wiley & Sons, September 1999; ISBN: 0471349593 CP-475 Mobile Computing (3-0-2)4 Introduction to mobile computing: principles, classification & overview of devices, operating systems. Wireless transmission: brief overview, multipath propagation, hidden & exposed terminals. Medium access control & protocols: SDMA, FDMA, TDMA, DAMA, FAMA, PRMA, Reservation TDMA, polling, CSMA/CA, CDMA etc. Wireless LAN: infrastructure & ad-hoc networks, IEEE 802.11, HIPERLAN. Mobile network layer: mobile IP, DHCP, infrastructure & Ad-hoc routing. Mobile transport layer: indirect TCP, snooping TCP, mobile TCP etc. mobile support, WWW & mobility, WAP. Text/ References: 1.Principles of mobile computing Hansmann & Merk., Springer 2. Mobile communications Jochen Schiller , Pearson 3. 802.11 wireless networks Matthew S.Gast, O'REILLY . 4. Wireless LANs: Davis & McGuffin, McGraw Hill 5. Mobile Communications Handbook by Jerry D. Gybson 6. Mobile Communications Handbook by Raymond Steel CP-477 Software Project Management (3-0-2)4 Software Project Management Concept: The Management Spectrum, People, Product, Process & Project. Software Process & Project Matrix: Software Measurement, Size Oriented Matrices, Function Oriented Matrices. Software Project Planning: Objectives, Decomposition Techniques and Empirical Estimation Model. Risk Analyses and Management: Risk Identification, Projection, Risk Identification, Projection, Risk Refinement, Risk Monitoring and Management. Project Scheduling & Tracking, Software Quality Assurance, Software Configuration Management. Text/References: 1.R. S. Pressman, Software Engineering 2.P. Jalote, Software Project Management in Practice. 3.B. Hughest & M. Cotterell, Software Project Management. CP-479 Data Compression (3-0-2)4 Compression: Need, Lossless v/s lossy compression, review of information theory, prefix codes, uniquely decodable code. Lossless Compression : Huffman coding – minimum variance, optimal, non-binary, extended, adaptive. Applications and limitations of Huffman codes, Run length encoding, Arithmetic coding, Predictive coding – Burrows-Wheeler transform, Delta modulation, Adaptive delta modulation Dictionary based compression - Lempel-Ziv-Welch, LZ77 and LZ-78 Lossy Compression Techniques – JPEG and its application Error detection and correction : Parity, 1,2,n dimensions, Hamming codes, p-out-of-q codes Quantization: Scalar and Vector Quantization. Texts/References: 1.Khalid Sayood, Introduction to Data Compression, Morgan Kauffman 2.Greg A. Harris, Darrel R. Hankerson, Peter

D. Jr. Johnson, Introduction to Information Theory and Data Compression, Second Edition , Chapman and Hall. 3.Saloman, Data Compression, Springer Verlag. 4.Nelson, The Data Compression book, Hungry Minds Program Elective IV (Semester VII) CP-481 Advances in Compiler Design (3-0-2)4 A Tour of Compiler Design, LR Parsers – SLR parsers, Canonical LR and LALR parsers, Lex and Yacc Tools, Control-flow Analysis, Control-flow Graphs, Basic Blocks, Data-flow Analysis, Dependence Analysis, Global Optimizations, Loop Optimizations, Dominators, Loop-invariant computations, Code motion, Data Dependence Analysis in Loops, Loop Scheduling, Runtime System Architectures and Automatic Memory Management Techniques. Text/References: 1.Aho, Alfred V ., Sethi, Ravi, Ullman, Jeffrey D., Compilers: Principles, Techniques and Tools, Addison-Wesley. 2.Steven Muchnick, Advanced Compiler Design & Implementation, Morgan Kaufmann. 3.Keith Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann. CP-483 Natural Language Processing (3-0-2)4 Introduction; Goals of Natural Language Processing and Computational Linguistics. Finite State Automata and Transducers, Morphology. Parsing: Context Free Grammars, Generalized Phrase Structure Grammar, Earley Parsing ALgorithm. Transformational Grammar, Computational Models and Knowledge Representation. Semantics; Interpretation, time, tense and lexical semantics. Machine Translation, Natural Language Interfaces, Natural Language Generation. Text/References: 1.Allen James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995. Grosz, Sparck-Jones Webber 2.Readings in Natural Lnaguage Processing, Morgan Kaufmann, 1986. Winograd T. 3.Language as a Cognitive Process, Addison Wesley, 1972. Marcus M. 4.A Theory of Synactic Recognition for Natural Language, MIT Press, 1980. CP-485 Programming Paradigms (3-0-2)4 Introduction: History of Programming Languages, Syntax and Semantics, Paradigms. Procedure-oriented Programming : Procedures and Modularity, Built-in and User-defined Functions, Scope and Lifetime of Variables, Structures, Recursion, Pointers and Dynamic Memory Allocation. Case Study: C language. Object-Oriented Programming : Objects and Classes, Encapsulation, Information hiding, Method and Signature, Polymorphism and Inheritance. Case Study: C++ language. Aspect-Oriented Programming : Crosscutting concerns, Aspect , Joinpoint and Pointcuts, Advice and static crosscutting. Case Study: AspectJ language. Functional programming: I ntroduction, lists, User-defined data types, type classes, and arrays, Input/Ouput and Monad, Simple applications/programs. Case Study: Haskell language. Text/References: 1.Kerninghan and Ritchie: The 'C' programming language, Pearson Education. 2.Robert Lafore: C++ Programming, Sams. 3.Laddad: AspectJ in Action, Dreamtech. 4.Thompson: Haskell, The Craft of Functional Programming, Addison-Wesley. CP-487 Wireless & Ad-hoc Networks (3-0-2)4 Fundamentals of Wireless Communication Technology The Electromagnetic Spectrum – Radio Propagation Mechanisms Characteristics of the Wireless Channel - IEEE 802.11a,b Standard Origin Of Ad hoc: Packet Radio Networks , Technical Challenges, Driving Applications, Components of Packet Radios What Is an Ad Hoc Network? Types of Ad hoc Mobile Communications. Key definitions of ad- hoc, Advantages of ad-hoc/sensor networks, Unique constraints and challenges, Driving Applications, Media Access Control (MAC) Protocols, Issues in designing MAC protocols, Classifications of MAC protocols, MAC protocols Routing Protocol: Global State Routing (GSR), Dynamic State Routing (DSR), Fisheye State Routing (FSR), Ad hoc On-Demand Distance Vector (AODV), Destination Sequenced Distance – Vector Routing (DSDV). Transport Layer, Security Protocols :Introduction Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks - Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks -Classification of Transport Layer Solutions, security in Ad Hoc Wireless Networks – Network Security Requirements - Issues and Challenges in Security Provisioning -Network Security Attacks. Text/References: 1.C. Siva Ram Murthy and B.S. Manoj “Ad Hoc Wireless Networks: Architectures and Protocols”, Prentice Hall PTR,2004 2.C.K. Toh, Ad Hoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR ,2001 Charles E. Perkins, Ad Hoc Networking, Addison Wesley, 2000 3.Wireless Communications: Principles and Practice, 2nd edition, T. Rappaport, Prentice Hall, 2002 4.K. Pahlavan & P. Krishnamurthy, Principles of Wireless Networks, Prentice Hall CP-489 Real Time Systems (3-0-2)4 Introduction to Real-time systems, Issues in Real-time Systems, Real-time System Components, Classification of Real-time systems and Real-time tasks. Misconceptions about Real-time computing. Real-time System requirements: Speed, Predictability, reliability, adaptability. Specification of timing constraints. Real-time scheduling: Requirements and Issues, Terminology, modeling, Introduction static and dynamic scheduling schemes, cyclic scheduling, priority driven scheduling of periodic tasks, schedulability tests, Aperiodic task scheduling: fixed priority server/non-server based scheduling algorithms. Practical factors/overheads. Task Synchronization: Need and priority inversion problem, Priority Inheritance protocol, priority ceiling protocol and stack-based priority ceiling protocol for fixed priority preemptive system. Introduction to multiprocessor real-time systems, problems and issues. An overview of a real-time operating system Text/References: 1.J.W.S.Liu: Real-Time Systems, Pearson Education Asia 2.S.T.Lavi, A.K.Agrawala: Real-time system Design , McGraw Hill 3.P.A.Laplante: Real-time Systems Design and Analysis, An Engineer’s Handbook , IEEE Press 4.P.D.Laurence, K.Mauch: Real-time Microcomputer System Design, An Introduction , McGraw Hill Program Elective V (Semester VII) CP-491 Cryptography (3-0-2)4 Review of Number theory : Prime numbers, modular arithmetic, Fermat’s theorem, Euler’s theorem, Chinese remainder theorem, Discrete logarithms, Random number generation, factoring, prime number generation. Cryptography: Need, conventional techniques, stream ciphers, block cipher, steganography. Public v/s private key cryptography. Stream Ciphers: Caesar Cipher, mono-alphabetic and poly-alphabetic ciphers, Playfair Cipher, Hill Cipher, Rotor machines, One time pad,. Random Number Generation: Pseudo Random Number, PRNG, LFSR, Blum-Blum Shub generator Private-key cryptography: Feistel structure, DES (Data encryption standard), design of S-boxes, AES, Triple DES. Public key cryptography: Key management, Key exchange – Diffie-Hellman, El-Gamal, Merkle's Puzzle, Authentication, Signatures, Deniability, RSA. Threshold Cryprography : Sharing Secrets. Digital Signature: DSA and its variants, discrete logarithm based digital signatures. One-way hash functions – MD5, SHA (Secure Hash Algorithm). Cryptanalysis: Differential and linear cryptanalysis - cracking DES. Text/References: 1.Stallings, Cryptography and Network Security: Principles and

Practice, Pearson Education Asia. ISBN 981-403-589-0. 2.B Schneier, Applied Cryptography, Wiley. ISBN 0-471-11709-9 3.D Kahn. The Codebreakers, Sphere books. ISBN 0-7221-51497 4.P Wayner, Disappearing Cryptography, Academic Press. ISBN 0-12-738671-8 5.Cracking DES, Electronic Frontier Foundation. ISBN 1-56592-520-3 6.A.J. Menezes, P.C. van Oorschot and S.A. Vanstone, Applied Cryptography, CRC Press, ISBN 0-8493-8523-7, 1997 7.D.R. Stinson, Cryptography - Theory and practice, CRC Press, ISBN 0-8493-8521-0, 1995 CP-493 Embedded Systems (3-0-2)4 Introduction to embedded systems., design representations, level of abstractions, design methodologies, Models and architectures, Taxonomy of models and architectures, brief descriptions of specification languages, Specification requirement for embedded systems, Spec Chart and Spec Chart Description. Design challenges & issues, hardware and software design, co-design of software and hardware, ASIC. Design quality estimation : Quality matrix, software and hardware estimation. Introduction Sample design Specification of Answering machine/ Microcontroller 8051. Text /References: 1.Denial D. Gajski , frank Vahid: Specification and design of embedded systems , PH 2.Jonathan W. Valvano: Embedded Microcomputer Systems , Thomson Learning 3.Myke Predko: Programming and Customizing the 8051 Micro Controller , TMH 4.Ayala : 8051 Micro controllers , Penram Press CP-495 Data Mining (3-0-2)4 Introduction : Basic Data Mining Tasks, Data Mining Issues, Data Mining Metrics, Data Mining from a Database Perspective. Data Mining Techniques : A Statistical Perspective on Data Mining, Similarity Measures, Decision Trees, Neural Networks, Genetic Algorithms. Classification : Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms, Neural Network-Based Algorithms, Rule-Based Algorithms, Combining Techniques. Clustering : Similarity and Distance Measures, Hierarchical Algorithms, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes. Association Rules : Basic Algorithms, Parallel and Distributed Algorithms, Incremental Rules, Advanced Association Rule Techniques, Measuring the Quality of Rules. Advanced Techniques : Web Mining, Spatial Mining, Temporal Mining. Text/References: 1.M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education. 2001. 2.J. Han and M. Kamber. Data Mining: Concepts and Techniques. Morgan Kaufman. 2001. 3.I. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2000. 4.D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001. CP-497 VLSI Algorithms (3-0-2)4 1.Introduction of VLSI Technology, VLSI design cycle, design styles, basic Layout rules and circuit abstraction, introduction to standard Cell, Gate array, FPGA 2.Overview of basic graph algorithms, Graph algorithms for physical Design 3.Partitioning: Classification of partitioning algorithms, Karnighan-Lin Algorithm, FM Algorithm, Ratio cut algorithm 4.Floor-planning: Rectangular dual graph approach of floor-planning, hierarchical tree based approach, Integer programming based floor-planning. 5.Placement: placement by simulated annealing and force directed method 6.Routing: classification of routing algorithms, Global routing: Maze routing algorithms, line probe algorithms, Steiner tree based algorithms, Detailed Routing: Single layer and two layer routing algorithms, routing in FPGAs Text/References: 1.Naveed Shervawani, “ Algorithms for VLSI physical

Design Automation “ III Ed Springer 2.Sarrafzadeh and Wong “ An introduction to VLSI Physical design “ MGH 3.Sze: VLSI Technology 4.Weste and Eshranghan, “ Introduction toVLSI Design”. Pearson Edu. 5.Sadiq M. Sait, Habib Youssef, "VLSI Physical Design Automation: Theory and Practice", World Scientific Publishing Company; 6.Cormen Leiserson, Rivest, “ Introduction to Algorithms”, Pearson Edu. Program Elective VI (Semester VIII) CP-470 Network Security (3-0-2)4 Review of wired/wireless network protocols, intrusion detection systems, malicious software. Review of cryptographic algorithms, protocols, cryptanalysis, authentication and signature protocols. Kerberos, PKI, real-time communication security, IPSec: AH, ESP, IKE . SSL/TLS, e-mail security, PEM and S/MIME, PGP, web security, network management security, wireless security. Threats in networks, network security controls, firewalls, intrusion detection, administering security Honeypots, password management, malicious software, viruses and countermeasures Text/References: 1.C. Kaufman, R. Perlman, Network Securit, Prentice Hall. 2.Kurose & Ross, Computer Networking , Pearson Education. 3.Schiller J., Mobile Communications , Pearson Education. 4.W. Stallings, Cryptography and Network Security Principles and practice , Pearson Education. CP-472 Biometrics (3-0-2)4 Biometrics: Need, Conventional techniques of authentication, challenges - legal and privacy issues. Biometrics: DNA, fingerprint, Iris, Retinal scan, Face, hand geometry, human gait, speech, ear. Handwriting, Keystroke dynamics, Signature Multimodal biometrics: Combining biometrics, scaling issues. Biometric template security. Texts/References: 1.Julian D. M. Ashbourn, Biometrics: Advanced Identify Verification: The Complete Guide 2.Davide Maltoni (Editor), et al, Handbook of Fingerprint Recognition 3.L.C. Jain (Editor) et al, Intelligent Biometric Techniques in Fingerprint and Face Recognition 4.John Chirillo, Scott Blaul, Implementing Biometric Security CP-474 High Level Synthesis of Digital Systems (3-0-2)3 Overview. Design methodologies. Abstractions and views. Review of basic concepts in algorithms and graph theory Design representation and modeling, Modeling languages, Abstract models Synthesis at higher levels of abstraction Scheduling, Resource sharing Structural synthesis: Module selection. Pipeline. Control Synthesis at lower levels of abstraction, Logic synthesis Text/Reference: 1.G. D. Micheli. Synthesis and optimization of digital systems . 2.N.D. Dutt, D. D. Gajski. High level synthesis, Kluwer, 2000. 3.T. H. Cormen, C. E. Leiserson and R. L. Rivest, “ Introduction to Algorithms ,” McGraw-Hill, 1990 . 4.Recent papers from journals and conferences. CP-476 Selected Topics in Cryptography (3-0-2)4 Elliptic Curve Cryptography Secret Sharing, Threhold cryptography – Robust ElGamal system Visual Cryptography. Interactive zero knowledge proofs, witness hiding protocols. Group encryption, decryption. Group signatures, ring signatures. EV oting: requirements, issues and challenges, existing solutions, write-in ballots. Pair based cryptography – Weil and Tate pairing. Contemporary Issues. Text/References: 1.Oded Goldrich. Foundations of Cryptography – V ol I & V ol II. 2.Selected paper and online reference material. CP-478 Digital Image Processing (3-0-2)4 Digital Image Fundamentals: Image Model, Sampling, Quantization, Neighborhood, connectivity of pixels, Labelling of connected components, Distance measures Image Transforms: Fourier Transform, Discrete Fourier Transform, Properties of 2D Discrete Fourier Transform, The fast Fourier

Transform and its algorithm, number of operations, the inverse FFT. Discrete Cosine Transform and its applications, KL Transform, Convolution and correlation Image Enhancement: Enhancement by point processing, spatial filtering, enhancement in frequency domain, generation of spatial masks from frequency domain specifications Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding, region oriented segmentation Representation and Description: Representation schemes, boundary descriptors, regional descriptors. Morphology: Dilation, erosion, opening, closing, Hit-or-Miss Transform, some basic morphological algorithms like pruning, thinning and thickening Text/References: 1.Gonzalez and Woods. Digital Image Processing, Addison Wesley. 2.Castleman. Digital Image Processing. Prentice Hall. 3.Duda and Hart. Pattern Classification. John Wiley. Program Elective VII (Semester VIII) CP-480 Evolving Architectures (3-0-2)4 Special, and emerging advanced topics in different areas of Computer Engineering will be covered under this course. Text and References: 1. Research reports and papers from journals. CP-482 Topics in Advanced Computing (3-0-2)4 Fault Tolerant Computing : Fault Tolerance Strategies - Fault detection, masking, containment, location, reconfiguration, and recovery. Fault Tolerant Design Techniques - Hardware redundancy, software redundancy, time redundancy, and information redundancy. Parallel and Distributed Computing : Concepts and issues in parallel and distributed computing. Concepts and issues in quantum computing, Trusted Computing, Grid Computing Any other contemporary and relevant issues. GPGPU and Multicore computing. Text and References: 1.P. Jalote, Fault Tolerance in Distributed Systems , Prentice-Hall Inc., 1994 2.D. K. Pradhan (editor), Fault-Tolerant Computing, Theory and Techniques, Prentice-Hall, 1998. 3.Los Alamitos, CA, "Fault-tolerant Software Systems: Techniques and Applications", IEEE Computer Society Press, 1992. 4.Design and Analysis of Fault Tolerant Digital Systems, Barry W. Johnson, Addison Wesley, 1989 (Chapters 1-5). 5.A.K. Somani and N.H. Vaidya, ``Understanding fault-tolerance and reliability,'' IEEE Computer, vol.30, no.4, pp.45-50, Apr. 1997. 6.Research papers and internet resources. CP-484 Software Testing and Validation (3-0-2)4 Basic software testing principles - Software Quality, Software testing, test generation and test management. Acceptance Testing: User acceptance testing, alpha and beta testing. Verification and Validation, Functional and Non-functional system testing. Static and dynamic testing, Black-box or functional testing, structural, white box or glass box testing. Integration testing, component testing. Software testing tools. Books/References: 1.Recent papers from conferences and journals. 2.A. P. Mathur, Fundamentals of software testing. CP-486 Machine Learning (3-0-2)4 Introduction: Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. Inductive Classification: The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Learning conjunctive concepts. The importance of inductive bias. Decision Tree Learning: Representing concepts as decision trees. Recursive induction of decision trees. Overfitting, noisy data, and pruning. Ensemble Learning Using committees of multiple hypotheses. Bagging, boosting, and

DECORATE. Active learning with ensembles. Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing. Rule Learning: Propositional and First-Order: Translating decision trees into rules. Heuristic rule induction using separate and conquer and information gain. First-order Horn-clause induction (Inductive Logic Programming) and Foil. Learning recursive rules. Inverse resolution. Artificial Neural Networks: Neurons and biological motivation. Linear threshold units. Perceptrons: representational limitation and gradient descent training. Multilayer networks and back propagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks. Bayesian Learning: Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies. Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbor algorithm. Case-based learning. Clustering and Unsupervised Learning: L earning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabeled data. Text/References: 1.Bishop, C. (2006) Mitchell, T. M. (1997) Machine Learning. McGraw-Hill 2.Pattern Recognition and Machine Learning. Berlin: Springer-Verlag. 3.Richard O. Duda, Peter E. Hart and David G. Stork. Pattern Classi_cation. Wiley-Interscience,second edition, 2001. 4.Thomas Mitchell. Machine Learning. McGraw Hill Higher Education, First edition, 1997. 5.Stuart Russell and Peter Norvig. Arti_cial Intelligence: A Modern Approach. Prentice Hall,second edition, 2003. (Machine-learning related chapters.) 6.Information Theory, Inference and Learning Algorithms by David MacKay. CP-488 Modelling and Simulation (3-0-2)4 Analytical v/s simulation modeling, performance measurement and benchmarking, Workload modeling, random variables, commonly used distributions, Stochastic Processes, Performance evaluation methods, Evaluation Metrics’ Markov chains, Birth and Death Processes, Markov chain models of Computer systems, Steady-state and transient analysis Queuing models, M/M systems and their steady state analysis, Single server and multi-server queues, open and closed queuing networks Petri Net based Performance Modeling : Classical Petri Nets, Timed Petri Nets, Discrete Petri Nets, Modeling multiprocessor systems Discrete event simulation – Simulation languages, random number generation and testing, model verification and validation, analysis of simulation results, confidence intervals, variance reduction techniques, Case studies of analytical and simulation studies of computer systems Text/References : 1.Law and Kelton, Simulation Modeling and Analysis, Mcgraw Hill 2.Raj Jain, The Art of Computer System Performance Analysis, John Wiley 3.K.S.Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, PHI 4.Kant, Introduction to Computer System Performance Evaluation, Mcgraw Hill BTech_IT.pdf IT Page 1Semester12345678CHICPCPEOETotal I & II 45451IT-221IT-223IT-225IT-251EC-251EC-253 III 2319423 (3-1-0)(3-0-0)(3-0-0)(0-0-3)(3-0-2)(3-0-0)4332434HS-200IT-222IT-226IT-228IT-250IT-252 IV DBMS LabOS

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(3-0-0)(3-0-0)(0-0-3)(0-0-3)(0-3-0)3322344 1IT-451 IT-453 VII Design Elective 25318425 (0-3-0)344464IT-452 VIIIProject Discipline191108019 1044 1 Total Credits18051753420180B.Tech (Information Technology) Discipline /NSS Discrete StructuresData Structures and AlgorithmsFormal Languages and Automata TheoryData Structure and Algorithm LabElectronics Devices and CircuitsSwitching Theory & Finite AutomataOpen Elective I Social Science and EconomicsData Base Modelling and AdministrationOperating SystemComputer ArchitectureOpen Elective II Creative Arts/ Sports/ NSS/ Hindi Information System SecurityE-Commerce and Web ApplicationsComputer Network & AdministrationInformation System Security LabWeb based Development LabNetwork Programming & Administration LabProgram Elective IOpen Elective III Software Engg. Free and Open Source LabProgram Elective IIOpen Elective IV Industrial TrainingProgram Elective IIIProgram Elective IVProgram Elective VOpen Elective V Program Elective VIProgram Elective VII IT Page 2Program Elective I IT-371Programming in Java IT-373Python Programming IT-375Scripting Language IT-377Management Information Systems Program Elective II IT-370Signals and Systems IT-372Object Oriented System Design IT-374Multimedia Technology IT-376Artificial Intelligence Program Elective III Program Elective IV Program Elective V IT-471Computer Graphics IT-481Advanced Compiler IT-491Information Retrieval IT-473Human Computer Interaction IT-483Design and Analysis of Algorithms IT-493Wireless Sensor Networks IT-475GUI Programming IT-485Semantic Web IT-495Topics in High Speed Networking IT-477Selected Topics in OS IT-487Data Mining and Data Warehousing IT-497 IT-479Mobile and Wireless Computing IT-489Implementation of Data Bases IT-499Software Project Management Program Elective VI Program Elective VII IT-470Digital Forensics IT-480 IT-472Biometric Security IT-482Software Testing IT-474VLSI Algorithms IT-484Distributed Systems IT-476Intrusion Detection IT-486Advanced Topics in Data Bases IT-478Pattern Recognition IT-488Expert SystemsDigital Watermarking and Steganography Multi-Core Architectures B.Tech Information Technology Semester III IT-221 Discrete Structures (3-0-0)3 Logic: Introduction to Logic, Propositional Logic and Predicate Logic Propositional Logic: Elements of Propositional Logic, Truth Table, Connectives, Construction of Proposition, Converse and Contrapositive, Reasoning with Propositions, Identities of Propositions and Dual, Use of Identities, Implications, Reasoning with Propositions, Proof of Identities, Proof of Implications. Predicate Logic: Well Formed Formula (Wff) of Predicate Logic, Predicate, Quantification, Constructing Formulas, Reasoning with Predicate Logic, Quantifiers and Connectives. Set and Functions : Sets, relations, functions, operations, and equivalence Relations, relation of partial order, partitions, binary relations, Equivalence relations . Recursion, Proof by Induction Number-theoretic algorithms : Greatest Common Divisor, Chinese Remainder Theorem, Primality testing, polynomial representation of binary number, Galois fields,

primitive roots, discrete logarithms. Text/ References: 1.Kolman B., Busby R: Discrete Mathematical Structures for Compute Science , PHI. 2.Liu: Introduction to Discrete Mathemetics , McGraw-Hill. 3.Graham, Knuth, Pratshnik : Concrete Mathematics . 4.Grimaldi: Discrete Mathematical Structures . 5.Grossman P, Discrete Mathematics for Computing , Macmillan 1995 6.Ross KA & Wright CRB, Discrete Mathematics , Prentice-Hall 1999 7.Johnsonbaugh R, Discrete Mathematics , Macmillan. 8.Wiitala, Discrete Mathematics , McGraw Hill. 9.Biggs N L, Discrete Mathematics , Oxford. 10.Truss J, Discrete Mathematics for Computer Scientists , Addison Wesley. IT-223 Data Structures and Algorithms (3-0-0)3 Introduction to data structures, dynamic aspects of operations on data, analysis of algorithms. Creation and manipulation of data structures: arrays, lists, stacks, queues, trees, graphs, heaps, hashing and hash tables, height balanced trees, tries. Algorithms and data structures for sorting and searching, merging, graph traversals, shortest path and minimum spanning tree, order statistics, data structures for images, greedy algorithms, dynamic programming, algorithms- data structures dependency, introduction to complexity analysis and measures. Special topics from problems in computational geometry and string matching Text/ Refernces: 1.Kruse R.L., Data Structure and Program Design, PHI. 2.Rivest, Cormen, Introduction to Algorithms, MIT Press 3.Horowitz and Sahni: Data Structure in C++ , Glagotia 4.Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures 5.Aaron M. Tenenbaum, Y . Langsam, Moshe J. Augenstein, Data Structures Using C IT-225 Formal Languages and Automata Theory (3-0-0)3 Introduction to formal languages and their operations, abstract machines. Finite automata and regular expressions, Non-deterministic finite automata, Mealy and Moore machines, minimization of finite automata, Pumping lemma for regular languages. Chomsky classification of languages, regular grammars, context free grammars, simplification of context free grammars, Normal forms of context free grammars. Push Down Automata Theory: Push down automata and context free languages, Pumping lemma for context free languages. Turing hypothesis, Turing machine, Minskey’s theorem, TM variation and encoding, computability and acceptability. Text/ References: 1.Hopcroft, Motwani and Ullman: Introduction to Automata Theory, Languages and Computation , Pearson Education. 2.Cohen: Introduction to Computer Theory , Addison Wesley. 3.Martin: Introduction to Languages and Theory of Computation, TMH. IT-251 Data Structure and Algorithm Lab (0-0-3)2 The following proposed coverage are broad guiding areas in lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with IT-223. 1.Implementation of experiments with, basic data structures and use in dynamic operations on data for different algorithms and problem domains; 2.Analysis of basic sorting and searching algorithms and their relationship to these data structures. Comparison of asymptotic complexity with real behaviour of algorithms; 3.Sorting programs: Bubble sort, Merge sort, Insertion sort, Selection sort, and Quick sort. 4.Searching programs: Linear Search, Binary Search. 5.Array implementation of Stack, Queue, Circular Queue, Linked List. 6.Implementation of Stack, Queue, Circular Queue, Linked List using dynamic memory allocation. 7.Implementation of Binary tree. 8.Program for Tree Traversals (preorder, inorder, postorder). 9.Program for graph traversal (BFS, DFS). 10.Program for minimum cost spanning tree, shortest path. Text/ References: 1.Kruse R.L., Data Structure and Program Design, PHI. 2.Rivest, Cormen, Introduction to Algorithms, MIT Press 3.Horowitz and Sahni: Data Structure in C++ , Glagotia 4.Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures 5.Aaron M. Tenenbaum, Y . Langsam, Moshe J. Augenstein, Data Structures Using C EC-251 Electronics Devices and Circuits (3-0-2)4- As offered by the ECE Department. EC-253 Switching Theory & Finite Automata (3-0-0)3- As offered by the ECE Department. Open Elective I (X-X-X)3/4 Please refer to concerned Department. B.Tech Information Technology Semester IV HF-201 Humanities and Social Sciences (X-X-X)2 Please refer to Humanities and Social Sciences Department. IT-222 Data Base Modelling and Administration (4-0-0)4 Design: Conceptual design, three tier architecture, ER Diagram – entity (strong and weak), Data aggregation, specialization, generalization. Data models: Relational, Network, Hierarchical and Object Oriented. Normalization: Constraints – integrity and domain, Primary key, Super key, foreign key, Alternate key, candidate key, normal forms 1NF, 2NF, 3NF, BCNF, 4NF. SQL: DDL and DML, Relational Algebra, SQL Queries, Triggers and views, Constraints assertions. Data Organization: Sequential, indexed random and hashed files. Inverted and multilist structures, B trees, B+ trees, Query Optimization, Join Algorithm, Statistics and Cost Base optimization. DBMS internals: Transaction Processing, concurrency control, and recovery management. Transaction model properties and state serialisability , Lock base protocols, two phase locking. Text/References: 1.Almasri and S.B. Navathe: Fundamentals of Database Systems , Addison Wesley. 2.Kevine Kline, SQL in Nutshell, O'Reilly & Associates. 3.Raghu Ramakrishnan, Johannes Gehrke Database Management Systems , McGraw Hill. 4.H.F. Korth, Silberschatz, Sudarshan: Database Systems Concepts , McGraw Hill 5.C.J. Date: Data Base Design, Addison Wesley 6.Hansen and Hansen : DBM and Design, PHI IT-224 Operating System (3-0-0)3 Operating System Overview: Operating Systems objectives & functions, the evolution of operating Systems, Major Achievements, Examples of Operating systems. Process Description & Control: Process states, Process Description, Process Control, and Processes & Threads. Concurrency: Mutual Exclusion & Synchronization Principles of Concurrency, Mutual Exclusion-Software Approaches. Graphical User Interface & OS: Introduction , Windowing Technology, GUI, Relationship between the OS & Windows, Components of GUI, and Requirement of a Windows based GUI, MS-WINDOWS & NT, and Windows 2000. Introduction to UNIX Operating system. Text/References: 1.Modern Operating Systems by Tanembaum (PHI) 2.Operating System Concepts- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley. 3. Systems Programming & Operating Systems (Second Edition) by Dhamdhere (TMH) IT-226 Computer Architecture (3-0-0)3 Introduction to computer architecture and organization: Digital components, V on Neumann Machine Architecture, Flynn Classification Register Transfer Language : Micro operations - data transfer operations, arithmetic, logic and shift micro operations and their hardware implementations as a simple Arithmetic and logic unit. CPU Organization: Addressing techniques - Immediate, direct, indirect, register, register indirect, index, relative and stack addressing techniques. Instruction formats : Instruction set design, Instruction types: example for zero address, one address, two address and three address machines, Stack, accumulator and general purpose register organization Arithmetic Algorithms : Arithmetic and Logic Unit, Adders - Full adder, Ripple carry adder, Carry look ahead adder, Carry select adder, carry save adder, Multiplication - Add and Shift method, Booth's Multiplier,m Array Multiplier, Division - Restoring and Non restoring method. Pipelining: Pipeline structure, pipeline performance measures, Pipeline types - Instruction and Arithmetic pipelines. Memory Organization: Memory device characteristics, RAM organization: 1D and 2D organization, Virtual memory - Paging and Segmentation, High speed memories: Associative and Cache memory Control Unit Design, Hardwired and Micro programmed control unit design implementation techniques Input-Output Design: IO interface, Bus structure, Modes of data transfer, Interrupts, Input Output Processor, Serial Communication Text/References: 1. Computer Architecture: A Quantitative Approach, J.L. Hennessy and D.A. Patterson, 4th Edition Elsevier. IT-252 DBMS Lab (0-0-3)2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with IT-222. 1. Conceptual designs using ER diagrams. 2. Design of databases. Based on templates, files and relational basis. 3. Development and implementation of DB system from the fundamentals. 4. Experiments on SQL queries. IT-254 OS Lab (0-0-3)2 The following proposed coverage are broad guiding areas in lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with IT-224. 1.Write shell scripts for (i) multiplication table generation, (ii) copying multiple files to a directory, (iii) counting the number of lines and words present in a given file, (iv) displays the list of all the files in a given directory. 2.Write a shell script to implement small calculator – addition, subtraction, multiplication and division of two integers. Division has two options: one returns the quotient and the other returns remainder. 3.Write a shell script to reverse the rows and column of a matrix. 4.Write a C program to implement CPU Scheduling. 5.Write a C program to page replacement algorithms. 6.Write a C program to implement virtual memory. 7.Write a C program using fork() to illustrate process management. 8.Write a C program to implement concurrent programming constructs through semaphores – dining philosophers' problem, consumer-producer, readers-writers etc. 9.Write a C program that inllustrate how to execute two commands concurrently with a command pipe. 10.Write a C program to implement deadlock avoidance algorithms. Text/References: 1.Unix concepts and applicaions by Sumitbha Das,TMH applications. 2.Unix Programming by stevens, Pearsons Education. 3.Shell Programming by Yashwant Kanetkar. 4.Operating System concepts by silberschatz, and Peter Galvin. Open Elective II (X-X-X)3/4 Please refer to concerned Department. B.Tech Information Technology Semester V IT-321 Information System Security (3-0-0)3 Review of Number theory : Prime numbers, modular arithmetic, Fermat's theorem, Euler's theorem, Chinese remainder theorem, Discrete logarithms, Random number, prime number, factoring, . Cryptography: Classical, stream and block cipher, steganography. Public v/s private key cryptography. Random Number Generation: Pseudo Random Number, PRNG, LFSR, Blum-Blum Shub generator Private-key cryptography: Feistel structure, DES, design of S-boxes, AES, Triple DES. Public key cryptography: Key management, Key exchange – Diffie-Hellman, El-Gamal, Merkle's Puzzle, Authentication, Signatures, Deniability, RSA. Threshold Cryprography : Sharing Secrets. Digital Signature: DSA and its variants, discrete logarithm based digital signatures. One-way hash functions – MD5, SHA (Secure Hash Algorithm). Cryptanalysis: Differential and linear cryptanalysis - cracking DES. Text & References: 1.Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education Asia. ISBN 981-403-589-0. 2.B Schneier, Applied Cryptography, Wiley. ISBN 0-471-11709-9 3.D Kahn. The Codebreakers, Sphere books. ISBN 0-7221-51497 4.P Wayner, Disappearing Cryptography, Academic Press. ISBN 0-12-738671-8 5.Cracking DES, Electronic Frontier Foundation. ISBN 1-56592-520-3 6.A.J. Menezes, P.C. van Oorschot and S.A. Vanstone, Applied Cryptography, CRC Press, ISBN 0-8493-8523-7, 1997 7.D.R. Stinson, Cryptography - Theory and practice, CRC Press, ISBN 0-8493-8521-0, 1995 IT-323 E-Commerce and Web Applications (3-0-0)3 Electronic commerce environment and opportunities: Back ground – The Electronic commerce Environment – Electronic Market Place Technologies. Modes of electronic commerce: Overview – EDI – Migration to open EDI – E commerce with WWW/Internet – Commerce Net Advocacy – Web commerce going forward. Approaches to safe electronic Commerce – Overview – Source – Transport Protocols – Secure Transactions – Secure Electronic Payment Protocol – Secure Electronic Transaction – Certificates for Authentication – Security on Web Servers and enterprise networks. Electronic cash and electronic payment schemes – Internet Monitory Payment and Security requirements – payment and purchase order process – online electronic cash. Master card/ Visa Secure electronic transaction: Introduction – Business requirements - Concepts - Payment Processing. Email and Secure Email Technologies for Electronic Commerce: Introduction – The means of Distribution – A model for Message Handling – How Does a Email Work. Internet Resources for Commerce: Introduction – Technologies for Web Servers – Internet Applications for commerce – Internet Charges – Internet Access and Architecture – Searching the Internet. Text/ References: 1.Web Commerce Technology Hand Book Daniel Minoli, Emma Minoli McGraw Hill 2.Frontiers of Electronic Commerce Ravi Kalakotar, Andrew B.Whinston Addison-Wesley IT-325 Computer Networks & Administration (4-0-0)4 1.Computer network architecture, Physical layer: Hardware, topology, data encoding, 2.Data Link Layer: Logical link Control: Error detection and Correction, ARQ protocols, Framing protocols(HDLC, LLC) Medium Access Control: Multiple access protocols, Channel Allocation, contention, reservation, round robin with Examples. 3.Network Inter connection: Generic switches, switch design issues, switching mechanism : virtual Circuit switching, datagram switching, source route switching, Bridge and bridge learning , Global Addressing scheme, fragmentation and reassembly, Address translation: ARP, RARP, ICMP, IP Scalability Issues, sub netting and super netting (CIDR) , IP Routing, EGP, BGP protocols 4.End to End protocols: End to end issues, UDP and TCP segment formats, connection establishment and termination, state transition sliding window protocol, TCP Flow control, Silly window syndrome, TCP retransmission, RTT Estimation, TCP Congestion Control and congestion avoidance protocols 5.Internet applications: Client server paradigm, DNS, SMTP, RPC, NFS and General network security issues. 6.Introduction to Network management protocols. Tools and techniques for network monitoring authentication, and administration. Text/References: 1.Data Networks: Bertsekas and Gallagher, Phi. 2.Computer Networking A Top down Approach: J.F.Kurose, Pearson. 3.Computer Networks A Systems Approach: L. Peterson and B. Davie, Elsevier 4.Computer Networks and Internet: D.E. Comer, Pearson IT-351 Information System Security Lab (0-0-3)2 The following proposed coverage are broad guiding areas in lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with IT-321. 1.Implementation of Classic Ciphers. 2.Extended Euclid algorithm implementation. 3.Implementation of DES encryption and decryption. 4.Implementation of Polynomial arithmetic, Galois Fields. 5.Implementation of AES encryption and decryption. 6.Implementation of hash function. 7.Solution of Equations through CRT. 8.Implementation of an authentication scheme. 9.RSA implementation. 10.Digital Signature implementation. Text/References: 1.B Schneier, Applied Cryptography, Wiley. ISBN 0-471-11709-9 2.A.J. Menezes, P.C. van Oorschot and S.A. Vanstone, Applied Cryptography, CRC Press, ISBN 0-8493-8523-7, 1997 3.D.R. Stinson, Cryptography - Theory and practice, CRC Press, ISBN 0-8493-8521-0, 1995 IT-353 Web based Development Lab (0-0-3)2 Topics to be covered in the lab: . Introduction to Web Programming . Installation of PHP/MySql and web server . Introduction to PHP programming . Writing PHP Programs . Loops, Control Structure and Arrays . PHP functions . String functions . Array functions . Mathematical function . Graphics functions . File system function . Date and time function . Miscellaneous Functions Error handling Object Oriented Features of PHP File and Directory handling . MySql database . Configuration of MySql server. Starting MySql server . MySql tables . Displaying MySql data . Adding and removing user access . Advance PHP programming . mail . PHP - generated PDF files . Web Servers . IIS web Server . Apache web server. Text/References: 1. Beginning PHP 4 Databases – Christopher Scollo, Harish Rawat, Dipak Thomas, Sanjay Abraham, Andrew Hill & Jim Hubbard; Wrox Press 2.PHP MySql Website Programming – Chris Bea, Mike Duzzard, Jessy White, Cinis & Dilip Thomas; Wrox Press 3.PHP Black Book – Peter Moulding, Coriolis Group 4.MySql – PHP Database Applications – Jay Greenspan & Brad Bulger; John Wiley & Sons 5.PHP MySql Website Programming: Problem-Design-Solutions – Chris Bea, Mike Duzzard, Jessy White, Cinis & Dilip Thomas; Apress 6.Essential PHP for Web Professionals – Christopher Cosentino; Prentice Hall 7.Sam's Teach Yourself PHP 4 in 24 Hours – Matt Zandstra; SAMS 8.PHP 5.1 For Beginners – Ivan Bayross, O'Reilly, Shroff Publishers & Distributors Pvt. Ltd IT-355 Network Programming & Administration Lab (0-0-3) 2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with IT-325. 1.Programming for data encoding, CRC detection and Correction. 2.Estimation of network delay through OS utilities. 3.Simulation and Emulation of Bus and Star topology, DLC, MAC protocols using Benchmark LAN trainer kits. 4.Packet measurement and observation using network sniffing tools. 5.Use of sniffers for protocol dynamics. 6.Installation and working of RRD toold for looging administration data for networks. 7.Bandwidth and other network parameter mechanism through SNMP protocols. Program Elective I (3-0-2)4 One/More of the following courses as offered by Department. IT-371 Programming in Java IT-373 Python Programming

IT-375 Scripting Languages IT-377 Management Information Systems Open Elective III (X-X-X)3/4 Please refer to concerned Department. B.Tech Information Technology Semester VI IT-322 Software Engg. (3-0-0)3 Introductory Concepts: Historical perspective, System Definition, Software Life Cycle, Software Engineering paradigms. System analysis: Feasibility study requirement analysis, Cost benefit analysis, Planning systems, Analysis tools and techniques. System Design: design fundamentals, Modular Design, Data and procedural design, object oriented design. System Development: Code documentation, Program design paradigms. Verification, Validation and Testing: testing methods, Formal Program Verification, Testing Strategies. Software Maintenance: Maintenance Characteristics, Maintainability, Maintenance tasks and side effects. Text/References: 1.Pressman R.S: Software Engineering: A Practitioner approach, McGraw Hill. 2.Sommerville I: Software Engineering, Addison Wesley 3.Ghezzi C. Jazayeri M and Mandrioli: Fundamentals of Software Engg. , PHI. IT-324 Compiler Design (3-0-0)3 Introduction to translators, compilers versus interpreters, compilation process. Lexical Analysis: Finite automata and Regular expressions, Minimization of finite automata. Syntax Analysis: Context Free Grammars, Bottom-up and Top-down Parsing. Ambiguity, Shift Reduce Parser, Operator Precedence Parser, Predictive Parsers, LR parsers. Syntax directed translation: Syntax directed translation, Synthesized and Inherited attributes, Intermediate codes- Postfix, Quadruples, Triples. Code optimization: Basic blocks, Flow graphs, Local and Global data flow analysis – DAG, ud- chaining, available expressions, Loop optimization. Code generation: Compilation of expression and control structures. Error detection and recovery. Symbol table organization: Hashing, linked list, tree structures. Text/References: 1.Aho, Ullman and Sethi: Compilers – Principles, techniques and tools, Pearson Education. 2.Tremblay, Sorenson: The Theory and Practice of Compiler Writing, BSP. 3.Holub, Compiler Design in C, PHI. IT-352 Compiler Lab (0-0-3)2 The following proposed coverage are broad guiding areas in lab. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with IT-324. 1.Programming exercises to implement typical lexical analyzers, parsers, intermediate code generation. 2.Assignments using LEX and YACC tools. 3.Programming assignments on some of the concepts related to Code Optimization. Text/References: 1.Aho, Ullman and Sethi: Compilers, Pearson Education. 2.Levine, Mason and Brown: Lex and Yacc, O'Reilly IT-354 Seminar (0-2-0)2 The topics selection covering the latest and relevant topics related to the emerging areas. Ideally, some recent reputed journal papers abstraction and presentation shall be encouraged for presentation. The evaluation shall be continuous and through components evaluation viz. content, coverage, depth, presentation, response to the queries, and seminar report. In case of unsatisfactory performance, an X grade can be awarded for extension work during summer term. Program Elective II (3-0-2)4 One/More of the following courses as offered by Department. IT-372 Signals and Systems IT-374 Object Oriented System Design IT-376 Multimedia Technology IT-378 Artificial Intelligence Open Elective IV (X-X-X)3/4 Please refer to concerned Department. Open Elective V (X-X-X)3/4 Please refer to concerned Department. B.Tech Information Technology Semester VII IT-451 Industrial Training (0-2-0)2 The evaluation shall be continuous and through components evaluation viz. content, coverage, depth, presentation, demonstration, response to the queries, and training report. In case of unsatisfactory performance, and failure extra credit course from the department equivalent to CP-451 can be permitted through consent of DUGC. IT-453 Free and Open Source Lab (0-0-3)2 The following proposed coverage are broad guiding areas lab. The instructor offering the course in consultation with the theory offered can adopt further variations. 1.Linux basics and installation and management of the Linux. 2.Different types of software development environment (Eclipse) 3.make and other software construction utilities on Linux. 4.Version control and managing project in open source. 5.Managing large software development through wiki or alike project management tools. 6.Introduction to scripting for system management. Program Elective III (3-0-2)4 One/More of the following courses as offered by Department. IT-471 Computer Graphics IT-473 Human Computer Interaction IT-475 GUI Programming IT-477 Selected Topics in OS IT-479 Mobile and Wireless Computing Program Elective IV (3-0-2)4 One/More of the following courses as offered by Department. IT-481 Advanced Compiler IT-483 Design and Analysis of Algorithms IT-485 Semantic Web IT-487 Data Mining and Data Warehousing IT-489 Implementation of Data Bases Program Elective V (3-0-2)4 One/More of the following courses as offered by Department. IT-491 Information Retrieval IT-493 Wireless Sensor Network IT-495 Topics in High Speed Networking IT-497 Digital Watermarking and Steganography IT-499 Software Project Management IT-455 Project Lab (0-2-3)5 Objective of this elective is to facilitate transfer of knowledge acquired by a student to a field of his own choice for application to solving a problem. Student is expected to collect and study relevant material under mentorship of a faculty member working in similar area; identify a suitable problem and propose methodology towards its solution. Alternately a student can explore hardware implementation of existing solution(s). This elective shall act as prequel to project work for next semester. The project coordinator(s) from the department for continuity shall coordinate this course. Grouping and division shall be applicable as defined in the major project of final semester. Open Elective VI (X-X-X)3/4 Please refer to concerned Department. B.Tech Information Technology Semester VIII IT-452 Project (X-X-X)10 The major project covers lab component of the final semester work. The evaluation of project shall be continuous and will be done through project coordinator(s). The evaluation mechanism shall be evolved based on the existing practices through DUGC rectified from time to time. Ideally the project should comprise with group size of two students shall be limited to maximum 4 students and the groups shall be evenly distributed among faculty through coordinator(s). Internal and external components shall not exceed 40% each of the overall marks. IT-454 Group Discussions (0-0-3)2VL This lab will remain only if Industrial training is given weightage of 02 credits. Program Elective VI (3-0-2)4 One/More of the following courses as offered by Department. IT-470 Digital Forensics IT-472 Biometric Security IT-474 VLSI Algorithms IT-476 Intrusion Detection IT-478 Pattern Recognition Program Elective VII (3-0-2)4 One/More of the following courses as offered by Department. IT-480 Multi-Core Architectures IT-482 Software Testing IT-484 Distributed Systems IT-486 Advanced Topics in Databases IT-488 Expert Systems Open Elective VII (X-X-X)3/4 Please refer to concerned Department. Program Elective

I (Semester V) IT-371 Programming in Java (3-0-2)4 Introduction: Internet, Java as a tool for internet applications, Byte Code and its advantages. Object Oriented Programming and Design: Review of Abstraction, Objects and other basics, Encapsulation, Information hiding, Method, Signature, Classes and Instances, Polymorphism, Inheritance, Exceptions and Exception Handling with reference to object modeling, Coupling and Cohesion in object oriented software. Object Oriented Design – Process, Exploration and Analysis. Java Programming Basics: Fundamentals: Variables and assignments, Input and Output, Data Types and Expressions, Flow of control, Local variables, Overloading Parameter passing, this pointer, Java Object Oriented Concepts: Objects and Classes: Use of file for I/O, Formatting output with stream functions, Character I/O, Inheritance, Public and private members, Constructors for initializations, Derived classes, Flow of Control Java Data Structures and Advanced Topics Arrays – Programming with arrays, arrays of classes, arrays as function arguments, Strings, Multidimensional arrays, Arrays of strings, vectors, Base classes. Introduction to Java Applets Text/References: 1.Herbert Schildt: JA V A 2 - The Complete Reference, TMH, Delhi 2.U.K. Chakraborty and D.G. Dastidar: Software and Systems - An Introduction, Wheeler Publishing, Delhi. 3.Joseph O'Neil and Herb Schildt: Teach Yourself JA VA, TMH, Delhi. IT-373 Python Programming (3-0-2)4 Introduction to Python: Data types, variables, expressions, operators. Sequence, set, dictionary, print statement, control-flow statements, functions. Objects and classes, metaclasses. Decorators, special methods. Exception handling. Modules sys, os, etc. Strings and regular expressions. File operations. Working with processes and threads. Pipes and signals Graphical user interface design in Python (including the Tkinter module), Widgets and basic components, Layout options, Event handling Network scripting (sockets, FTP, and e-mail clients), Server-side scripting Databases and persistence in Python (including pickled objects and shelf files) Custom and built-in data structures in Python C integration with Python (including the SWIG module), Embedding Python calls within C Text/References: 8.Programming Python by Mark Lutz, O'Reilly. 9.Learning Python, 3rd Edition by Mark Lutz, O'Reilly 10.Python in a Nutshell by Alex Martelli, O'Reilly. 11.An Introduction to Python by Guido van Rossum and Jr. Fred L. Drake, Network Theory Ltd. IT-375 Scripting Language (3-0-2)4 Shell and Scripting languages introduction. AWK, Perl, and Python programming paradigms. Text/References: 1. Relevant online material with the latest version of the scripting languages. IT-377 Management Information Systems (3-0-2)4 Interpretation and understanding of information, need and role of information technology in business and organization. Information system: Basic elements, data, information, knowledge, infrastructure and types and its development. Organizing data and information: Basics of data arrangement and access, data knowledge & decision support, DBMS – An overview. Introduction to management information system Hardware and software used for information systems, transaction processing, office automation. Decision making process, concepts of information, humans as information processors, system concepts, organizational structure and management concepts. Text/ References : 1.Management Information and System, Davis and Olson, Mc-graw Hill. 2.Recent papers from conferences and journals. Program Elective II (Semester VI) IT-372

Signals and Systems (3-0-2)4 Review of signal description Review of Fourier and Laplace transforms Spectrograms; frequency modulation Sampling and aliasing The z-transform Filters: Transfer functions, FIR filters, IIR filters Spectral analysis: DFT for periodic signals, DFT for non-periodic signals Texts/References: 1.J H McClellan, R W Schafer & M A Yoder, DSP First: a Multimedia Approach , Prentice-Hall International 1998 2.A V Oppenheim , R W Schafer & J R Back, Discrete-time Digital Signal Processing , Prentice Hall Int 1999. Third major revision of classic text 3.A V Oppenheim , A S Willsky & S H Nawab, Signals and Systems, Prentice Hall Int 1996. 4.N K Sinha, Linear systems, John Wiley 1991 5.J G Proakis and D G Hanolakis, Digital Signal Processing , Maxwell Macmillan Int 1992 IT-374 Object Oriented System Design (3-0-2)4 Object Oriented Programming and Design : Review of abstraction, objects and other basics, Encapsulation, Information hiding, method, Signature, Classes and Instances, Polymorphism and inheritance. C++ Programming Basics : Fundamentals, variables and assignments, Input and Output, Data types and expressions, flow of control, subprograms, top-down design, predefined functions, user defined functions, procedural abstractions, local variables, overloading function names, operator overloading, parameter passing, this pointer, destructors, copy constructor, overloading the assignment operator, virtual functions, function calling functions, friend functions, recursive functions, recursive member functions. Static member function. C++ Object oriented concepts : Objects and classes, use of file for I/O, formatting output with stream functions, Character I/O, inheritance, structures for diverse data, structures as function arguments, initializing structures, defining classes and member functions, public and private members, constructors for initialization, standard C++ classes, derived classes, flow of control, use of Boolean expressions, multiway branches, use and design of loops. Friend function and friend class. C++ Data structures and Advanced Topics : Arrays – programming with arrays, arrays of classes, arrays as function arguments, strings, Multidimensional arrays, Arrays of strings, pointers Dynamic arrays, Classes and dynamic arrays, Base classes, access control, Templates- generic classes and functions, namespaces. Standard Template Library. Text/References: 1.Balaguruswamy: Object-oriented Programming with C++. 2.Robert Lafore: C++ Programming 3.Ashok N. Kamthane : Object Oriented with C++, Pearson Education IT-376 Multimedia Technology (3-0-2)4 Introduction to Multimedia, Graphics and Image data representations, Color in image and video CIE, RGB, CMY , HSL color models Fundamental concepts in video, NTSC, PAL and Digital video Compression methods: Lossy and Loss less compression techniques.: Huffman coding, Arithmetic coding, LZW Image compression standards: DCT Transform and Fourier transforms, JPEG coding Video representation and compression techniques Motion vector search: sequential, 2D logarithmic search. I, P and B frames, MPEG Video coding, MPEG-1, MPEG-2 and MPEG-3: video coding and decoding Basic Audio compression: Fletcher- Munson curves, Critical Bands, Psychoacoustic phenomenon, MPEG Layer 3 (MP3) Audio Text/References: IT-378 Artificial Intelligence (3-0-2)4 Overview of AI, Problems, Problem space and searching techniques, Definition production system, Control strategies, Heuristic search techniques. Knowledge representation: Representation, mappings, approaches and issues, Predicate logic, prepositional logic, Resolution, Procedural and declarative knowledge, forward and backward reasoning, Matching, Semantic nets, Frames scripts. Learning and learning systems: Introduction to Hopfield networks, introduction to neural networks, learning in neural networks, applications of neural networks, Recurrent network. Natural Language Processing, Perceptions and actions. Introduction to Expert Systems, Definition types, Component, development process. Introduction to AI languages: PROLOG and LISP. Text/References: 1.Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill. 2.Introduction to AI & Expert System: Dan W. Patterson, PHI. Program Elective III (Semester VII) IT-471 Computer Graphics (3-0-2)4 Introduction to computer graphics : Vector and Raster graphics, Graphic primitives and attributes. Computer graphics devices - CRT, plasma, LCD, plotters, Scan conversion of line, circle and ellipse. Viewing Transformations : Coordinate system - world, device and normalized device coordinates, Window and Viewport and viewing transformations Filling and Clipping - Flood fill and seed fill algorithms and scan line polygon filling algorithms, Cohen Sutherland clipping algorithms for Polygon Geometric transformations - 2D and 3D transformations: Translation, Scaling, rotation, Shearing, reflection etc., Transformations about an arbitrary axis Projections: Parallel - Orthographic, Plans and Elevations, Axonometric - Isometric, Diametric, trimetric, Perspective - One point, two point, three point. Hidden surface removal : Object space and image space algorithms, Back space removal, Z-buffer, scan line, area subdivision, painters, BSP tree, Floating horizon and ray tracing methods Curves: Spline representations, Curve representation techniques, Continuity constraints, Hermite Interpolation, Bezier curves, B-Spline curves Text/References: 1.Foley, Van Dam. Computer Graphics: Principles and Practic. Addison Wesley. 2.Hearn and Baker. Computer Graphics. PHI. 3.Rogers and Adams. Mathematical Elements of Computer Graphics. McGraw Hill. 4.Rogers and Adams. Procedural Elements of Computer Graphics. McGraw Hill. IT-473 Human Computer Interaction (3-0-2)4 Human factors issues in the development of software, use of database systems, and design of user interfaces for interactive systems. Science base (theories, models, usability studies, and controlled experimentation), and software engineering with user interface development environments. Issues include: command languages, menus, forms, and direct manipulation, graphical user interfaces, computer supported cooperative work, information search and visualization, World Wide Web design, input/output devices, and display design. Text /References: 1.B. Shneiderman, Designing the User Interface, 3rd Edition , Addison-Wesley, (1998) 2.Interaction Design by Jenny Preece, Yvonne Rogers, and Helen Sharp. John Wiley & Sons: New York, 2002. ISBN: 0471492787. 3.User Centered Web Site Design , by D.D. McCracken and R.J. Wolfe. Pearson Prentice Hall: Upper Saddle River, NJ, 2004. ISBN: 013041161-2. 4.The Web Wizard's guide to Web Design , J.G. Lengel, Addison-Wesley, 2002. ISBN: 0201745623. IT-475 GUI Programming (3-0-2)4 Issues and Challenges in GUI design. Overview of intelligent interface design. Graphics versus web interface. Principles of good interface. System Menu and Navigation schemes. Interaction devices. Screen based controls. Usability, testing, design for web, humans. Colors. Text/ References: 1.Wilbert O. Galitz. The Essential Guide to User Interface Design. Wiley. 2.Susan Weinschenk, Pamela Jamar, Sarah C. Yeo. GUI Design Essentials (Paperback) 3.Jenifer Tidwell. Designing

Interfaces: Patterns for Effective Interaction Design, O'Reilly. 4.B. Shneiderman, Designing the User Interface, 3rd Edition , Addison-Wesley. IT-477 Selected Topics in OS (3-0-2)4 Processes and Threads, Concurrency control, Directory and File structure, File sharing, NFS, Storage management. Design issues of Distributed OS, Distributed v/s network operating system. Communication: Client Server, RPC Distributed OS: Issues, process management, inter-process communication, scheduling, deadlocks Design and implementation of distributed file systems, distributed shared memory Security: Concepts and Distributed Systems Distributed Concurrency, Transactions. Case study: Unix, Amoeba. Text/References: 1.Operating System A Design Approach-Crowley, TMH. 2.Tanenbaum: Distributed Operating Systems, Pearson Education. 3.Bach, Design of Unix O/S. 4.Coulouris et al, Distributed Systems: Concepts and Design , Addison Wesley. 5.Mullender: Distributed Systems , Addison Wesley. 6.Tanenbaum and Steen: Distributed Systems: Principles and Paradigms , Pearson Education IT-479 Mobile and Wireless Computing (3-0-2)4 Wireless communication fundamentals: Introduction, wireless transmission, frequencies for radio transmission,signals, antennas, signal propagation, multiplexing, modulations, spread spectrum, MAC, SDMA, FDMA, TDMA, CDMA, cellular wireless networks. Telecommunication networks: Telecommunication systems :GSM,GPRS, DECT, UMTS, IMT-2000, Satellite networks - basics – parameters and configurations – capacity allocation: FAMA and DAMA. Wirless LAN: IEEE- 802.11, architecture, services, MAC, physical layer, IEEE 802.11a, 802.11b standards, HIPERLAN, BLUE TOOTH. Mobile network layer: mobile ip, dynamic host configuration protocol,routing,DSDV ,DSR . Transport and application layers : traditional TCP, classical TCP improvements – WAP, WAP 2.0. Text/References: 1.Jochen Schiller, "Mobile Communications", PHI/Pearson Education, Second Edition, 2003. 2.William Stallings, "Wireless Communications and Networks", PHI/Pearson Education, 2002. 3.Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks", PHI/Pearson Education, 2003. 4.Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, New York, 2003. 5.Hazysztof Wesolowshi, "Mobile Communication Systems", John Wiley and Sons Ltd, 2002. Program Elective IV (Semester VII) IT-481 Advanced Compiler (3-0-2)4 A Tour of Compiler Design, LR Parsers – SLR parsers, Canonical LR and LALR parsers, Lex and Yacc Tools, Control-flow Analysis, Control-flow Graphs, Basic Blocks, Data-flow Analysis, Dependence Analysis, Global Optimizations, Loop Optimizations, Dominators, Loop-invariant computations, Code motion, Data Dependence Analysis in Loops, Loop Scheduling, Runtime System Architectures and Automatic Memory Management Techniques. Text/References: 1.Aho, Alfred V ., Sethi, Ravi, Ullman, Jeffrey D., Compilers: Principles, Techniques and Tools, Addison-Wesley. 2.Steven Muchnick, Advanced Compiler Design & Implementation, Morgan Kaufmann. 3.Keith Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann. IT-483 Design and Analysis of Algorithms (3-0-2)4 Review of Algorithms : Seaching and Sorting, Tree and Graph traversal. DFS and its applications. Shortest path algorithms, minimum spanning tree algorithm. Algorithm Design Techniques: Greedy algorithm, dynamic programming, divide and conquer, backtracking, branch and bound. Algorithm Analysis : Asymptotic notation, solution of recurrence, model of computation, time and space complexities, average and worst case analysis, Amortized analysis. Master's theorem. Recurrence solving. Graph Algorithms: network flow, matching, coverings, applications of DFS:- bi-connectivity, Euler circuits, strongly connected components, topological sort, and articulation point. Network Flow. Greedy Algorithms: Knapsack problem. Dynamic Programming : Chained matrix multiplication, longest common subsequence. Divide and Conquer: Order Statistics – finding the median, exponentiation, matrix multiplication, LCS. Approximate Algorithm : Travelling Salesman Problem, vertex-cover problem. Randomized Algorithms: Matrix Algorithms – Strassen Matrix multiplication, LUP decomposition. Number Theoretic Algorithms: Primality Testing, Factorization. Miscellaneous: Introduction to appoximate, randomized and probabilistic algorithms. Introduction to problem classes – NP, NPC, NP-Hard. Text / References: 1.Cormen, Leiserson, Rivest: Introduction to Algorithms , Prentice Hall of India. 2.Horowitz and Sahani: Fundamental of Computer algorithms . 3.Aho A.V , J.D Ulman: Design and analysis of Algorithms , Addison Wesley 4.Brassard : Fundamental of Algorithmics , PHI. 5.W.W. Peterson and E. J. Weldon: Error correcting codes . 6.Sara Baase, Allen Van Gelder: Computer Algorithms: Introduction to Design and Analysis , Pearson Education. IT-485 Semantic Web (3-0-2)4 Basics of knowledge representation and informal introduction to OWL Description logics and classiers - the ALC family and its extensions. Expressiveness versus tractability; highly expressive description logics; implemented description logic systems; description logics and the ``Semantic Web''. Practical issues in ontologies: Basic principles, normalisation and the "Ontoclean" methodology, upper ontologies, Common problems in ontology development: parts and wholes, time, space, fundamental limitations. Text/References: 1.The Description Logic Handbook, Baader et al, CUP, 2003. 2.Ian Pratt. Artificial Intelligence. Macmillan, 1994. 3.John Sowa. Principles of Semantic Networks: Explorations in the representation of knowledge. Morgan Kaufmann, 1991. 4.Russell and Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall, 1995. 5.Han Reichgelt. Knowledge Representation: An AI Perspective. Ablex Publishing, 1991. IT-487 Data Mining and Data Warehousing (3-0-2)4 Introduction to Decision Support Systems, Data Warehouse and Online Analytical Processing. Data Warehouse Architecture: System Processes, Process Architecture: Load Warehouse, Query, Detailed and Summarized Information. Design: Data Base Schema Facts, Dimensions and Attributes. Introduction to Data Base and Metadata. Data Warehouse Implementation. Data Mining : Introduction and need. Data Processing : Data Cleaning, Data Integration and Transformation, Data Reduction. Data Mining Primitives : Descriptive and Predicative Data Mining, Language DMQL and its Preliminary Clauses. Data Mining Methods: Association – Single and Multilevel, Characterization and Comparison, Regression Analysis, Classification and Predication. Data Mining Algorithms: Clustering, Association, Regression, Decision Trees. OLAP : OLAP Architecture, ROLAP, and MOLAP. Application and Trends in Data Mining. Text/References: 1.Data Warehousing in the Real World – Anahory and Murray, Pearson Education. 2.Data Mining – Concepts and Techniques – Jiawai Han and Micheline Kamber. 3.Building the Data Warehouse – WH Inmon, Wiley. IT-489 Implementation of Data Bases (3-0-2)4 Issues in Implementation of Centralized Database Systems - Query

Processing, Query Optimization, Transaction Processing, Concurrency, Recovery Management. Database System Architectures – Centralized and Client-Server architecture, Parallel Systems, Distributed Database Systems. Implementation of Distributed Database Systems- Distributed Data Storage, Distributed Transactions, Concurrency control in Distributed Database Systems, Distributed Query Processing. Text & References: 1.Silberschatz A, Korth HF, Sudarshan S, Database System Concepts, McGrall Hill. 2.Elmasri R and Navathe SB, Fundamentals of Database Systems, 3rd Edition, Addison Wesley,2000. This book covers most of the material on the course. 3.Ceri S, Pelagatti G, Distributed Databases – Principles and Systems, McGraw Hill. Program Elective V (Semester VII) IT-491 Information Retrieval (3-0-2)4 INTRODUCTION- Information storage and retrieval systems, Data Structures and Algorithms Related to Information Retrieval RETRIEVAL STRATEGIES - Vector Space Model, Probabilistic Retrieval Strategies, Language Models, Inference Network, Extended Boolean retrieval, Latent Semantic Indexing RETRIEVAL UTILITIES - Relevance Feedback , Clustering, Passage-Based Retrieval, N-grams, Regression Analysis, Thesauri, Stemming, Semantic Networks, Parsing, Ranking EFFICIENCY- Inverted Index, Query Processing, Signature Files, Duplicate Document Detection INTEGRATING STRUCTURED DATA AND TEXT - Review of the Relation Model, A Historic Progression, Information Retrieval as a Relational Application, Semi-Structured Search using a Relational Schema, Multi-dimensional Data Model Text/References: 1.Information Retrieval Data Structures & Algorithms by William B. Frakes, Ricardo Baeza-Yates 2.Information retrieval- by D A Grossman , Ophir Frieder, Springer International Edition IT-493 Wireless Sensor Networks (3-0-2)4 Introduction – motivation, applications, sensors, architectures, platforms for WSN Actual Systems - Berkeley motes, TinyOS and nesC.Wireless Radio Realities – radio irregularities and impact on protocols. MAC protocols – S-MAC, multi-channel MAC. Routing –Geographic routing, DSR, AODV , Directed Diffusion, SPEED. Clock Synchronization - FTSP, TPSN. Localization – TDOA, Walking GPS, range free solutions .Power Management – per node, system-wide, sentry services, sensing coverage Data Services and Databases – architectures, queries (SQL), data dissemination. Programming Abstractions – programming models, EnviroTrack, new APIs Security and Privacy – problems, attacks, solutions, open research areas.Case Study: A Complete System – surveillance and tracking application. How to program actual WSN. Text/References 1.Protocols and Architectures for Wireless Sensor Networks . H. Karl and A. Willig. John Wiley & Sons, June 2005. 2.Wireless Sensor Networks: Technology, Protocols, and Applications . K. Sohraby, D. Minoli, and T. Znati. John Wiley & Sons, March 2007. 3.Wireless Sensor Networks . C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors. Springer Verlag, Sep. 2006. 4.Wireless Sensor Networks: Architectures and Protocols . E. H. Callaway, Jr. AUERBACH, Aug. 2003. 5.Networking Wireless Sensors . B. Krishnamachari. Cambridge University Press, Dec. 2005. 6.Wireless Sensor Networks: An Information Processing Approach . F. Zhao and L. Guibas. Morgan Kaufmann, Jul. 2004. 7.Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications . N. P. Mahalik. Springer Verlag, Nov. 2006. 8.Wireless Sensor Networks: A Systems Perspective , N. Bulusu and S. Jha, Editors, Artech House, August 2005. IT-495 Topics in High Speed Networking (3-0-2)4 Overview of Internet Technologies, Issues in next generation Internet - Routing, Multicasting, Packet Scheduling, Quality of Service etc. Admission control in Internet: Effective bandwidth, Differentiated services, Policy-based networking, Real time communications over Internet, Internet telephony, V oice over IP, Integrated services. Web QoS, Intelligent caching, Traffic measurement and characterization. Text/ References: 1.Kurose: Computer Networking A Top Down Approach , Pearson. 2.Peterson and Davie: Computer Networks: A systems approach , Morgan Kaufman and Elsevier. 3.J.Walrand, High Performance Computer Networks , Elsevier 4.A.Kumar, D.Manjunath, Communication Network MKP. 5.Recent papers from conferences and journals. IT-497 Digital Watermarking and Steganography (3-0-2)4 Watermarking: Applications, technqiues, models, detection techniques. Visible and invisible watermarks. Embedding. Robust watermarking, watermark security. Steganography – Least Bit, DCT, Spread spectrum. Audio seganography. Steganalysis techniques. Text/References: 1.Ingemar Cox, Matthew Miller, Jeffrey Bloom, and Jessica Fridrich . Digital Watermarking and Steganography, 2nd Ed, (The Morgan Kaufmann Series in Multimedia Information and Systems). (Hardcover - Nov 16, 2007) 2.Frank Y . Shih. Digital Watermarking and Steganography: Fundamentals and Techniques , CRC Press.g 3.Stefan Katzenbeisser, Fabien, and A.P. Petitcolas. Information Hiding Techniques for Steganography and Digital Watermarking, Artech House. 4.Neil F. Johnson; Zoran Duric; Sushil Jajodia. Information Hiding: Steganography and Watermarking - Attacks and Countermeasures , Springer. 5.Gregory Kipper. Investigator's Guide to Steganography , Auerbach Publications. IT-499 Software Project Management (3-0-2)4 Software Project Management Concept: The Management Spectrum, People, Product, Process & Project. Software Process & Project Matrix: Software Measurement, Size Oriented Matrices, Function Oriented Matrices. Software Project Planning: Objectives, Decomposition Techniques and Empirical Estimation Model. Risk Analyses and Management: Risk Identification, Projection, Risk Identification, Projection, Risk Refinement, Risk Monitoring and Management. Project Scheduling & Tracking, Software Quality Assurance, Software Configuration Management. Text /References: 5.R. S. Pressman, Software Engineering 6.P. Jalote, Software Project Management in Practice. 7.B. Hughest & M. Cotterell, Software Project Management. Program Elective VI (Semester VIII) IT-470 Digital Forensics (3-0-2)4 File System Forensics : Duplicating hard disks for "dead analysis”, reading hidden data on a disk's Host Protected Area (HPA), Direct versus BIOS access, dead versus live acquisition, Disk partitions - DOS, Apple, and GPT partitions, BSD disk labels, Sun V olume; multiple disk volumes - RAID and disk spanning; Analyzing FAT, NTFS, Ext2, Ext3, UFS1, and UFS2 file systems, Finding evidence: File metadata, recovery of deleted files, Using The Sleuth Kit (TSK), Autopsy Forensic Browser, and related open source tools Web Forensics: network-based evidence in Windows and Unix environments, Reconstructing Web browsing, e-mail activity, Tracing domain name ownership and the source of e-mails System Forensics: Windows Registry changes, Duplicating and analyzing the contents of PDAs and flash memory devices Electronic document, computer image verification and authentication Texts/References: 1.Brian Carrier. File System

Forensic Analysis , Addison Wesley. 2.Chris Prosise, Kevin Mandia. Incident Response and Computer Forensics , McGraw Hill. 3.Linda V olonino, Reynaldo Anzaldua, and Jana Godwin. Computer Forensics: Principles and Practices, Prentice Hall. 4.Keith J. Jones, Richard Bejtlich, and Curtis W. Rose. Real Digital Forensics: Computer Security and Incident Response , Addison Wesley 5.Vacca, John R., Computer Forensics Computer Crime Scene Investigation , Charles River Media. 6.Nelson, Phillips, Enfinger, Steuart. Guide to computer Forensics and Investigation , Course Technology. 7.Papers from Journals/Conferences. IT-472 Biometric Security (3-0-2)4 Biometrics: Need, Conventional techniques of authentication, challenges - legal and privacy issues. Biometrics in use: DNA, fingerprint, Iris, Retinal scan, Face, hand geometry, human gait, speech, ear. Handwriting, Keystroke dynamics, Signature Multimodal biometrics: Combining biometrics, scaling issues. Biometric template security. Texts/References: 1.Julian D. M. Ashbourn, Biometrics: Advanced Identify Verification: The Complete Guide 2.Davide Maltoni (Editor), et al, Handbook of Fingerprint Recognition 3.L.C. Jain (Editor) et al, Intelligent Biometric Techniques in Fingerprint and Face Recognition 4.John Chirillo, Scott Blaul, Implementing Biometric Security IT-474 VLSI Algorithms (3-0-2)3 1.Introduction of VLSI Technology, VLSI design cycle, design styles, basic Layout rules and circuit abstraction, introduction to standard Cell, Gate array, FPGA 2.Overview of basic graph algorithms, Graph algorithms for physical Design 3.Partitioning: Classification of partitioning algorithms, Karnighan-Lin Algorithm, FM Algorithm, Ratio cut algorithm 4.Floor-planning: Rectangular dual graph approach of floor-planning, hierarchical tree based approach, Integer programming based floor-planning. 5.Placement: placement by simulated annealing and force directed method 6.Routing: classification of routing algorithms, Global routing: Maze routing algorithms, line probe algorithms, Steiner tree based algorithms, Detailed Routing: Single layer and two layer routing algorithms, routing in FPGAs Text/References: 1.Naveed Shervawani, “ Algorithms for VLSI physical Design Automation “ III Ed Springer 2.Sarrafzadeh and Wong “ An introduction to VLSI Physical design “ MGH 3.Sze: VLSI Technology 4.Weste and Eshranghan, “ Introduction toVLSI Design”. Pearson Edu. 5.Sadiq M. Sait, Habib Youssef, "VLSI Physical Design Automation: Theory and Practice", World Scientific Publishing Company; 6.Cormen Leiserson, Rivest, “ Introduction to Algorithms”, Pearson Edu. IT-476 Intrusion Detection (3-0-2)4 Introduction- Intrusion detection system (IDS), intrusion prevention system (IPS), Unauthorized access – buffer overflow, packet fragmentation, out-of-spec packets. Review of Network protocol – TCP/IP. Intrusiond detection through tcpdump. IDS and IPS – Architecture and internals. Malicious and non-malicious traffic, IP headers, TDP, UPD and ICMP protocols and header formats, Header information to detect intrusion, logs and their analysis, IDS through reaction and response Intrusion analysis – data correlation, tools, SNORT. Text/References: 1.Matt Fearnow, Stephen Northcutt, Karen Frederick, and Mark Cooper. Intrusion Signatures and Analysis, SAMS. 2.Carl Endorf, Gene Schultz, Jim Mellander, Intrusion Detection and Prevention , McGraw Hill. 3.Stephen Northcutt and Judy Novak. Network Intrusion Detection , SAMS. 4.Paul E. Proctor. The Practical Intrusion Detection Handbook , Prentice Hall. IT-478 Pattern Recognition (3-0-2)4 Digital Image Fundamentals: Image Model, Sampling, Quantization, Neighborhood, connectivity of pixels, Labelling of connected components, Distance measures Image Transforms: Fourier Transform, Discrete Fourier Transform, Properties of 2D Discrete Fourier Transform, The fast Fourier Transform and its algorithm, number of operations, the inverse FFT. Discrete Cosine Transform and its applications, KL Transform, Convolution and correlation Image Enhancement: Enhancement by point processing, spatial filtering, enhancement in frequency domain, generation of spatial masks from frequency domain specifications Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding, region oriented segmentation Representation and Description: Representation schemes, boundary descriptors, regional descriptors. Morphology: Dilation, erosion, opening, closing, Hit-or-Miss Transform, some basic morphological algorithms like pruning, thinning and thickening Text/References: 1.Gonzalez and Woods. Digital Image Processing, Addison Wesley. 2.Castleman. Digital Image Processing. Prentice Hall. 3.Duda and Hart. Pattern Classification. John Wiley. Program Elective VII (Semester VIII) IT-480 Multi-Core Architectures (3-0-2)4 Multiple core programming models. GPGPU programming and streaming data processing. Issues related with coherency, languages and communication overheads in multi-core programming. Text/References: 1. Art of Multiprocessor Programming: Nir Shavit, Elsevier. IT-482 Software Testing (3-0-2)4 Basic software testing principles - Software testing, test case generation and test management. Acceptance Testing: User acceptance testing, alpha and beta testing. Verification and Validation, Functional and Non-functional system testing. Software quality assurance. Static and dynamic testing, Black-box or functional testing, structural, white box or glass box testing. Integration testing, component testing. Text/References: 1.Recent papers from conferences and journals. 2.A. P. Mathur, Fundamentals of software testing. IT-484 Distributed Systems (3-0-2)4 Introduction: What is a distributed system? Main characteristics. Advantages/Disadvantages. Design goals. Main problems. Models of distributed systems. Communication in Distributed Systems: Message passing and the client/server model. Remote Procedure Call. Group Communication. Time and State in Distributed Systems: Time in distributed systems. Logical clocks. Vector clocks. Causal ordering of messages. Global state and state recording. Distributed Mutual Exclusion: Mutual exclusion in distributed systems. Non-token based algorithms. Token based algorithms. Distributed elections. Transaction and concurrency control: Introduction. Transactions. Nested transactions. Locks. Optimistic concurrency control. Timestamp ordering. Comparison method of concurrency control Distributed Transactions : Introduction. Flat and nested distributed transactions . Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks . Transaction recovery Replication: Motivation for replication. Consistency and ordering. Total and causal ordering. Update protocols and voting. Recovery and Fault Tolerance: Transaction recovery. Checkpointing and recovery. Fault tolerance in distributed systems. Hardware and software redundancy. Byzantine agreement. File Systems: Introduction, File Service Architecture. Sun network file system. The Andrew File system. Recent Advances Text/References: 1.Distributed Systems: Concepts and Design, 4rd ed by Coulouris, G, Dollimore, J., and Kindberg, T., Addison-Wesley, 2006. ISBN: 0321263545 2.Distributed Systems: Principles and Paradigms, 2nd ed by

Tanenbaum, A. and van Steen, M., Prentice Hall, 2007. ISBN: 0132392275. IT-486 Advanced Topics in Data Bases (3-0-2)4 Transaction Management - Transaction Processing, Concurrency Control, Recovery Management. Advanced SQL – Complex queries, Nested Subqueries, Views, Materialized Views, Triggers, Referential Integrity, Security and Authorization. Query Processing and Query Optimizations. Database System Architectures, Distributed Databases, Distributed Transactions, Distributed Query Processing. Text/References: 1.Silberschatz A, Korth HF, Sudarshan S, Database System Concepts, McGrall Hill. 2.Elmasri R and Navathe SB, Fundamentals of Database Systems, 3rd Edition, Addison Wesley,2000. This book covers most of the material on the course. 3.Date CJ, An Introduction to Database Systems , 7th Edition, Addison Wesley. IT-488 Expert Systems (3-0-2)4 Overview of AI, Problem space and searching techniques, Production system, Control strategies, Heuristic search techniques, Knowledge representation acquisition and learning. Introduction to Expert Systems, Definition types, Component, development process. Architecture of Expert System, Case studies and expert system development tools. Introduction to AI languages: PROLOG and LISP. Text/References: 1.Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill. 2.Introduction to AI & Expert System: Dan W. Patterson, PHI. 3.Fundamentals of expert system, S.N. Sharan, CBS Publishers. Btech_CP_April_oldscheme.pdf Ist year AUTUMN SEMESTER MA-101 Mathematics-I BS 4 3-1-0 PH-101 Physics-I BS 5 3-1-2 EE-101 Electrical Science* ESA 43-1-2/2 HS-101 English (Basic/Advanced)* HS 4 3-0-2 CH-101 Fundamentals of Bio-Tech* ESA 2 2-0-0 ME-101 Basic Mechanical Engg. ESA 3 2-0-2 CE-101 Engineering Graphics I ESA 3 1-0-3 CY-101 Chemistry* BS 5 3-1-2 IC-101Computer Systems & Programming*ESA 4 3-0-2 SPRING SEMESTER MA-102 Mathematics-II BS 4 3-1-0 PH-102 Physics-II BS 5 3-1-2 EC-102 Electronics ESA 4 3-1-0 ME-102 Engineering Graphics II ESA 3 1-0-3 IC-101Computer Systems & Programming*ESA 4 3-0-2 HS-101 English (Basic/Advanced)* HS 4 3-0-2 EE-101 Electrical Science* ESA 43-1-2/2 CH-101 Fundamentals of Bio-Tech* ESA 2 2-0-0 CY-101 Chemistry* BS 5 3-1-2

Department of Computer Engineering Malaviya National Institute of Technology Curricular Structure BTech (Computer Engg.) 2nd Year AUTUMN SEMESTER Teaching Scheme Contact Hrs/Week Exam Duration Relative WeightageS.No.Subject CodeCourse Title Subject AreaPr Credit Lecture Tutorial Practical Theory Practical CWS PRS MTE ETE PRE CH 1IC-201 Mathematics III BS 4 3 1 0 3 -25 -25 50 - 4 2CP-201 Logic System Design DC EC-102 4 3 0 2 3 - -30 20 50 - 6 3CP-203 Data Structures DC IC-101 5 3 1 2 3 -10 20 20 50 - 6 4CP-205 Discrete Structures DC 4 3 1 0 3 -20 -30 50 - 4 5CP-207 Electronic Circuits and Design ESA EC-102 4 3 0 2 3 - -30 20 50 - 5 6 Institute Elective I IE 4 3 1 0 3 -25 -25 50 - 4 25 18 4 6 29 SPRING SEMESTER Pr Cr CH 1IC-202 Social Science & Economics HS 4 3 1 0 25 -25 50 - 4 2CP-202Principles of Programming LanguagesDC CP-203 4 3 0 2 3 - -30 20 50 - 5 3CP-204 Microprocessor & Interfaces DC CP-201 4 3 0 2 3 - -30 20 50 - 5 4CP-206 Object Oriented Design DCIC-101, CP-2034 3 0 2 3 - -30 20 50 - 6 5CP-208Principles of Communication EngineeringESA EC-102 4 3 1 0 3 -20 -30 50 - 4 6 Institute Elective II IE 4 3 1 0 3 -25 -25 50 - 4 24 18 3

6 Creative Arts /Sports/NSS/Hindi ECA 2 28 Discipline ECA 2 Total Credits: 53

Department of Computer Engineering Malaviya National Institute of Technology Curricular Structure BTech (Computer Engg.) 3rd Year AUTUMN SEMESTER Teaching Scheme Contact Hrs/Week Exam Duration Relative WeightageS.No.Subject CodeCourse Title Subject AreaPr Credit Lecture Tutorial Practical Theory Practical CWS PRS MTE ETE PRE CH 1CP-301 Computer Architecture DCCP- 2014 3 1 0 3 -20 -30 50 - 4 2CP-303 Data Base Management Systems DC 4 3 0 2 3 - -30 20 50 - 6 3CP-305 Software Engineering DC 4 3 1 0 3 -20 -30 50 - 4 4CP-307Design and Analysis of AlgorithmsDCCP- 2034 3 0 2 3 - -30 20 50 - 6 5CP-309 Computer Networks DC 4 3 0 2 3 - -30 20 50 - 2 6CP-311 Group Discussion and Viva Voce DC 2 0 2 0 - - - - - -100 4 7 Institute Elective III IE 4 3 1 0 3 -25 -25 50 - 4 26 18 5 6 30 SPRING SEMESTER CH 1IC-301 Technical Communication HS 4 2 2 0 2 -25 -25 50 - 5 2CP-302 Operating System DCCP- 2034 3 0 2 3 - -30 20 50 - 5 3CP-304 Digital Signal Processing ESA 4 3 1 0 3 -20 -30 50 - 4 4CP-306 Theory of Computation DCCP- 2034 3 1 0 3 -20 -30 50 - 4 5CP-308 Computer Graphics DC 4 3 0 2 3 - -30 20 50 - 5 6CP-310 Scripting Language DC 1 0 0 2 - - -100 - - - 2 7 Department Elective I DE 4 3 1 0 3 -20 -30 50 - 25 17 5 6 3 Creative Arts /Sports/NSS/Hindi ECA 0 Total Credits: 53 2 Discipline ECA 2 30 Department Elective I CP-322 Optimization Techniques DE CP-324 Combinatorics DE CP-326 Advanced Microprocessors DECP- 204 CP-328 Neural Networks DE CP-330 Mathematical Programming DE CP-332 Information Theory and Coding DE Department of Computer Engineering Malaviya National Institute of Technology Curricular Structure BTech (Computer Engg.) Final Year AUTUMN SEMESTER Teaching Scheme Contact Hrs/Week Exam Duration Relative WeightageS.No.Subject CodeCourse Title Subject AreaPr Credit Lecture Tutorial Practical Theory Practical CWS PRS MTE ETE PRE CH 1CP-401 Principles of Compiler Design DC CP-308 4 3 0 2 3 - -30 20 50 - 5 2CP-403 AI and Expert Systems DC 4 3 0 2 3 - -30 20 50 - 5 3CP-405 Introduction to VLSI Design DC 4 3 0 2 3 - -30 20 50 - 5 4CP-407 Real Time Systems DCCP-204, CP-3014 3 0 2 3 - -30 20 50 - 4 5 Department Elective II DE 4 3 0 2 3 - -30 20 50 - 5 6 Department Elective III DE 4 3 0 2 3 - -30 20 50 - 4 7 Industrial Field/Training DC 2 - - - - - - - - -100 26 18 012 28 SPRING SEMESTER CH 1IC-401 Industrial Management HS 4 3 1 0 2 -25 -25 50 - 5 2CP-402 Major Project DC 12 0 2 6 - -20 -20 -60 5 3 Department Elective IV DE 4 3 0 2 3 - -30 20 50 - 4 4 Department Elective V DE 4 3 0 2 3 - -30 20 50 - 5 5 2 6 24 9 310 Creative Arts /Sports/NSS/Hindi ECA 0 Total Credits: 52 21 Discipline ECA 2 Department Elctive II (Semester VII)Department Elctive IV (Semester VIII) CP-421Advanced Topics in Computer GraphicsDE CP-206CP- 420Advanced Topics in OS DE CP-423 Advanced Topics in Networking DE CP-301CP- 422Parallel and Distributed Computing DE CP-425 Distributed Data Bases DE CP-304CP- 424Computer Human Interaction DE CP-427 VHDL DE CP-303CP- 426 Software Project ManagementDE CP-429 Simulation and Modelling DECP- 428Advanced Topics in Databases DE Department Elctive III (Semester VII)CP-304, CP-425Department Elctive V (Semester VIII) CP-441 Embedded Systems DECP- 440Robotics DE CP-443 Cryptography DE CP-429CP- 442Behavioural Synthesis DE

CP-445Advaned Data Structures and AlgorithmsDECP-303, CP-427CP-444Multimedia Systems DE CP-447Image Processing and Pattern RecognitionDECP-446Mobile Computing DE CP-449 Biometrics DECP- 448Advanced Computer Architecture DE Department of Computer Engineering Department of Computer Engineering Malaviya National Institute of Technology Malaviya National Institute of Technology BTech (Computer Engg.) Teaching Scheme BTech (Computer Engg.)Credits Lecture Tutorial Practical HS BS HS ESA DC DE IED+n+S/C TOTAL First year 54 4 23 4 23 2+2+2 56 Semester III 25 18 4 6 4 4 13 4 - 25 Semester IV 24 18 3 6 4 4 4 12 4 2+0+2 28 Semester V 26 18 5 6 22 4 - 26 Semester VI 25 17 5 6 4 4 4 13 4 2+0+0 27 Semester VII 26 18 0 12 18 8 - 26 Semester VIII 24 9 3 10 4 12 12 8 2+0+0 26 Total 204 16 27 24 35 90 20 12 8+2+4 214 214

Ist year AUTUMN SEMESTER MA-101 Mathematics-I BS 4 3-1-0 PH-101 Physics-I BS 5 3-1-2 EE-101 Electrical Science* ESA 4 3-1-2/2 HS-101 English (Basic/Advanced)* HS 4 3-0-2 CH-101 Fundamentals of Bio-Tech* ESA 2 2-0-0 ME-101 Basic Mechanical Engg. ESA 3 2-0-2 CE-101 Engineering Graphics I ESA 3 1-0-3 CY-101 Chemistry* BS 5 3-1-2 IC-101Computer Systems & Programming*ESA 4 3-0-2 SPRING SEMESTER MA-102 Mathematics-II BS 4 3-1-0 PH-102 Physics-II BS 5 3-1-2 EC-102 Electronics ESA 4 3-1-0 ME-102 Engineering Graphics II ESA 3 1-0-3 IC-101Computer Systems & Programming*ESA 4 3-0-2 HS-101 English (Basic/Advanced)* HS 4 3-0-2 EE-101 Electrical Science* ESA 4 3-1-2/2 CH-101 Fundamentals of Bio-Tech* ESA 2 2-0-0 CY-101 Chemistry* BS 5 3-1-2 2nd Year AUTUMN SEMESTER Teaching SchemeS.No.Subject Code Course Title Subject AreaPr Credit B.Tech (Computer Engineering) CP-201 Logic System Design Credits: 4 (3-0-2) Introduction to Boolean algebra : Binary connectives, Evaluation of truth functions, Truth – function calculus as Boolean Algebra, Duality, Fundamental theorems of Boolean Algebra and simplification of Boolean expressions. Realisation of Logic Circuits : Standard forms of Boolean Functions, Minterm and Maxterm, designation of functions. Simplification of functions on Karnaugh maps, incompletely specified functions. Combinational circuits : Adder, subtract, encoder, decoder, multiplexer, demultiplexer, parity checker and generator.Cubical representation of Boolean functions and determination of prime implicants. Selection of an optimal set of prime implicants, multiple output circuits and map minimization of multiple output circuits. Tabular determination of multiple output prime implicants. Latches, Flip Flops : JK, SR, D Type and T type Flip Flops and their working principals. Counters and shift registers: Ripple, decade, up-down counters, Mod-n counters and series, parallel registers. General characteristic of sequential circuits, clock, pulse and level mode sequential circuits. Analysis and design of sequential circuit. Synthesis of state diagrams, finite memory circuits, equivalence relations, equivalent states and circuits, determination of classes of in distinguishable states and simplification by implicant tables. Mealy and Moore machines, state assignment and memory element input equation, Partitioning and state assignment. General pulse-mode circuits, clock input counters, extended state tables. Asynchronous Mode Circuits : Analysis of a fundamental mode circuits, Synthesis of flow tables, minimization, transition tables, excitation maps and output maps, Cycles and Races, Race free assignments, Hazards in sequential circuits. Introduction to A/D and D/A converters. Text/ References: 1.Morris-Mano : Logic System and Design, Mc Graw Hill 2.Hill & Peterson: Switching Theory and Logic Design, John Wiley 3.J.F.Wakerly: Digital Design, Principle and Practices, Pearson. 4.Malvino leech: Digital Electronics 5.Digital Systems and Hardware and Firmware Algorithms: M.Ercegovac and T. Lang, Pearson. 11/09/2012 1 B.Tech (Computer Engineering) CP-203 Data Structures Credits 5 (3-1-2) Arrays: Representation – row-major, column-major, sparse matrix – implementation, addition, multiplication; polynomial – representation, addition, evaluation and multiplication. Strings: Representation, operations, string matching - Brute force or naïve, Robin-Karp, Knuth- Morris-Pratt. Linked List: Static and dynamic implementation,single, double, circular, multiple linked list. Stack: Static and dynamic implementation, expression evaluation, prefix (polish), infix, postfix (inverse polish) expressions, application, multiple stacks, recursion. Queues: Static and dynamic implementation,applications, circular queue, multiple queue. Tree: Binary tree, binary search tree, static and dynamic implementation, tree operations - insertion, deletion and search, tree traversal, Binary heaps. Introduction to AVL trees and B trees. Sorting: Insertion sort, selection sort, Bubble sort, quick sort, merge sort, heap-sort, radix sort (bucket sort). Searching: Linear and binary search, hashing. Graph: Representation of graphs, BFS, DFS, topological sort. Text/References: 1.Aho A.V., J.E. Hop croft, J.D. Ullman, Data Structures and algorithms , Addison Wesley. 2.Kruse R.L., Data Structure and Program Design , PHI. 3.Horowitz and Sahni: Data Structure in C++ , Glagotia 4.Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures 5.Aaron M. Tenenbaum, Y. Langsam, Moshe J. Augenstein, Data Structures Using C 6.Niklaus Wirth, Algorithms + Data Structures = Programs (Prentice-Hall Series in Automatic Computation) 7.Sartaj Sahni, Data Structures, Algorithms, and Applications in C++ 8.Mark Allen Weiss, Data Structures and Algorithm Analysis in C++ (2nd Edition) 11/09/2012 2 B.Tech (Computer Engineering) CP-205 Discrete Structures Credits 4 (3-1-0) Set and Functions : Sets, relations, functions, operations, and equivalence Relations, relation of partial order, partitions, binary relations, Equivalence relations . Monoids and Groups : Groups, Semi groups and Monoids, Cyclic semi graphs and sub monoids, Subgroups and cosets. Congruence relations on Semi groups. Morphisms Normal sub groups. Structure of cyclic groups, Permutation groups, dihedral groups, elementary applications in coding theory. Rings: Rings, Subrings, Morphism of rings, ideal and quotient rings, Euclidean domains. Number-theoretic algorithms : Greatest Common Divisor, Chinese Remainder Theorem, Primality testing. Field Theory: Integral domains and Fields, polynomial representation of binary number, Galois fields, primitive roots, discrete logarithms. Text/ References: 1.Kolman B., Busby R: Discrete Mathematical Structures for Compute Science , PHI. 2.Liu: Introduction to Discrete Mathemetics , McGraw-Hill. 3.Graham, Knuth, Pratshnik : Concrete Mathematics . 4.Grimaldi: Discrete Mathematical Structures . 5.Grossman P, Discrete Mathematics for Computing , Macmillan 1995 6.Ross KA & Wright CRB, Discrete Mathematics , Prentice-Hall 1999 7.Johnsonbaugh R, Discrete Mathematics , Macmillan. 8.Wiitala, Discrete Mathematics , McGraw Hill. 9.Biggs N L, Discrete Mathematics , Oxford. 10.Truss J, Discrete Mathematics for Computer Scientists , Addison Wesley. 11/09/2012 3 B.Tech

(Computer Engineering) CP-207 Electronic Circuits And Design Credits: 4 (3-0-2) 1.Transistor Characteristics : the junction transistor, transistor current component, the transistor as an amplifier, transistor construction, the common base configuration, the common emitter configuration, the CE cut of region, the CE saturation region, typical transistor junction voltage values, common-emitter current gain, the common collector configuration. 2. Transistor Biasing & Thermal Stabilization : the operating point, bias stability, self-bias or emitter bias, stabilization against variation in I co, VBE, and ®, bias compensation, biasing techniques, for linear integrated circuits, thermistor and sensitor compensation, thermal runway, thermal stability. 3.The transistor at low frequencies : graphical analysis of the CE configuration, two-port devices and the hybrid model, transistor hybrid model, the h-parameter, conversion formulas for the parameters of the three transistor configuration, analysis of a transistor amplifier circuit using h- parameters, the emitter follower, comparison of transistor amplifier configuration. Simplified calculations for common-collector configuration, the common-emitter amplifier with an emitter resistance, high input resistance transistor circuits. 4.High Frequency model of BJT amplifiers. 5.Introduction to switching devices : positive and negative logic of OR , AND, NOR, NAND, Exclusive OR and Exclusive NOR gates. RTL, DTL,DCTL, TTL, ,ECL, HTL, MOS and CMOS logic circuit and their realisation. Speed and Delay in logic circuit. 6.Field Effect Transistors : The junction field effect transistor, the pinch-off voltage, the JEFT volt-ampere characteristics, the FET small signal model, the metal-oxide-semiconductor FET (MOSFET), the low frequency common source and common drain amplifiers, the FET as a voltage variable resistors (VVR). 7.Feedback Amplifiers and Oscillators : Concepts of feedback. Various topologies for amplifiers. Positive feedback, various oscillator circuits. 8.Multivibrators: Astable, Bistable and Monostable Multivibrators. Text/References: 1.Integrated Electronics, Millman Halkias, TMH. 2.Solid state Electronics Devices, Streetman, PHI. 3.Microelectronic Circuits, Sedra Smith, Oxford Press, India. 11/09/2012 4 B.Tech (Computer Engineering) CP-202 Principles of Programming Languages Credits 4 (3-0-2) Importance of programming languages, brief history and features, attributes of good programming language. Introduction to language translator, binding and binding time. Language translation issues: Formal translation models-BNF grammars, regular grammar, FSA. Elementary and structured data types, their specifications, representations, and implementation of numbers, vectors and arrays, records, character string, variable size data structure, sets, input output files. Type checking and type conversion, type equivalence. Encapsulation and information hiding, sub programs. Implicit and explicit sequence control. Subprogram sequence control. Recursive sub programs, exception and exception handlers. Co-routines and scheduled subprograms, task and concurrent exception. Name and reference environments, static dynamic and block structure. Local data and local referencing environments. Dynamic and static scope of shared data. Block structure, parameters and their transmission. Task and shared data storage requirement for major runtime elements. Program and system controlled storage management. Static and stack based storage management. Fixed size and variable size heap storage management. Text / References: 1.Ghezzi: Programming Language Concepts , Addison Wesley 2.Pratt, Zelkowitz: Programming Language Design and

Implementation PHI. 3.Sebasta: Concept of Programming Language , Addison Wesley 4.Sethi Ravi: Programming language Concepts & Constructs , Addison Wesley. 11/09/2012 5 B.Tech (Computer Engineering) CP-204 Microprocessor And Interfaces Credits 4 (3-0-2) The 8085 Microprocessor: Block diagram, pins and their description, demultiplexing of buses, control signal and flags. Introduction to 8085 based microcomputer system. Instruction and timing: instruction classification, instruction formats, addressing modes, instruction timings and status, interrupts. Programming the 8085: 8085 instruction set, data transfer instruction, arithmetic logic & branch operations: Rotate and compare. Instruction related to stack operations. Programming Techniques: looping, counting and indexing, counters and time delays, subroutines. Interfacing concepts: basic interfacing concepts, memory mapped and peripheral mapped I/O. Interfacing peripherals: Descriptions, programming and interfacing of 8255, 8253, 8259A with 8085. Description of simple systems using above chips. Direct Memory Access: basic concepts of DMA techniques, Description, programming and interfacing of DMA controller 8257. Serial I/O: Basic concept of serial I/O, software controlled serial I/O. Basic Idea of Following Bus Standard: RS232C, IEEE-4888. Text/References: 1.Douglas V. Hall : Microprocessors and Interfacing, McGraw Hill 2.Gaonkar ; 8085 Programming, Penram Press 11/09/2012 6 B.Tech (Computer Engineering) CP-206 Object Oriented Design Credits 4 (3-0-2) Object Oriented Programming and Design : Review of abstraction, objects and other basics, Encapsulation, Information hiding, method, Signature, Classes and Instances, Polymorphism and inheritance. C++ Programming Basics : Fundamentals, variables and assignments, Input and Output, Data types and expressions, flow of control, subprograms, top-down design, predefined functions, user defined functions, procedural abstractions, local variables, overloading function names, operator overloading, parameter passing, this pointer, destructors, copy constructor, overloading the assignment operator, virtual functions, function calling functions, friend functions, recursive functions, recursive member functions. Static member function. C++ Object oriented concepts : Objects and classes, use of file for I/O, formatting output with stream functions, Character I/O, inheritance, structures for diverse data, structures as function arguments, initializing structures, defining classes and member functions, public and private members, constructors for initialization, standard C++ classes, derived classes, flow of control, use of Boolean expressions, multiway branches, use and design of loops. Friend function and friend class. C++ Data structures and Advanced Topics : Arrays – programming with arrays, arrays of classes, arrays as function arguments, strings, Multidimensional arrays, Arrays of strings, pointers Dynamic arrays, Classes and dynamic arrays, Base classes, access control, Templates- generic classes and functions, namespaces. Standard Template Library. Text/References: 1.Balaguruswamy: Object-oriented Programming with C++. 2.Robert Lafore: C++ Programming 3.Ashok N. Kamthane : Object Oriented with C++, Pearson Education 11/09/2012 7 B.Tech (Computer Engineering) CP-208 Principles Of Communication Engineering Credits: 4 (3-1-0) Transmission Media : Primary and secondary line constant, telephone lines and cables, Electronic Public Switch Telephone Network. Twisted pair, coaxial cable. Introduction and principles of light communication in fibers, losses in optical fiber, dispersion, light sources and photo detectors, connectors. Modulation Of Signals : Introduction to Radio communications. Principles of Analog modulation techniques like FM, PM, SSB, Generation and detection. FDM, Pulse Modulation: Pulse transmission over band-limited signals, sampling theory, pulse amplitude modulation, Time division multiplexing. Digital Communication : Digital representation of information, characterization of communication channels: Time and frequency domain. Fundamental limits of digital transmission: Nyquist signalling rate and Shannon channel capacity. PCM, DPCM, DM, ADM, comparison of above systems on the basis of performance criterion such as bit transmission, signalling rate, error probability, S/N ratio, bandwidth requirements. Text/ References: 1. Simon Haykin, Comm. System 3/e ,Wiley Eastern Ltd. 3. Taub & Schilling, Principles of Comm. Systems. , McGraw Hill publications. 4.John D. Ryder:Network lines and fields,PHI 5. Communication Networks: Leon Garcia and Widjaja, Tata McgrawHill 6. Digital Telephony: John.C.Bellamy 11/09/2012 8 B.Tech (Computer Engineering) CP-301 Computer Architecture Credits 4 (3-1-0) Basic Structure of computer Hardware and Software, Basic computer organization and design, Von Neumann Architecture Processor Design: Some Fundamental Concepts, Instruction Sets: Characteristics and functions and formats. Computer Arithmetic: Fixed Point Arithmetic and Floating point Arithmetic, Fast Adders and Multipliers, ALU Design. Control Design: Execution of a complete Instruction. Instruction Sequencing, Instruction Interpretation. Control Unit Operations: Hardware Control and Micro programmed Control Memory Organization: Memory Technology, Virtual Memory: Hierarchies, Segments, Pages ,High Speed Memories, Interleaved, Internal Memory, External Memory, Cache. System Organization: Communication with I/O devices (Asynchronous, Synchronous) Input Output: I/O HW, Standard I/O Interfaces. Text / References: 1. Computer Organization and Architecture - William Stallings (Pearson Education Asia) 2. Computer Organization and Architecture -John P. Hayes (McGraw -Hill) 3. Computer Organization -V. Carl. Hamacher (McGraw-Hill) 4. Computer System Architecture -M. Morris Mano (PHI) 11/09/2012 9 B.Tech (Computer Engineering) C P-303 Data Base Management Systems Credits 4 (3-0-2) Need, purpose and goal of DBMS, Three tier architecture, ER Diagram, data models-Relational, Network, Hierarchical and Object Oriented. Data Base Design: Conceptual data base design, Theory of Normalization Primitive and Composite data types, concept of physical and logical databases, data abstraction and data independence, data aggregation, Relational Calculus. SQL : DDL and DML, Relational Algebra. Application Development using SQL : Host Language interface, embedded SQL programming, Stored procedures and triggers and views, Constraints assertions. Internal of RDBMS : Physical data organisation in sequential, indexed random and hashed files. Inverted and multilist structures, B trees, B+ trees, Query Optimisation, Join Algorithm, Statistics and Cost Base optimisation. Transaction Processing, concurrency control, and recovery management. Transaction model properties and state serialisability . Lock base protocols, two phase locking. Text/References: 1.H.f. Korth and Silberschatz: Database Systems Concepts , McGraw Hill 2.Almasri and S.B. Navathe: Fundamentals of Database Systems , 3.C.J. Date: Data Base Design, Addison Wesley 4.Hansen and Hansen : DBM and Design, PHI 11/09/2012 10 B.Tech (Computer Engineering) CP-305 Software Engineering Credits 4 (3-1-0) Introductory

Concepts : Historical perspective, System Definition, Software Life Cycle, Software Engineering paradigms. System analysis: Feasibility study requirement analysis, Cost benefit analysis, Planning systems, Analysis tools and techniques. System Design: design fundamentals, Modular Design, Data and procedural design, object oriented design. System Development : Code documentation, Program design paradigms, Efficiency Consideration. Verification, Validation and Testing : testing methods, Formal Program Verification, Testing Strategies. Software Maintenance : Maintenance Characteristics, Maintainability, Maintenance tasks and side effects. Text / References: 1.Pressman R.S: Software Engineering: A Practitioner approach, McGraw hill 2.Sommerville I: Software Engineering, Addison Wesley 3.Ghezzi C. Jazayeri M and Mandrioli: Fundamentals of software Engg. , PHI 11/09/2012 11 B.Tech (Computer Engineering) CP-307 Design and Analysis of Algorithms Credits 4 (3-0-2) Algorithm Analysis : Asymptotic notation, solution of recurrence, model of computation, time and space complexities, average and worst case analysis. Algorithm Design Techniques : Greedy algorithm, dynamic programming, divide and conquer, backtracking, branch and bound. Greedy Algorithms : Knapsack problem. Dynamic Programming : Chained matrix multiplication, longest common subsequence. Divide and Conquer: Order Statistics – finding the median, exponentiation, matrix multiplication. Graph Algorithms : Shortest path algorithms, minimum spanning tree algorithm, network flow, matching, coverings, applications of DFS:- biconnectivity, Euler circuits, strongly connected components, topological sort, and articulation point. Approximate Algorithm : Travelling Salesman Problem, vertex-cover problem. Set algorithms: Disjoint set operations. Matrix inversion – LUP decomposition. Construction of codes: Shannon Fano and Huffman codes. Introduction to problem classes – NP, NPC, NP-Hard. Text / References: 1.Cormen, Leiserson, Rivest: Introduction to Algorithms , Prentice Hall of India. 2.Horowitz and Sahani: Fundamental of Computer algorithms . 3.Aho A.V , J.D Ulman: Design and analysis of Algorithms , Addison Wesley 4.Brassard : Fundamental of Algorithmics , PHI. 5.W.W. Peterson and E. J. Weldon: Error correcting codes . 6.Sara Baase, Allen Van Gelder: Computer Algorithms: Introduction to Design and Analysis , Pearson Education. 11/09/2012 12 B.Tech (Computer Engineering) CP-309 Computer Networks Credits: 4 (3-0-2) Computer Network Architecture, Circuit switching, Packet And Massage Switching, Network Structure. OSI 7-layer architecture. Physical Layer, Data Link Layer, Framing, Error detection. Retransmission algorithms. Queueing models and introduction to Little’s theorem, M/M/1 and M/M/m queues. Network of queues. Introduction to M/G/1 queues, reservations and priority. Stability of queueing systems. Multiple access and Aloha. CSMA/CD and Ethernet. High Speed LANs and Token Ring. High speed switch scheduling. Broadcast routing and spanning trees. Shortest path routing. Distributed routing algorithms, optimal routing. Flow control – window/credit schemes, rate control schemes. Transport layer and TCP/IP. Introduction to ATM networks and Network Management And Interoperability. Performance Issues Of LAN And WAN. Text/ References: 1.Data Networks: Bertsekas and Gallagher, Phi. 2.Computer Networking A top down Approach : J.F.Kurose, Pearson. 3.Data & Computer Communication : W. Stalling , Phi 4.Computer Networks : L. Peterson and Davie, MKP 5.Computer Networks and

Internet : D.E. Comer, Pearson 11/09/2012 13 B.Tech (Computer Engineering) CP-302 Operating System Credits: 4 (3-0-2) 1.Introduction: Need of Operating System, its evolution, types of operating systems, batch, multiprogramming, time sharing systems, real time systems. 2.Processes and processor management : process concept, systems programmers view of processes, operating systems view of processes, Process scheduling, Schedulers, interprocess communication and synchronization, race condition, mutual exclusion, semaphores, monitors, messages. Deadlocks prevention , avoidance, detection and recovery. 3.Memory Management : a.Contigious allocation- partitioned memory allocation – fixed and variable partitioning, memory management with bit maps – swapping – relocation- protection and sharing. b.Non contigious allocation – i.Paging – principles , page allocation, segmentation. ii.Virtual memory concepts, address translation, management of virtual memory, page replacement policies, protection and sharing, working set model, hardware support. 4.File management: Command language users view of file system, file system design, disk space management directory structure, shared files, file system performance. File servers, security, protection mechanism. 5.Input/Output Management : Device drivers, disk scheduling. 6.Introduction to loaders, linkers and relocating loaders. 7.Case study: UNIX. References/text: 1.A.Silberschatz and Peter B Galvin: Operating System concepts , Addison Wesley publishing Company. 2.Deitel H.M: Operating Systems , Addison Wesley. 3.Stalling W: Operating Systems , Prentice Hall. 4.Tanenbaum: Operating System Concepts , Prentice Hall. 11/09/2012 14 B.Tech (Computer Engineering) CP-304 Digital Signal Processing Credits: 4 (3-1-0) Introduction to Continuous time Systems ,idea about Linear Time Invariant System LTI systems. Fourier Transforms. Discrete Time Systems: Sampling and aliasing, LTIs , Representation of Sequences by Fourier Transform and properties of Fourier Transform. Z-Transform, Structures for discrete system, DFT, Computation of DFT. FIR Filters, frequency response of FIR filters. IIR Filters, spectrum analysis. FFT Algorithms Text/ References: 1.Discrete Time Signal Processing by Alan V Oppenheim, Ronald W Schafer.- PHI 2.Digital Signal Processing Primer : K.Steiglitz, Pearson. 3.Signal and Systems : S.Haykin and Veen, Wiley 4.DSP First: A Multimedia Approach : J.F.McClellan, Schafer and Yodar, Pearson. 11/09/2012 15 B.Tech (Computer Engineering) CP-306 Theory of Computation Credits 4 (3-1-0) Introduction to automata theory, languages, recursive definitions, regular expressions, finite automata, transition graphs and Kleen’s theorem. Non-determination, finite automata with output, regular languages, minimization of finite automata. Chomsky classification of languages, regular grammars, context free grammars, simplification of context free grammars, Normal forms of CFG. Push Down Automata Theory: push down automata and context free languages. Turing hypothesis, Turing machine, Minskey’s theorem, TM variation and encoding, computability and acceptability. Elements of prepositional logic and predicate calculus. Text/ References 1.Aho, Hopcropt and Ullman, Introduction to Automata Theory, Formal Languages and Computation, Narosa 2.Cohen, Introduction to Computer Theory , Addison Wesley. 3.Papadimitriou, Introduction to Theory of Computing , Prentice Hall. 4.K.Krishnamurthy: Theory of Computation . 11/09/2012 16 B.Tech (Computer Engineering) CP-3 08 Computer Graphics Credits: 4 (3-0-2) Introduction to Interactive

Computer Graphics : Picture analysis, Overview of programmer's model of interactive graphics, Fundamental problems in geometry. Basic Raster Graphics : Scan Conversion, Aliasing, and Anti Aliasing, Polygon: Representation, Filling and Clipping. Geometric Manipulation : Transformations, Vectors, Matrices, and Homogeneous Co-ordinates. Elementary 3D Graphics : Planar Geometric Projections, Vanishing Points, Specification of 3-D View. Hidden Lines & Surfaces : Image and Object space, Depth Buffer Methods, Hidden Facets removal, Scan line algorithm, Area based algorithms, Floating horizon, Painters & BSP tree algorithms . Curves and Splines : Parametric and Non parametric Representations, Bezier and B-Spline Curves. Rendering: Color, Simple Light Illumination Model, Ray tracing, Gouraud and Phong Shading. Text/ References: 1.J. Foley, A. Van Dam, S. Feiner, J. Hughes: Computer Graphics-Principles and Practice , Addison Wesley. 2.D. Hearn and Baker: Computer Graphics , PHI 3.D. Rogers and Adams: Mathematical Elements of Computer Graphics , Mc Graw Hill. 4.D. Rogers : Procedural Elements of Computer Graphics , McGraw Hill. 11/09/2012 17 B.Tech (Computer Engineering) CP-322 Optimization Techniques Credits 4 (3-1-0) 1.Introduction: Introduction, Engineering applications (models) of optimization. 2.Linear Programming : Graphical, simplex method, Concept of duality, Dual simplex method,. 3.Dynamic Programming: 4.Transportation Problems : basic feasibility solution by different methods, optimal solution, Degeneracy in transportation problem, unbalanced transportation problems 5.Assignment Problems : Balanced and unbalanced assignment, assignments to given schedule. 6.Introduction to Non-linear programming :. Text/References 1.Rao S S, Optimization: Theory and Applications. 2.N.S. Kambo : Mathematical Programming Techniques , East West Press 3.Hamdy A. Taha : Operation Research an Introduction , PHI 4.Vasek Chvatal : Linear Programming , W.H. Freeman & Co. 5.Walsh G R, Methods of Optimisation 6.Williams H P, Model Building in Mathematical Programming 7.Williams H P, Model Solving in Mathematical Programming 8.Winston W L, Operations Research: Applications and Algorithms . 9.Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms and Complexity , PHI. 11/09/2012 18 B.Tech (Computer Engineering) CP-324 Combinatorics Credits 4 (3-1-0) Graph Theory: Graphs – Directed and Unidirected, Eulerian chains and Cycles. Hamiltonian chains and cycles. Trees, chromatic number, Connectivity and other graphical parameters. Applications. Polya's Theory of enumeration and its applications. Number Systems: Sums and Product rules, Permutation and combinations. Pigeon hole principle, Inclusion and Exclusion Principles, Ramsey, Catalan and Stirling numbers. Sequences and selections, Proofs, Induction, Relations, Combinatorial number theory. State Machines: Invariants and Termination Recursive De■nitions and Structural Induction Sums, Products & Asymptotics Probability Theory: Introduction to Probability, Random Variables and Expectation Text/References: 1.Graham, Knuth, and Patashnik: Concrete Mathematics: A Foundation for Computer Science , Pearson 2.Kenneth H. Rosen: Discrete Mathematics and its Applications , Fourth Edition. 3.Tucker: Applied Combinatorics , Wiley. 4.Gibbsons, A.: Algorithmic Graph Theory , Cambridge University Press. 5.Narsingh Deo:Graph Theory with Application to Engineering and Computer Science , Prentice- Hall. 6.Narsingh Deo: Com binatorial Algorithms: Theory and Practice , Prentice-Hall. 11/09/2012 19 B.Tech (Computer Engineering)

CP-326 Advanced Microprocessors Credits 4 (3-1-0) Architectural Features of X86 Microprocessors and Pentium Processors and comparison. Addressing Modes of x86, Instruction Sets, Instruction templates, Interrupts and interrupt handling, assembly language programming. Memory management: Real, Protected And Virtual Real Modes, segmentation and paging. Multitasking and task switching Features in x86. Text/ References : 1.Douglas V. Hall: Microprocessor and interfacing, Programming And Hardware, TMH 2.B.S. Chhabra: 8086 architecture and interfacing, DRP 3.Liu Gibson: Introduction to 8086/88 architecture and interfacing, PHI 4.James L. Antonakof: Introduction to Intel Family of Microprocessors, Pearson Edu. Asia Credits 4 (3-1-0) 11/09/2012 20 B.Tech (Computer Engineering) CP-328 Neural Networks Credits 4 (3-1-0) Neural Architecture : Neuron model, transfer function, hamming and hopfield network, perceptron, learning rule, recurrent networks. Backpropagation: generalized delta rule, limitations, modeifications – momentum, variable learning rate, conjugate gradient. Learning: Supervised, associative, competitive, unsupervised learning. Unsupervised learning : Self-organising maps, Adaptive Resonance Theory. Neural network applications : Pattern classification, function approximation. Text/ References: 1.Simon Haykin: Neural Networks: A Comprehensive Foundation (2nd Edition) 2.Christopher M. Bishop: Neural Networks for Pattern Recognition 3.James A. Freeman, David M. Skapura: Neural Networks, Pearson Education. 4.Martin T. Hagan: Neural Network Design, Thomson Learning . 5.N. Gupta, Optimization Techniques for Engineers , Ashirwad Publishers and Distributors 11/09/2012 21 B.Tech (Computer Engineering) CP-330 Mathematical Programming Credits 4 (3-1-0) Classical Optimization: Polyhedra; Extreme Points. Degeneracy; Optimality Conditions; The Simplex Method. Duality; Dual Simplex, Farkas Lemma, Separating Hyperplanes and Duality, Cones, Rays, Representation of Polyhedra, Dantzig-Wolfe Decomposition Non-linear Programming : Unconstrained and constrained optimization Integer programming Project Scheduling : CPM and PERT. Theory of Games: Two person zero sum game, solution of pure strategy game (with saddle point). Search Methods: Line search, steepest descent and Newton's method. Text/References: 1.D. Bertsimas and J. N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, 1997. 2.Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms and Complexity , PHI. 3.Rao S S, Optimization: Theory and Applications. 4.N.S. Kambo : Mathematical Programming Techniques , East West Press 5.Hamdy A. Taha : Operation Research an Introduction , PHI 6.N. Gupta, Optimization Techniques for Engineers , Ashirwad Publishers and Distributors 11/09/2012 22 B.Tech (Computer Engineering) CP-332 Information Theory and Coding Credits 4 (3-1-0) Mathematical Theory of Foundation Of Information Theory in Communication system. Measures of Information- Self information, Mutual Information, Average Information, entropy and its properties. Source Model and Coding, channels Model and Coding. Problems of unique decipherable Codes, condition of Instantaneous codes, Code word length, Kraft Inequality. Noiseless Coding Theorem. Construction of codes: Shannon Fano, Shannon Binary and Huffman codes. Discrete Memory less channels: Classification of channels, calculation of channel capacity. Decoding scheme- the ideal observer. The fundamental theorem of Information theory. Error Correcting Codes: Minimum distance principle. Relation between distance and error correcting properties of codes, The Hamming bound. Parity check Coding. Bounds on the error correcting ability of Parity Check Codes. Text /References 1.Information theory and Reliable Communication by R.G.Gallager 2.Information Theory by Robert Ash 3.An Introduction to Information Theory by F. M. Reza 4.Error correcting codes by W.W. Peterson and E. J. Weldon 11/09/2012 23 B.Tech (Computer Engineering) CP-401 Principles of Compiler Design Credits 4 (3-0-2) Translators: Introduction to compilers, translators, and interpreters, compilation process. Lexical Analysis: Finite automata, Regular expressions, Design & implementation of lexical analysers. Syntax Analysis: Context Free Grammars, Derivation and Parse trees, Bottom-up and Top-down Parsing. Syntax directed translation: Syntax directed translation, Intermediate codes, Quadruples, Triples. Symbol table organization: Hashing, linked list, tree structures. Memory allocation: Static and dynamic structure allocation. Code optimization: Basic blocks, Flow graphs, DAG, Global data flow analysis, Loop optimization. Code generation: Compilation of expression and control structures. Error detection and recovery. Text & References: 1.Aho, Ullman and Sethi: Compilers, Addison Wesley. 2.Holub, Compiler Design in C, PHI. 11/09/2012 24 B.Tech (Computer Engineering) CP-403 AI & Expert System Credits 4 (3-0-2) Overview of AI, Problems, Problem space and searching techniques, Definition production system, Control strategies, Heuristic search techniques. Knowledge representation: Representation, mappings, approaches and issues, Predicate logic, prepositional logic, Resolution, Procedural and declarative knowledge, forward and backward reasoning, Matching, Semantic nets, Frames scripts. Learning and learning systems: Introduction to Hopfield networks, introduction to neural networks, learning in neural networks, applications of neural networks, Recurrent network. Natural Language Processing, Perceptions and actions. Introduction to Expert Systems, Definition types, Component, development process. Introduction to AI languages: PROLOG and LISP. Text & References: 1.Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill. 2.Introduction to AI & Expert System: Dan W. Patterson, PHI. 11/09/2012 25 B.Tech (Computer Engineering) CP-405 Introduction to VLSI Design Credits: 4 (3-0-2) •Introduction: IC system design options, CMOS processing, layout and design rules, Stick diagrams •CMOS Design and Characterization using SPICE: Inverter transfer characteristics, noise margins, SPICE simulation, Transient response and transistor sizing, SPICE simulation, Speed-area trade-off , Circuit Power Consumption, design tradeoffs speed- power, introduction to low power circuit design, Capacitance estimation, buffer design, area-speed design tradeoffs. Transistors, gates and wires fabrication. •CMOS Circuit Design and Layout: Static complementary gates, Transmission gates and tristate circuits, Storage elements, Pass transistor logic, Dynamic logic, Structured macros: PLAs etc •Introduction to Low power design Text/References: 1.Modern VLSI Design : Wayne Wolf, Pearson 2.Rabaey JM, Digital Integrated Circuits , Prentice-Hall/Pearson 3.Weste NHE, Eshraghian K, Principles of CMOS VLSI Design with Verilog/VHDL manual , Addison-Wesley/Pearson, 2000 . 11/09/2012 26 B.Tech (Computer Engineering) CP-407 : Real Time Systems Credits: 4 (3-0-2) Introduction to Real-time systems, Issues in Real-time Systems, Real-time System Components, Classification of Real-time systems and Real-time tasks. Misconceptions about Real-time computing. Real-time System requirements: Speed, Predictability, reliability, adaptability. Specification of timing constraints. Real-time scheduling: Requirements and Issues, Terminology, modeling, Introduction static and dynamic scheduling schemes, cyclic scheduling, priority driven scheduling of periodic tasks, schedulability tests, Aperiodic task scheduling: fixed priority server/non-server based scheduling algorithms. Practical factors/overheads. Task Synchronization: Need and priority inversion problem, Priority Inheritance protocol, priority ceiling protocol and stack-based priority ceiling protocol for fixed priority preemptive system. Introduction to multiprocessor real-time systems, problems and issues. An overview of a real-time operating system Text & References: 1.J.W.S.Liu: Real-Time Systems , Pearson Education Asia 2.S.T.Lavi, A.K.Agrawala: Real-time system Design , McGraw Hill 3.P.A.Laplante: Real-time Systems Design and Analysis, An Engineer’s Handbook , IEEE Press 4.P.D.Laurence, K.Mauch: Real-time Microcomputer System Design, An Introduction , McGraw Hill 11/09/2012 27 B.Tech (Computer Engineering) CP-421 Advanced Topics in Computer Graphics Credits: 4 (3-0-2) Visibility: Polygon Meshes, Depth Sorting. Triangle decomposition, Geometric Sort, Warnock's Methods Hidden Lines and Surfaces : Special cases, Surfaces defined by a function y=f(x,y), Grid surfaces. Colour in Computer Graphics : Color Vision, Measuring Color, Color Models, Color output, color usage. Object Lighting and Shading : Local reflection models, shading surfaces, Texture and transparency, Forward & backward Ray-tracing Global Illumination and classical radiosity. Modeling natural phenomena: Fractals and chaos. Animation Techniques : Position, speed or orientation. Animation by hierarchic control, scenario- based systems, movement control. Shadows, Morphing. Efficiency and complexity issues in graphics algorithms Text/ References: 1.J. Foley, A. Van Dam, S. Feiner, J. Hughes: Computer Graphics-Principles and Practice, Addison Wesley.(2nd edition in C) 2.Alan Watt- 3D Computer Graphics (3rd edition) 3.Alan Watt, Mark Watt: Advanced Animation & Rendering Techniques:Theory & Practice , Addison-Wesley. 4.D. Rogers and Adams: Mathematical Elements of Computer Graphics , Mc Graw Hill. 5.Thomas Moller: Real-time Rendering , Eric Haines, A.K Peters Ltd 11/09/2012 28 B.Tech (Computer Engineering) CP-423 Advanced Topics in Networking Credits: 4 (3-0-2) Review of MAC and LLC Issues: Techniques for multiple access, Adaptive LLC mechanisms for wireless links . Internet Routing Architecture: Internet Service Providers and Peering. Border Gateway Protocol (BGP). Review of Open Shortest Path First Border Gateway Protocol (continued), BGP instability. Fair queuing. TCP congestion control. TCP variants. Random Early Detect (RED). TCP RTT estimation. Fast retransmit, Fast recovery. Resource ReSerVation Protocol (RSVP). Differentiated Services. Wireless TCP Mobile IP. Multicast routing Scalable Multicast routing. Core Based Trees (CBT). Scalable Multicast routing Protocol Independent Multicast (PIM). Scalable Reliable Multicast. Overlay Networks. Peer-to-Peer Networks. Domain Name System (DNS). LDAP/NIS. DHCP/BOOTP Introduction to Web-server and redirection mechanisms. Web cache sharing: Summary-Cache. Traffic Engineering. Introduction to the Next generation IP, IPv6, IP Next Layer (IPNL)ng,. Multi-Protocol Label Switching (MPLS) Access technologies: xDSL. Text/ References: 1.Computer Networks : L. Peterson and Davie, MKP\ 2.Wireless communication and Networking : W. Stallings 3.Recent RFCs and suggested reading form SIGCOMM/ACM/IEEE. 11/09/2012 29 B.Tech (Computer

Engineering) CP-42 5 Distributed Databases Credits: 4 (3-0-2) Introduction To Distributed DBMS, Overview of Relational DBMS and Computer Networking. Distributed DBMS Architecture, Architecture Models for Distributed Data Base System, Client - Server Systems, Peer-to-Peer Distributed Systems. Distributed Data Base Design, Distribution Design Issues, Fragmentation and Allocation. Semantic Data Control, View Management, Data Security, Query Processing, Characterization of Query Processor, Layers of Query Processing, Query Decomposition, Localization of Distributed Data, Optimization Of Distributed Queries. Introduction To Transaction Management, Distributed Concurrency Control, Distributed DBMS Reliability. Text & References: 1.Distributed Database: Principles and System - Ceri Pelagatti (McGraw Hill) 2.Principles of Distributed Database Systems - M. Tamer Ozsu, Patrick Valduriez (Pearson Education) 3.Distributed Data Base Systems - David Bill, Jane Grimson (Addison - Wesely) 11/09/2012 30 B.Tech (Computer Engineering) CP-427 VHDL Credits 4 (3-0-2) Origins of VHDL. VHDL Design Cycle, the standardisation process. Register-Transfer Level Design: RTL design stages. Design of Combinational Logic blocks. Synthesis and simulation models. Types and operators. Standard packages. Sequential VHDL: Concept of processes, Registers : simulation model, synthesis model, templates and types of registers. Hierarchy of components within VHDL designs. Subprograms and special structures. Test benches, data and file handling. Libraries. Text/References: 1.Designer's Guide to VHDL : P.J.Ashenden, MKP 2.Digital system Design with VHDL : M.Zwolinski, Pearson. 3.VHDL coding style and methodologies : Ben Cohen 4.VHDL Primer; J.Bhaskar, Pearson 5.VHDL for logic synthesis : A. Rushton, Wiley 11/09/2012 31 B.Tech (Computer Engineering) CP-429: Simulation and Modelling Credits: 4 (3-0-2) Definition of a system, System concepts, type of system, continuous & discrete systems, modeling process verification & validation. Markov chains. Weak law of large numbers. Central limit theorem. Strong law of large numbers. Queuing models: Little's Theorem, M/M/1, M/M/m, M/M/ э, M/M/m/m, M/G/1, and M/M/1/J queuing systems. Introduction, classification of simulation models, advantages and disadvantages of simulation. Discrete system simulation: Monte Carlo method, Random number generators. Probability Distributions. Element of inventory theory, more complex inventory models, finite and infinite delivery rate model with and without back ordering. Simulation of inventory systems. Text/ References: 1.System simulation, Gorden G., Prentice Hall of India 2.System simulation, Narsing Deo, McGraw Hill. 3.Simulation modeling and analysis , Law and Kelton, McGraw Hill. 11/09/2012 32 B.Tech (Computer Engineering) CP-44 1 Embedded Systems Credits: 4 (3-0-2) Introduction to embedded systems., design representations, level of abstractions, design methodologies, Models and architectures, Taxonomy of models and architectures, brief descriptions of specification languages, Specification requirement for embedded systems, Spec Chart and Spec Chart Description. Design challenges & issues, hardware and software design, co-design of software and hardware, ASIC. Design quality estimation : Quality matrix, software and hardware estimation. Introduction Sample design Specification of Answering machine/ Microcontroller 8051. Text / References: 1.Denial D. Gajski , frank Vahid: Specification and design of embedded systems , PH 2.Jonathan W. Valvano: Embedded Microcomputer Systems , Thomson Learning

3.Myke Predko: Programming and Customizing the 8051 Micro Controller , TMH 3. Ayala : 8051 Micro controllers , Penram Press 11/09/2012 33 B.Tech (Computer Engineering) CP-443 Cryptography Credits: 4 (3-0-2) Number theory: Prime numbers, modular arithmetic, Fermat's theorem, Euler's theorem, Chinese remainder theorem, Discrete logarithms, Random number generation, factoring, prime number generation, one-way hash functions – MD5, SHA (Secure Hash Algorithm). Cryptography: Need, conventional techniques, stream ciphers, block cipher, steganography. Public v/s private key cryptography. Stream Ciphers: Caesar Cipher, mono-alphabetic and poly-alphabetic ciphers, Playfair Cipher, Hill Cipher, Rotor machines, One time pad,. Steganography: Visual, Textual, Cipher hiding, False errors. Private-key cryptography: Feistel structure, DES (Data encryption standard), design of S-boxes, AES, Triple DES, Public key cryptography: Key management, Key exchange – Diffie-Hellman, Authentication, Signatures, Deniability, RSA. Digital Signature: DSA and its variants, discrete logarithm based digital signatures. Algorithms: International data encryption algorithm (IDEA), PGP. Cryptanalysis: Differential and linear cryptanalysis - cracking DES. Text & References: 1.Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education Asia. ISBN 981-403-589-0. 2.B Schneier, Applied Cryptography, Wiley. ISBN 0-471-11709-9 3.D Kahn. The Codebreakers, Sphere books. ISBN 0-7221-51497 4.P Wayner, Disappearing Cryptography, Academic Press. ISBN 0-12-738671-8 5.Cracking DES, Electronic Frontier Foundation. ISBN 1-56592-520-3 6.A.J. Menezes, P.C. van Oorschot and S.A. Vanstone, Applied Cryptography, CRC Press, ISBN 0-8493-8523-7, 1997 7.D.R. Stinson, Cryptography - Theory and practice, CRC Press, ISBN 0-8493-8521-0, 1995 11/09/2012 34 B.Tech (Computer Engineering) CP-445 Advanced Data Structures and Algorithms Credits 4 (3-0-2) Binary heaps, binomial heaps, Fibonaaci heaps. AVL trees, Red-black trees, B-trees, Splay trees. Disjoint set – union and path compression, Amortized analysis Recurrence equations. Time and space complexity, NP, NPC and NP-Hard problems, undecidability. Convex hull, line segments, Optimal polygon triangulation. Primality testing, Integer factorization, Randomized algorithms, Probabilistic algorithms. Dynamic programming: Longest common subsequence. Chain of matrix multiplication, Approximate Algorithms: Vertex-cover, set-covering problems, Travelling Salesman problem. Combinatorial algorithms, Randomized algorithms. Texts/References: 1.Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India. 2.Horowitz and Sahani: Fundamental of Computer algorithms . 3.Aho A.V , J.D Ulman: Design and analysis of Algorithms , Addison Wesley 4.Brassard : Fundamental of Algorithmics , PHI. 5.W.W. Peterson and E. J. Weldon: Error correcting codes . 6.Sara Baase, Allen Van Gelder: Computer Algorithms: Introduction to Design and Analysis , Pearson Education. 7.Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms and Complexity , PHI. 11/09/2012 35 B.Tech (Computer Engineering) CP-447 Image Processing & Pattern Recognition Credits: 4 (3-0-2) Image processing: Image formation, Image acquisition - cameras, displays, frame grabbers, Sampling and quantisation. Image Transforms: Fourier transform, Discrete Fourier transform (DFT), fast Fourier transform (FFT), Discrete cosine transform (DCT), wavelet transform, Principal component analysis (PCA), independent component analysis (ICA). Image Enhancement : Point and region operators, Image filtering, Convolution, Histogram. Morphological operations – dilation and erosion. Image Segmentation: Segmentation by thresholding, optimal thresholding, region – representation, split and merge regions, quadtree, shape number, boundary descriptors. Image Restoration: Direct, inverse, pseudo-inverse. Image Representation: 2-D Shape representation and matching, Recovering depth information, 3-D representation and matching. Image Interpretation: Edge detection, feature extraction, template matching, Hough transform. Image classification: Metric, k-NN classification, clustering. Case Studies: Ultrasound image analysis, Face recognition. Text & References: 1.Gonzalez et al., Digital Image Processing, Prentice Hall, 2001 2.Sonka M, Hlavac V and Boyle R, Image Processing, Analysis and Machine Vision, Chapman and Hall, 2nd Ed. 1999. 3.Jain A K, Fundamentals of Digital Image Processing, Prentice Hall, 1989. 4.Stockman and Shapiro, Computer Vision, Prentice Hall, 2001 5.Banks S J, Signal Processing, Image Processing and Pattern Recognition, Addison Wesley, 1991. 6.Rabiner L R and Gold B, Theory and Applications of digital Signal Processing, Prentice Hall, 1975. 7.Efford, N., Digital Image Processing Using Java, Addison Wesley, 2000 11/09/2012 36 B.Tech (Computer Engineering) CP-449 Biometrics Credits 4 (3-0-2) Biometrics: Need, Conventional techniques of authentication, challenges - legal and privacy issues. Biometrics: DNA, fingerprint, Iris, Face, hand geometry, human gait, speech, infra-red spectrum, ear. Combining biometrics, scaling issues. Texts/References: 1.Julian D. M. Ashbourn, Biometrics: Advanced Identify Verification: The Complete Guide 2.Davide Maltoni (Editor), et al, Handbook of Fingerprint Recognition 3.L.C. Jain (Editor) et al, Intelligent Biometric Techniques in Fingerprint and Face Recognition 4.John Chirillo, Scott Blaul, Implementing Biometric Security 5.Nalini Ratha (Editor), Ruud Bolle 6.Authentication: From Passwords to Public Keys, Richard E. Smith 11/09/2012 37 B.Tech (Computer Engineering) CP-420 Advanced topics in Operating Systems Credits 4: (3-0-2) Introduction: Goals, Functions, Design issues of Distributed OS, Distributed v/s network operating system. Communication: Client Server, RPC Distributed OS: Issues, process management, inter-process communication, scheduling, deadlocks Design and implementation of distributed file systems, distributed shared memory Security: Concepts and Distributed Systems Distributed Concurrency, Transactions. Case study: Unix, Amoeba. Text/References: 1.Tanenbaum: Distributed Operating Systems, Pearson Education. 2.Bach, Design of Unix O/S . 3.Coulouris, Dollimore and Kindberg, Distributed Systems: Concepts and Design , Addison Wesley. 4.Mullender: Distributed Systems , Addison Wesley. Tanenbaum and Steen: Distributed Systems: Principles and Paradigms , Pearson Education 11/09/2012 38 B.Tech (Computer Engineering) CP-422: Parallel and Distributed Computing Credits 4 (3-0-2) Introduction to parallel computing. Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O Parallel reduction, Prefix sums, List ranking, Preorder tree traversal, Merging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS Thread and process level parallel architectures: MIMD, multi-threaded architectures. Distributed and shared memory MIMD architectures. Dynamic interconnection networks. Mapping and scheduling: Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock. Parallel programming and parallel algorithms: Programming models, parallel programming on multiprocessors and multicomputers. Parallel algorithm structure, analyzing parallel algorithm. Elementary parallel algorithms, Matrix algorithms, sorting, Graph algorithms. Text & References: 1.Parallel computing – theory and practice, Quinn, Tata McGraw Hill. 2.Advanced Computer Architectures, Sima and Fountain, Pearson Education. 3.Computer Architectures single and parallel systems, Mehdi R. Zargham, PHI. 4.Foundations of parallel processing, Ghosh, Moona and Gupta, Narosa publishing. 5.Michael Quinn: Parallel Computing-Theory and Practice, MGH 6.Ed. Afonso Ferreira and Jose' D. P. Rolin, Parallel Algorithms for irregular problems - State of the art, Kluwer Academic Publishers. 7.Selim G. Akl, The Design and Analysis of Parallel Algorithms, PH International. 11/09/2012 39 B.Tech (Computer Engineering) CP-424 Computer Human Interaction Credits: 4(3-0-2) Goals of human Computer Interaction and its relevance to the appluications of interactive computer graphics Phychological Aspects Cognitive psychology, visual perception, auditory perception, haptic perception, human memory, human error Devices for human computer interactuion : Text input devices, positioning and pointing devices, 3D devices, Devices for visual, auditory, and haptic output, Interfaces and devices for disabled users Models and paradigms of HCI : Characterizing different phases of interaction. Ergonomic aspects of interaction. Interaction styles: from command language to 3D interfaces. Windows interfaces(WIMP). Menu and icon design. Interaction paradigms. HCI and software Lifecycle : Analysis of usability requirements, Usability principles. User-centered design. Usability engg, prototyping techniques, Environment, user, task Analysis Formal Methods in HCI : State transition Networks and other diagrammatic notations, Textual notations Guidelines and standard user interfaces: Definition choosing and using guidelines. ISO 9241 standard Tools for user interface implementation : windowing ststem, programming techniques, user interface management systems. Usability Evaluation : Goals, recording tools, predictive evaluation, interpretive evaluation Help: Requirement, Main approaches, adaptive and adaptable interfaces. Recent Paradigms of HCI : Virtual reality, Multi-sensory intyerfaces, information visualization, Hypertext, Multimedia and Hypermedia interfaces, WWW interfaces. Design of usable web pages. Text / References: 1. A.Dix, J.Finlay, G. Abowd and R. Beale, Human Computer Interaction, Second Edition, PHI, 1998 2. B. Scneiderman, Designing the User Interface, Addison Wesl;ey, III ed. 3. Preece, Rodgers, Sharp, Benion, Holland and Carey, Human Computer Interaction, Addison Wesley 4. Dix A, Finlay J, Abowd G and Beale R, Human-Computer Interaction , 3rd Edition. Prentice Hall, 2003 5. Norman DA, The Design of Everyday Things , Doubleday, 1990 6. Preece J and Keller L, Human-Computer Interaction, Prentice Hall, 1989 7. Barfield L, The User Interface: Concepts & Design , Addison Wesley, 1993 8. Cox K & Walker D, User Interface Design , Prentice Hall, 1993 9. Preece J, Rogers Y, Sharp H Interaction Design: beyond human- computer interaction , Wiley, 2002. 11/09/2012 40 B.Tech (Computer Engineering) CP-426 Software Project Management Credits 4 (3-0-2) 1.Software

Project Management Concept: The Management Spectrum, People, Product, Process & Project. 2.Software Process & Project Matrix: Software Measurement Size Oriented Matrixes, Function Oriented Matrices. 3.Software Project Planning: Objectives, Decomposition Techniques, Empirical Estimation Model. 4. Risk Analyses And Management: Risk Identification, Projection, Risk Identification, Projection, Risk Refinement, Risk Monitoring And Management. 5.Project Scheduling & Tracking, Software Quality Assurance, Software Configuration Management. Text & References: 1.R. S. Pressman, Software Engineering 2.P. Jalote, Software Project Management In Practice. 3.B. Hughest & M. Cotterell, Software Project Management. 11/09/2012 41 B.Tech (Computer Engineering) CP-428 Advanced Topics in Databases Credits 4 (3-0-2) Real-time Database: Implementation and issues. Concurrency control and locking. Recovery. Transaction management. Design and implementation issues in Relational Databases, Object-Oriented Databases, Temporal databases, Spatial databases, Multi-media databases Data mining, Data warehouse Text/References 1)Elmasri R and Navathe SB, Fundamentals of Database Systems, 3rd Edition, Addison Wesley,2000. This book covers most of the material on the course. 2)Connolly T, Begg C and Strachan A, Database Systems, 2nd Edition, Addison Wesley, 1999 3)Simon AR, Strategic Database Technology: Management for the Year 2000 , Morgan Kaufmann, 1995 4)Gray J and Reuter A, Transaction Processing: Concepts and Techniques , Morgan Kaufmann, 1993 5)Date CJ, An Introduction to Database Systems , 7th Edition, Addison Wesley, 1999 6)Khashafian S and Baker AB, Multimedia and Imaging Databases , Morgan Kaufmann,1996 7)McFadden FR, Hofer JA and Prescott MB, Modern Database Management 5th Edition, Addison-Wesley 1999 11/09/2012 42 B.Tech (Computer Engineering) CP-440 Robotics Credits: 4 (3-0-2) Robotics: Introduction to robotics, advantages, applications. Robotic kinematics and dynamics: Direct and inverse kinematics problem. Axis transformations as applied to robotics; application and definition of the DH matrix; forward and reverse kinematics, trajectory planning. Robot manipulators and their control. Robot sensors: Active and passive robot sensors Construction of tactile, touch and vision sensors; interpretation of sensory information; vision processing; use of sensory data to determine kinematic information. Robot Intelligence: State space search, Robot learning, Robot task planning, robotics in computer vision applications. Robotic end effectors: Stable grip; constraints; types of contact; mathematical representation of stable grip; use of screw twist, and wrench gripper design; tools as end effectors. Problems of implementation of automatic systems. Text & References: 1.Fu K, Gonzalez R and Lee C, Robotics - Control Sensing Vision & Intelligence , McGraw Hill. 2.Craig J J, Introduction to Robotics, Mechanics and Control , Addison Wesley, 1993. 3.McKerrow P J, Introduction to Robotics , Addison Wesley, 1993. 4.Selig M, Introductory Robotics , Prentice Hall, 1992. 11/09/2012 43 B.Tech (Computer Engineering) CP-442 Behavioural Synthesis Credits 4 (3-0-2) •Review of hardware description languages and behavioural synthesis of digital systems. •Behavioural synthesis data structures and algorithms: Data and control flow representations, Data flow graph (DFG) descriptions, Control data flow graph (CDFG) descriptions, Extended Petri-net models •Synthesis and design space: Design space exploration, Constructive vs. transformational/iterative techniques, Behavioural optimization, Scheduling, allocation, module binding and controller synthesis •Scheduling algorithms – constructive: Unconstrained scheduling: ASAP and ALAP algorithms, Constrained scheduling: list scheduling and force-directed scheduling, Scheduling of multicycled and pipelined functional modules •Allocation and binding algorithms: Lifetime analysis of registers, Variable-to-register mapping using the left edge algorithm •Interconnect allocation and optimisation •Transformational/iterative approaches: Cost functions, Transformations, Simulated annealing, Genetic algorithms •Test synthesis for digital systems: Design for testability: scan-based and built-in-self- test (BIST) techniques, Test scheduling, Test controllers, On-line test •Related areas: Aalogue synthesis, HW/SW codesign, Design confidence (design verification, online test), Optimisation with respect to power dissipation, routability, interconnect delay, testability, Logic optimisation Text/References: 1.Giovanni De Micheli, Synthesis and optimisation of digital circuits, McGraw Hill. 2.Sabih Gerez, Algorithms for VLSI design automation, , Wiley 3.John P Elliott, Understanding behvioural synthesis, , Kluwer. 11/09/2012 44 B.Tech (Computer Engineering) CP-444: Multimedia Systems Credits 4 (3-0-2) Multimedia Systems Design : An introduction. Compression and Decompression. Data and file format standards : Overview of other image file formats as JPEG, GIF, TIFF, BMP, PNG etc. Multimedia Input/Output Technologies : Storage and retrieval technologies, Architectural and telecommunication consideration. Making still images ; editing and capturing images; scanning images; computer color models; color palettes; vector drawing; 3-D drawing and rendering; Multimedia application design, Multimedia authoring and user interface. Multimedia information networks, distributed multimedia systems, System design methodology and considerations, Multimedia applications. MPEG Audio; audio compression & decompression; brief survey of speech recognition and generation; audio synthesis; Musical Instrument Digital Interface (MIDI); digital video and image compression; MPEG motion video compression standard; DVI technology; time-based media representation and delivery. Introduction to Virtual Reality Text & References: 1.Multimedia Systems Design, Prabhat Andleigh and Thakkar, PHI. 2.Multimedia Information Networking, N.K.Sharda, PHI. 3.Villamil & Molina, Multimedia : An Introduction, PHI 4.Lozano, Multimedia : Sound & Video, PHI. 5.Tay Vaughan, Multimedia :Making it work, TMH 6.Sinclair, Multimedia on the PC, BPB. 7.Villamil & Molina, Multimedia : Production, Planning and Delivery, PHI. 11/09/2012 45 B.Tech (Computer Engineering) CP-446: Mobile Computing Credits: 4 (3-0-2) Introduction to mobile computing: principles, classification & overview of devices, operating systems. Wireless transmission: brief overview, multipath propagation, hidden & exposed terminals. Medium access control & protocols: SDMA, FDMA, TDMA, DAMA, FAMA, PRMA, Reservation TDMA, polling, CSMA/CA, CDMA etc, Wireless LAN: infrastructure & ad-hoc networks, IEEE 802.11, HIPERLAN. Mobile network layer: mobile IP, DHCP, infrastructure & Ad-hoc routing. Mobile transport layer: indirect TCP, snooping TCP, mobile TCP etc. mobile support, WWW & mobility, WAP. Text & References: 1.Principles of mobile computing Hansmann & Merk. , Springer 2.Mobile communications Jochen Schiller , Pearson 3.802.11 wireless networks Matthew S.Gast, O'REILLY. 4.Wireless LANs: Davis & McGuffin, McGraw Hill 5.Mobile Communications Handbook by Jerry D. Gybson 6.Mobile

Communications Handbook by Raymond Steel 11/09/2012 46 B.Tech (Computer Engineering) CP-448: Advanced Computer Architecture Fundamentals: Computational models, concept of computer architecture, Von Newmann architecture. Instruction level parallel processors: Pipelining (instruction and arithmetic), Pipeline scheduling (static and dynamic), Throughput improvement, VLIW architectures. RISC and CISC architectures: RISC design versus CISC design. Instruction level data-parallel architectures: SIMD, vector architectures. Interconnection networks: Network topology, Static NW, Interconnection design decisions. Multiprocessors and multicomputers, Common interconnection structures, Data Flow computers: Introduction, Data Flow Program Graph, Activity Template, Scheme, Implementation, Pipelining in Data Flow Programs, Basic Mechanism, Data Flow Multiprocessor, Token labeling, MIT architecture. Text & References: 1.Advanced Computer Architectures , Sima and Fountain, Pearson Education. 2.Computer Architectures single and parallel systems , Mehdi R. Zargham, PHI. 3.Advanced Computer Architectures , Hwang, Tata McGraw Hill. 11/09/2012 47 Btech_IT_April_oldscheme.pdf Ist year AUTUMN SEMESTER MA-101 Mathematics-I BS 4 3-1-0 PH-101 Physics-I BS 5 3-1-2 EE-101 Electrical Science* ESA 43-1-2/2 HS-101 English (Basic/Advanced)* HS 4 3-0-2 CH-101 Fundamentals of Bio-Tech* ESA 2 2-0-0 ME-101 Basic Mechanical Engg. ESA 3 2-0-2 CE-101 Engineering Graphics I ESA 3 1-0-3 CY-101 Chemistry* BS 5 3-1-2 IC-101Computer Systems & Programming*ESA 4 3-0-2 SPRING SEMESTER MA-102 Mathematics-II BS 4 3-1-0 PH-102 Physics-II BS 5 3-1-2 EC-102 Electronics ESA 4 3-1-0 ME-102 Engineering Graphics II ESA 3 1-0-3 IC-101Computer Systems & Programming*ESA 4 3-0-2 HS-101 English (Basic/Advanced)* HS 4 3-0-2 EE-101 Electrical Science* ESA 43-1-2/2 CH-101 Fundamentals of Bio-Tech* ESA 2 2-0-0 CY-101 Chemistry* BS 5 3-1-2

Department of Computer Engineering Malaviya National Institute of Technology Curricular Structure BTech (Computer Engg.) 2nd Year AUTUMN SEMESTER Teaching Scheme Contact Hrs/Week Exam Duration Relative WeightageS.No.Subject CodeCourse Title Subject AreaPr Credit Lecture Tutorial Practical Theory Practical CWS PRS MTE ETE PRE CH 1IC-201 Mathematics III BS 4 3 1 0 3 -25 -25 50 - 4 2CP-201 Logic System Design DC EC-102 4 3 0 2 3 - -30 20 50 - 6 3CP-203 Data Structures DC IC-101 5 3 1 2 3 -10 20 20 50 - 6 4CP-205 Discrete Structures DC 4 3 1 0 3 -20 -30 50 - 4 5CP-207 Electronic Circuits and Design ESA EC-102 4 3 0 2 3 - -30 20 50 - 5 6 Institute Elective I IE 4 3 1 0 3 -25 -25 50 - 4 25 18 4 6 29 SPRING SEMESTER Pr Cr CH 1IC-202 Social Science & Economics HS 4 3 1 0 25 -25 50 - 4 2CP-202Principles of Programming LanguagesDC CP-203 4 3 0 2 3 - -30 20 50 - 5 3CP-204 Microprocessor & Interfaces DC CP-201 4 3 0 2 3 - -30 20 50 - 5 4CP-206 Object Oriented Design DCIC-101, CP-2034 3 0 2 3 - -30 20 50 - 6 5CP-208Principles of Communication EngineeringESA EC-102 4 3 1 0 3 -20 -30 50 - 4 6 Institute Elective II IE 4 3 1 0 3 -25 -25 50 - 4 24 18 3 6 Creative Arts /Sports/NSS/Hindi ECA 2 28 Discipline ECA 2 Total Credits: 53

Department of Computer Engineering Malaviya National Institute of Technology Curricular Structure BTech (Computer Engg.) 3rd Year AUTUMN SEMESTER Teaching Scheme Contact Hrs/Week Exam Duration Relative WeightageS.No.Subject CodeCourse Title Subject AreaPr Credit Lecture Tutorial Practical Theory Practical CWS PRS MTE ETE PRE CH 1CP-301 Computer Architecture DCCP- 2014 3 1 0 3 -20 -30 50 - 4 2CP-303 Data Base Management Systems DC 4 3 0 2 3 - -30 20 50 - 6 3CP-305 Software Engineering DC 4 3 1 0 3 -20 -30 50 - 4 4CP-307Design and Analysis of AlgorithmsDCCP- 2034 3 0 2 3 - -30 20 50 - 6 5CP-309 Computer Networks DC 4 3 0 2 3 - -30 20 50 - 2 6CP-311 Group Discussion and Viva Voce DC 2 0 2 0 - - - - - -100 4 7 Institute Elective III IE 4 3 1 0 3 -25 -25 50 - 4 26 18 5 6 30 SPRING SEMESTER CH 1IC-301 Technical Communication HS 4 2 2 0 2 -25 -25 50 - 5 2CP-302 Operating System DCCP- 2034 3 0 2 3 - -30 20 50 - 5 3CP-304 Digital Signal Processing ESA 4 3 1 0 3 -20 -30 50 - 4 4CP-306 Theory of Computation DCCP- 2034 3 1 0 3 -20 -30 50 - 4 5CP-308 Computer Graphics DC 4 3 0 2 3 - -30 20 50 - 5 6CP-310 Scripting Language DC 1 0 0 2 - - -100 - - - 2 7 Department Elective I DE 4 3 1 0 3 -20 -30 50 - 25 17 5 6 3 Creative Arts /Sports/NSS/Hindi ECA 0 Total Credits: 53 2 Discipline ECA 2 30 Department Elective I CP-322 Optimization Techniques DE CP-324 Combinatorics DE CP-326 Advanced Microprocessors DECP- 204 CP-328 Neural Networks DE CP-330 Mathematical Programming DE CP-332 Information Theory and Coding DE CP- 306 CP- 301 CP- 301 Department of Computer Engineering Malaviya National Institute of Technology Curricular Structure BTech (Computer Engg.) Final Year AUTUMN SEMESTER Teaching Scheme Contact Hrs/Week Exam Duration Relative WeightageS.No.Subject CodeCourse Title Subject AreaPr Credit Lecture Tutorial Practical Theory Practical CWS PRS MTE ETE PRE CH 1CP-401 Principles of Compiler Design DC CP-308 4 3 0 2 3 - -30 20 50 - 5 2CP-403 AI and Expert Systems DC 4 3 0 2 3 - -30 20 50 - 5 3CP-405 Introduction to VLSI Design DC 4 3 0 2 3 - -30 20 50 - 5 4CP-407 Real Time Systems DCCP-204, CP-3014 3 0 2 3 - -30 20 50 - 4 5 Department Elective II DE 4 3 0 2 3 - -30 20 50 - 5 6 Department Elective III DE 4 3 0 2 3 - -30 20 50 - 4 7 Industrial Field/Training DC 2 - - - - - - - - -100 26 18 012 28 SPRING SEMESTER CH 1IC-401 Industrial Management HS 4 3 1 0 2 -25 -25 50 - 5 2CP-402 Major Project DC 12 0 2 6 - -20 -20 -60 5 3 Department Elective IV DE 4 3 0 2 3 - -30 20 50 - 4 4 Department Elective V DE 4 3 0 2 3 - -30 20 50 - 5 5 2 6 24 9 310 Creative Arts /Sports/NSS/Hindi ECA 0 Total Credits: 52 21 Discipline ECA 2 Department Elctive II (Semester VII)Department Elctive IV (Semester VIII) CP-421Advanced Topics in Computer GraphicsDE CP-206CP- 420Advanced Topics in OS DE CP-423 Advanced Topics in Networking DE CP-301CP- 422Parallel and Distributed Computing DE CP-425 Distributed Data Bases DE CP-304CP-424Computer Human Interaction DE CP-427 VHDL DE CP-303CP- 426 Software Project ManagementDE CP-429 Simulation and Modelling DECP- 428Advanced Topics in Databases DE Department Elctive III (Semester VII)CP-304, CP-425Department Elctive V (Semester VIII) CP-441 Embedded Systems DECP-440Robotics DE CP-443 Cryptography DE CP-429CP- 442Behavioural Synthesis DE CP-445Advaned Data Structures and AlgorithmsDECP-303, CP-427CP-444Multimedia Systems DE CP-447Image Processing and Pattern RecognitionDECP-

446Mobile Computing DE CP-449 Biometrics DECP- 448Advanced Computer Architecture DE Department of Computer Engineering Department of Computer Engineering Malaviya National Institute of Technology Malaviya National Institute of Technology BTech (Computer Engg.) Teaching Scheme BTech (Computer Engg.)Credits Lecture Tutorial Practical HS BS HS ESA DC DE IED+n+S/C TOTAL First year 54 4 23 4 23 2+2+2 56 Semester III 25 18 4 6 4 4 13 4 - 25 Semester IV 24 18 3 6 4 4 4 12 4 2+0+2 28 Semester V 26 18 5 6 22 4 - 26 Semester VI 25 17 5 6 4 4 4 13 4 2+0+0 27 Semester VII 26 18 0 12 18 8 - 26 Semester VIII 24 9 3 10 4 12 12 8 2+0+0 26 Total 204 16 27 24 35 90 20 12 8+2+4 214 214

Ist year AUTUMN SEMESTER MA-101 Mathematics-I BS 4 3-1-0 PH-101 Physics-I BS 5 3-1-2 EE-101 Electrical Science* ESA 4 3-1-2/2 HS-101 English (Basic/Advanced)* HS 4 3-0-2 CH-101 Fundamentals of Bio-Tech* ESA 2 2-0-0 ME-101 Basic Mechanical Engg. ESA 3 2-0-2 CE-101 Engineering Graphics I ESA 3 1-0-3 CY-101 Chemistry* BS 5 3-1-2 IC-101Computer Systems & Programming*ESA 4 3-0-2 SPRING SEMESTER MA-102 Mathematics-II BS 4 3-1-0 PH-102 Physics-II BS 5 3-1-2 EC-102 Electronics ESA 4 3-1-0 ME-102 Engineering Graphics II ESA 3 1-0-3 IC-101Computer Systems & Programming*ESA 4 3-0-2 HS-101 English (Basic/Advanced)* HS 4 3-0-2 EE-101 Electrical Science* ESA 4 3-1-2/2 CH-101 Fundamentals of Bio-Tech* ESA 2 2-0-0 CY-101 Chemistry* BS 5 3-1-2 2nd Year AUTUMN SEMESTER Teaching Scheme Contact Hrs/Week Exam Duration Relative WeightageS.No.Subject Code Course Title Subject AreaPr Credit Lecture Tutorial Practical Theory Practical CWS PRS MTE ETE PRE CH 1 IC-201 Mathematics III BS 4 3 1 0 3 - 25 -25 50 - 4 2 IT-201 Digital Electronics DC EC-102 4 3 0 2 3 - - 30 20 50 - 6 3IT-203Data Structures & AlgorithmsDC IC-101 5 3 1 2 3 - 10 20 20 50 - 6 4IT-205Mathematical Foundations of ITDC 4 3 1 0 3 - 20 -30 50 - 4 5IT-207Electronic Devices and CircuitsES AEC-102 4 3 0 2 3 - - 30 20 50 - 5 6 Institute Elective I IE 4 3 1 0 3 - 25 -25 50 - 4 25 18 4 6 29 B.Tech (Information Technology) IT-201 Digital Electronics Credits: 4 (3-0-2) Number Systems and Codes Introduction to positional number system, signed magnitude numbers, floating point numbers, binary arithmetic: addition, subtraction, multiplication and division, Base conversion, conversion formulas with examples, one’s and two’s compliment arithmetic, Computer codes – BCD codes, gray codes, excess-3 codes, parity checks, Hamming and alphanumeric codes. Digital Logic Families Qualitative introduction to digital ICs, TTL, Schottky TTL, ECL, MOS Logic, CMOS Logic, Tri- state logic: Characteristics and properties. Combinational Logic Design Introduction, standard representations for logical functions, Karnaugh map representation, simplification of logical functions using K-map, minimization of logical functions specified in minterms/maxterms or Truth Table, minimization of logical functions not specified in minterms/maxterms, Don’t care conditions, design examples, Ex-or and Ex-nor simplification of K-maps, five and six-variable K-maps, QM method, MEV method. Combinational Logic Design using MSI circuits Introduction, multiplexers and their use in combinational logic design, demultiplexers/decoders and their use in combinational logic design, adders and their use as subtractors, digital comparators, parity generators/checkers, code converters, priority encoders, 7-segment decoder/driver. Synchronous Sequential Circuits

Introduction, FSM model, memory elements and their excitation functions. Synthesis of synchronous sequential circuits, capabilities and limitation of FSM, state equivalence and minimization, simplification of incompletely specified machines. Asynchronous Sequential Circuits Fundamental mode circuits synthesis, state assignment, pulse mode circuits. A to D and D to A Converters Introduction, Study of different types of analog to digital and digital to analog converters, their resolution, conversion time, sensitivity accuracy and other parameters. Study of some commercially available ADC and DAC chips. Books/References: 1.R.P. Jain: Modern Digital Electronics, TMH. 2.Z Kohavi: Switching and Finite Automata Theory, TMH 3.M.M. Mano: Digital Logic Design, PHI. 30 April, 2004 1 B.Tech (Information Technology) IT-203 Data Structures and Algorithms Credits: 5 (3-1-2) Static/Linear: Various Implementation of linear data structures – arrays, strings. Searching and Sorting methods. Dynamic/Non-linear : List as dynamic strauctures, single v/s double, generalized lists, garbage collection. Stack: Implementation, expression evaluation using stacks, stacks and recursion. Queue: Implementation and applications of queue. Tree: Implementation, binary and multiway tree, tree traversal, BST and heap Graph: Representation of graphs, BFS, DFS. Algorithms: Techniques, Complexity, Shortest path, MST, Matrix inversion, String matching – KMP, Dynamic programming – Matrix multiplication. Text/ Refernces: 1.Kruse R.L., Data Structure and Program Design , PHI. 2.Rivest, Cormen, Introduction to Algorithms , MIT Press 3.Horowitz and Sahni: Data Structure in C++ , Glagotia 4.Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures 5.Aaron M. Tenenbaum, Y. Langsam, Moshe J. Augenstein, Data Structures Using C 30 April, 2004 2 B.Tech (Information Technology) IT-205 Mathematical Foundations of IT Credits 4 (3-1-0) Set Theory: Basic notation and examples, Venn diagrams. Union, intersection and complement, Disjoint sets. Subsets, Laws of set theory. Principle of duality, Pairs, tuples, cartesian products. Powersets, Finite and infinite sequences Functions: Extensional view. Equality of functions. Intensional view, Domain and range. Partial functions. Typed view, Composition and application, Identity and inverse functions, Polynomials. Exponential and log functions. Graphs of functions, Equivalence relations. Number Systems: Natural numbers. Counting. Cardinality of finite sets. Laws, Mathematical induction. Prime numbers. Fundamental theorem of arithmetic. Well- ordering principle. Number bases. Modulo arithmetic. Integers. Laws of arithmetic. Integer powers and logarithms. Recurrence relations Field Theory: Rings and fields, Application in coding, Discrete logarithms, Primitive root, Polynomial representation of binary strings. Variable lengths codes and Huffman's algorithm. Texts/References: 1)Velleman DJ, How To Prove It: A Structured Approach , Cambridge University Press 1994 2)Aho and Ullman, Foundations of Computer Science , Addison Wesley 1992 3)Grossman P, Discrete Mathematics for Computing , Macmillan 1995 4)Ross KA & Wright CRB, Discrete Mathematics , Prentice-Hall 1999 5)Johnsonbaugh R, Discrete Mathematics , Macmillan 1986 6)Biggs N L, Discrete Mathematics , Oxford 1985 7)Wiitala, Discrete Mathematics , McGraw Hill 1987 8)Truss J, Discrete Mathematics for Computer Scientists , Addison Wesley 1999 30 April, 2004 3 B.Tech (Information Technology) IT-207 Electronic Devices and Circuits Credits: 4 (3-0-2) Introduction: Concepts of Fermi level, band structure of insulators, Metals & Semiconductors, mobility, conductivity, doping, continuity equation, injected minority carrier injection. Transistor Characteristics: the junction transistor, transistor current component, the transistor as an amplifier, transistor construction, the common base configuration, the common emitter configuration, the CE cut of region, the CE saturation region, typical transistor junction voltage values, common-emitter current gain, the common collector configuration, analytical expressions for transistors characteristics, maximum voltage rating, the photo transistor. Transistor Biasing & Thermal Stabilization: the operating point, bias stability, self-bias or emitter bias, stabilization against variation in I co, VBE, and ®, bias compensation, biasing techniques, for linear integrated circuits, thermistor and sensitor compensation, thermal runway, thermal stability. The transistor at low frequencies: graphical analysis of the CE configuration, two-port devices and the hybrid model, transistor hybrid model, the h-parameter, conversion formulas for the parameters of the three transistor configuration, analysis of a transistor amplifier circuit using h- parameters, the emitter follower, comparison of transistor amplifier configuration, linear analysis of a transistor circuit, cascading transistor amplifiers, simplified calculations for common-collector configuration, the common-emitter amplifier with an emitter resistance, high input resistance transistor circuits. Field Effect Transistors: The junction field effect transistor, the pinch-off voltage, the JEFT volt-ampere characteristics, the FET small signal model, the metal-oxide-semiconductor FET (MOSFET), the low frequency common source and common drain amplifiers, the FET as a voltage variable resistors (VVR). Introduction to semiconductor devices: Construction and working principles of UJT, SCR, thyristor, diac, triac, phototransistor, HBT. Text/References: 1.Integrated Electronics, Millman Halkias, TMH. 2.Solid state Electronics Devices, Stretman, PHI. 3.Microelectronic Circuits, Sedra Smith, Oxford Press, India. 30 April, 2004 4 B.Tech (Information Technology) IT-202 Principles of Information Technology Credits: 4 (3-0-2) Interpretation and understanding of information, need and role of information technology in business and organisation. Information system: Basic elements, data, information, knowledge, infrastructure and types and its development. Information technology infrastructure: Computer Hardware, computer software, Telecommunications: Practical uses of communication & connectivity, telephone related communication. Fax & voice mail, video/voice communication: video conferenceing, picture phones, online information services, the intranet and internet, introduction to web technologies, shared resources: workgroup computing, electronic data interchange & extranets, communication technology, tele-computing, virtual offices and mobile workspace. Organization data and information: Basics of data arrangement and access, data knowledge & decision support, DBMS – An overview, data warehouses, data mining, electronic commerce. Benefits of information revolution, information technology: Ethics, impact and security. Text/References: 1.Turban, Rainer : Introduction to Information Technology . 2.Dennis P. Curtin, Kim Foley: Information Technology . 3.Henry C. Lucas: Information Technology for Management . 4.Brain K. Williams, Stacey C. Sawyer: Using Information Technology . 30 April, 2004 5 B.Tech (Information Technology) IT-204 Microprocessor based System Design Credits: 4 (3-0-2) 8086 Microprocessor: Introduction 8086 based microcomputer system. Block diagram, pins and their description, demuliplexing of buses, control signal and flags. Instruction and timing: instruction classification, instruction formats,instruction timings and status, addressing modes,and interrupts. Software model: instruction set, data transfer instruction, arithmetic logic & branch operations: Program diretives, String manipulation. Control loop Techniques: IF then Else, While loop, For loop techniques in 8086 assembly language programming Interfacing peripherals: Descriptions, programming and interfacing of 8255, 8257, 8253, 8259A with 8086. Basic Idea of Following Bus Standard: RS232C, IEEE-4888. Introduction to 80386,80486 and pentium processors.Multitasking, Task Switching and protection in 80386. Text/References: 1.Douglas V. Hall : Microprocessors and Interfacing, McGraw Hill 2.Gaonkar ; 8085 Programming, Penram Press 3Uffenback;80x86 family, design,programming and interfacing , pearson edu. 4bray; Intel Microprocessors, tmh 5Intel MANUALS 30 April, 2004 6 B.Tech (Information Technology) IT-206 Internet Programming in Java Credits: 4 (3-0-2) Introduction: Internet, Java as a tool for internet applications, Byte Code and its advantages. Object Oriented Programming and Design: Review of Abstraction, Objects and other basics, Encapsulation, Information hiding, Method, Signature, Classes and Instances, Polymorphism, Inheritance, Exceptions and Exception Handling with reference to object modeling, Coupling and Cohesion in object oriented software. Object Oriented Design – Process, Exploration and Analysis. Java Programming Basics: Fundamentals: Variables and assignments, Input and Output, Data Types and Expressions, Flow of control, Local variables, Overloading Parameter passing, this pointer, Java Object Oriented Concepts: Objects and Classes: Use of file for I/O, Formatting output with stream functions, Character I/O, Inheritance, Public and private members, Constructors for initializations, Derived classes, Flow of Control Java Data Structures and Advanced Topics Arrays – Programming with arrays, arrays of classes, arrays as function arguments, Strings, Multidimensional arrays, Arrays of strings, vectors, Base classes. Introduction to Java Applets Books/References 1.Herbert Schildt: JAVA 2 - The Complete Reference, TMH, Delhi 2.U.K. Chakraborty and D.G. Dastidar: Software and Systems - An Introduction, Wheeler Publishing, Delhi. 3.Joseph O'Neil and Herb Schildt: Teach Yourself JAVA, TMH, Delhi. 4.Elliotte Rusty Harold, Java Network Programming, 2nd Edition , O'Reilly and Associates. 30 April, 2004 7 B.Tech (Information Technology) IT- 208 Communication Systems Credits 4 (3-1-0) Review of Representation of Signals: Fourier series, Fourier transform and its properties, spectral systems, transmission of signals through linear systems, ideal low-pass and high-pass filters, band-pass signals, spectral density and power spectral density. Analog Communication: Amplitude modulation- SSB, DSB, Vestigial side bands, frequency modulation and phase modulation, Comparison of these techniques in respect of SNR, AM and FM receivers, Pulse time modulation Multiplexing – TDMA, FDMA, CDMA, spread spectrum modulation. Digital Communication: Pulse digital modulation, PCM, differential PCM, delta and adaptive delta modulation. Digital passband transmission: ASK, FSK, QPSK, m-ary shift keying. Line codes: On-off (RZ/NRZ), Polar and Bipolar, Basics of Satellite communication and mobile communications. Texts/References: 1)Communication Systems, Simon Haykin, John Wiley. 2)Communication Systems Engineering, Prakis & Salehi, Pearson Education. 3)Analog and Digital Communications, B.P. Lathi.

4)Modern Digital & Analog Communications, B.P. Lathi, Wiley Eastern. 5)Communication Systems, Taub and Schilling. 30 April, 2004 8 B.Tech (Information Technology) IT-301 Computer Organization Credits 4 (3-1-0) 1.Introduction Basic Machine Principle, Structure and representation of real world data, Von-Newman Model and stored program concept, Subroutine, Branching & Macro facility. 2.Processor Design Processor Organization, Information representation and Number format, Instruction cycle and Instruction format, Addressing modes, Arithmetic operation, timed point addition, subtraction, multiplication and division, ALU design and floating point arithmetic, Parallel processing – Performance consideration, Pipeline processor and Multiunit processor. 3.Control Design Instruction sequencing and Interpretation, Hardware Control design method, Multiplier control unit and CPU control unit, Microprogrammed Control, Minimizing Instruction Size, Microprogrammed computer. 4.Memory organization Memory device characteristic, Random access and serial access memories, Virtual memory – memory hierarchies, Main Memory allocation & replacement policies, Segments, pages and file organization, High speed memories – Interlocked, cache and associative memory. 5.System Organization Local and long distance communication, Programmed I/O, DMA and interrupts, I/O processors & CPU – I/O interaction, Multiprocessor Introduction. Books/References 1.J.P. Hayes: Computer Architecture and Organization, 3rd Ed. TMH, 1999. 2.C.W. Gear: Computer organization and Programming, TMH. 3.T.C. Bartee: Digital Computer Fundamental, TMH. 4.M.M. Mano: Computer System Architecture, PHI. 5.A. S. Tanenbaum: Computer System Organization, PHI. 30 April, 2004 9 B.Tech (Information Technology) IT-303 Data Modelling and Design Credits: 4 (3-0-2) Design: Conceptual design, Three tier architecture, ER Diagram – entity (strong and weak), Data aggregation, specialization, generalization. Data models: Relational, Network, Hierarchical and Object Oriented. Normalization: Constraints – integrity and domain, Primary key, Super key, foreign key, Alternate key, candidate key, normal forms 1NF, 2NF, 3NF, BCNF, 4NF. SQL: DDL and DML, Relational Algebra. Applications. SQL Quries, Triggers and views, Constraints assertions. Data Organization: Sequential, indexed random and hashed files. Inverted and multilist structures, B trees, B+ trees, Query Optimisation, Join Algorithm, Statistics and Cost Base optimisation. DBMS internals: Transaction Processing, concurrency control, and recovery management. Transaction model properties and state serialisability . Lock base protocols, two phase locking. Text/References: 1.Almasri and S.B. Navathe: Fundamentals of Database Systems , Addison Wesley. 2.Kevine Kline, SQL in Nutshell, O'Reilly & Associates. 3.Raghu Ramakrishnan, Johannes Gehrke Database Management Systems , McGraw Hill. 4.H.F. Korth, Silberschatz, Sudarshan: Database Systems Concepts , McGraw Hill 5.C.J. Date: Data Base Design, Addison Wesley 6.Hansen and Hansen : DBM and Design, PHI 30 April, 2004 10 B.Tech (Information Technology) IT-305 System Analysis and Design Credits 4 (3-1-0) System concept : Definition and characteristics , elements and boundaries , types of system development lifecycle , recognition of needs , feasibility study , prototyping , role of system analyst . System planning and tools like DFD , data dictionary , decision trees, structured analysis and decision tables . Feasibility study and reports, Object Oriented Analysis and Data Modeling.

System Design methodology , structured design , from driven methodology ,IPO charts, structured walkthrough, input output from design , requirement and classification of forms , layout considerations form control, object oriented Design Concepts and methods. Text/Reference :- 1.Awad : System Analysis and design 2.pressman :software Engineering 3.Salzinger Jackson ,Burd: System Analysis and Desingn Course Technology. 30 April, 2004 11 B.Tech (Information Technology) IT-307 Data Compression Credits: 4 (3-0-2) Compression: Need, Lossless v/s lossy compression, review of information theory, prefix codes, uniquely decodable code. Huffman coding – minimum variance, optimal, non-binary, extended, adaptive. Applications and limitations of Huffman codes. Run length encoding, Arithmetic coding, Predictive coding – Burrows-Wheeler transform, Delta modulation, Adaptive delta modulation Lossy Compression Techniques – JPEG and its application Error detection and correction: Parity, 1,2,n dimensions, Hamming codes, p-out-of-q codes Dictionary based compression - Lempel-Ziv-Welch, LZ77 and LZ-78 Quantization – Scalar and Vector Quanitization. Texts/References: 1)Khalid Sayood, Introduction to Data Compression, Morgan Kauffman 2)Greg A. Harris, Darrel R. Hankerson, Peter D. Jr. Johnson, Introduction to Information Theory and Data Compression, Second Edition , Chapman and Hall. 3)Saloman, Data Compression, Springer Verlag. 4)Nelson, The Data Compression book, Hungry Minds. 30 April, 2004 12 B.Tech (Information Technology) IT-309 Data Networks Credits: 4 (3-0-2) Definition of a Communications Network Concept of a node; Nodes connected by links to form networks; Names & Addresses; the idea of "address resolution" Types of Network Understanding of operation and examples of use. ■Point-to-point Connections Fixed configuration; dedicated capacity ■Circuit-switched Networks Circuit setup; reserved capacity; (e.g. telephony) ■Message-switched Networks Circuit set-up; store and forward; message headers; (e.g. telex) ■Packet-switched Networks Packet headers; pipelining; datagram networks; (e.g. Internet) Types of Equipment ■End Systems (ES) (e.g. client or server) ■Intermediate Systems (IS) (e.g. router, bridge) Types of Packet-Switched Network ■Wide Area Networks (WANs) ■Internet Service Providers (ISPs) ■Local Area Networks (LANs) Differences in ownership, speed, cost, number of nodes Types of Communication ■Client and Server Communication (e.g. DNS, arp, ping) ■Broadcast, Unicast and Multicast modes ■Simplex, Duplex and Half-Duplex Information Flow Open System Interconnection Definition of OSI; Reasons for using the Reference Model ■Protocol Layers ■The Seven Layers of the OSI Reference Model Knowledge of the seven layers and their BASIC functions, particularly of the four lowest layers. ■Communications between layers ■Protocols ■Peer to Peer Communication between Remote Layers ■Service Access Points ■Service Primitives and Communication Between Adjacent Layers ■Encapsulation of PDUs Addition of headers on transmission; Removal on reception ■Segmentation & reassembly by protocol layers TCP/IP Networks and protocol stack. Text/References: 1.Computer Network and Internet, D.Comer, Pearson 2.Computer Networks: A top down approach, Kurose and Ross, Pearson. 3.Data Networks: Bertsekas and Gallager, PhI. 30 April, 2004 13 B.Tech (Information Technology) IT-302 System Software Credits: 4 (3-0-2) Translators: Introduction to compilers, translators, and interpreters, compilation process. Assemblers: Two pass, one pass assemblers, macro processors. Editors and Debuggers: Design and implementation. Linkers and Loaders : Relocation, static and dynamic linking. Compilers: Lexical, syntax, semantic analysis, LL v/s LR Parser, Predictive parsing, Symbol table management, Intermediate code generation, Brief overview of code optimization. Operating System: OS as a resource manager, I/O management – disk scheduling, CPU management – scheduling, Process management - deadlocks, Memory management – virtual memory, paging, segmentation. Text & References: 1.System Software and Operating Systems, Dhamdhere. 2.System Programming : Donovon. 3.Holub, Compiler Design in C, PHI. 30 April, 2004 14 B.Tech (Information Technology) IT-304 Signals and Systems Credits 4 (3-1-0) Review of signal description Review of Fourier and Laplace transforms Spectrograms; frequency modulation Sampling and aliasing The z-transform Filters: Transfer functions, FIR filters, IIR filters Spectral analysis: DFT for periodic signals, DFT for non-periodic signals Texts/References: 1)J H McClellan, R W Schafer & M A Yoder, DSP First: a Multimedia Approach , Prentice-Hall International 1998 2)A V Oppenheim , R W Schafer & J R Back, Discrete-time Digital Signal Processing , Prentice Hall Int 1999. Third major revision of classic text 3)A V Oppenheim , A S Willsky & S H Nawab, Signals and Systems, Prentice Hall Int 1996. Includes companion book with Matlab examples 4)N K Sinha, Linear systems, John Wiley 1991 5)J G Proakis and D G Hanolakis, Digital Signal Processing , Maxwell Macmillan Int 1992 30 April, 2004 15 B.Tech (Information Technology) IT-306 VLSI Algorithms Credits 4 (3-0-2) Introduction: The VLSI Design Problem. Design Domains. Design Actions Algorithmic and System Design. Structural and Logic Design.Transistor-level Design. Layout Design. Verification Methods Algorithmic Graph Theory and Computational Complexity: Data Structures for the Representation of Graphs. Computational Complexity. Depth-first Search. Breadth-first Search Dijkstra's Shortest-path Algorithm Prim's Algorithm for Minimum Spanning Trees Tractability Issues: Combinatorial Optimization Problems Decision Problems Complexity Classes NP-completeness and NP-hardness Combinatorial Optimization: The Unit-size Placement Problem.Backtracking and Branch-and-bound. Dynamic Programming Linear and Integer Linear Programming.Local Search Simulated Annealing Tabu Search Genetic Algorithms Design Problems and Algorithms: Layout Compaction Design Rules Symbolic Layout Applications of Compaction Informal Problem Formulation Graph-theoretical Formulation Maximum-distance Constraints Algorithms for Constraint-graph Compaction Longest-path Algorithm for DAGs The Longest Path in Graphs with Cycles The Liao- Wong Algorithm The Bellman-Ford Algorithm Placement and Partitioning: Circuit Representation Wire-length Estimation Types of Placement Problem Constructive Placement Iterative Improvement Partitioning The Kernighan-Lin Partitioning Algorithm Floorplanning: Floorplanning Concepts Terminology and Floorplan Representation Optimization Problems in Floorplanning Shape Functions and Floorplan Sizing Routing: Types of Local Routing Problems Area Routing Channel Routing Channel Routing Models The Vertical Constraint Graph Horizontal Constraints and the Left-edge Algorithm Channel Routing Algorithms Introduction to Global Routing Standard-cell Layout Building-block Layout and Channel Ordering Algorithms for Global Routing Efficient Rectilinear Steiner-tree Construction Local Transformations for Global Routing Simulation: General VLSI

Simulation Gate-level Modeling and Simulation Signal Modeling Gate Modeling Delay Modeling Connectivity Modeling Compiler-driven Simulation Event-driven Simulation Switch-level Modeling and Simulation Connectivity and Signal Modeling Simulation Mechanisms Logic Synthesis and Verification: Introduction to Combinational Logic Synthesis Basic Issues and Terminology Binary-decision Diagrams ROBDD Principles ROBDD Implementation and Construction ROBDD Manipulation Variable Ordering Applications to Verification Applications to Combinatorial Optimization Two-level Logic Synthesis Heuristic Based on ROBDDs Text/References: 1.Sabih H. Gerez, Algorithms for VLSI Design Automation, John Wiley & Sons 2.Introduction to Algorithms, Rivest, Korman et.al.,Pearson. 30 April, 2004 16 B.Tech (Information Technology) IT-308 Multimedia Techniques Credits: 4 (3-0-2) 1.Basics of multimedia technology Computers, Communication and Entertainment; Multimedia -An introduction; Framework for multimedia systems; multimedia devices, CD-Audio, CD-ROM,CD-I; presentation devices and the user interface; multimedia presentation and authoring; professional development tools; LANs & multimedia ;Internet, World Wide Web(World Wide Web) & multimedia ;distribution network-ATM & ADSL; multimedia servers & databases; vector graphics; 3-D graphics programs; animation techniques; shading; anti-aliasing; morphing ;video on demand 2.Image Compression & Standards Making still images; editing and capturing images; scanning images; computer color models; color palettes; vector drawing; 3-D drawing and rendering; JPEG-objectives and architecture; JPEG-DCT encoding and quantization, JPEG statistical coding; JPEG predictive lossless coding; JPEG performance; Overview of other image file formats as GIF, TIFF, BMP, PNG etc. 3.Audio & Video Digital representation of sound; time domain sampled representation; method of encoding the analog signals; subband coding; Fourier method; transmission of digital sound; digital audio signal processing; stereophonic & quadraphonic signal processing; editing sampled sound; MPEG Audio; audio compression & decompression; brief survey of speech recognition and generation; audio synthesis; Musical Instrument Digital Interface (MIDI); digital video and image compression; MPEG motion video compression standard; DVI technology; time-based media representation and delivery. 4.Virtual Reality Applications of multimedia, Intelligent multimedia system, Desktop Virtual Reality (VR), VR operating System, Virtual environment displays and orientation tracking; visually coupled system requirements; intelligent VR software systems. Applications of environments in various fields viz. Entertainment, manufacturing, business, education, etc. Books/References 1. Villamil & Molina, Multimedia : An Introduction, PHI. 2. Lozano, Multimedia : Sound & Video, PHI. 3. Villamil & Molina, Multimedia : Production, Planning and Delivery, PHI. 4. Sinclair, Multimedia on the PC, BPB. 5. Tay Vaughan, Multimedia :Making it work, TMH 30 April, 2004 17 B.Tech (Information Technology) IT-322 Operations Research Credits 4 (3-1-0) Project Management: Network models of Engineering projects, scheduling and monitoring of projects CPM and PERT methods. Queueing Theory: Review of necessary probability functions, Dynamics of a queueing system, Mathematical Models of a simple queue, Use and limitations of analytical approach. Discrete Event Simulation: Discrete event simulation as a modelling technique, activity flow diagrams and examples. Decision Analysis: Use of Decisions Trees for more complex situations including those that require Bayes Theorem to revise probabilities. Case Study: Inventory Models Texts/References: 1)Michael Pidd, Computer Simulation in Management Science, Wiley. 2)Anderson, Sweeney and Williams, An Introduction to Management Science, West Publishing Co., (also an accompanying study guide). 3)System simulation, Gorden G., Prentice Hall of India 4)Discrete Event Simulation, Banks 5)System simulation, Narsing Deo, McGraw Hill. 6)Simulation modeling and analysis , Law and Kelton, McGraw Hill. 30 April, 2004 18 B.Tech (Information Technology) IT-324 Management Information System Credits 4 (3-1-0) Introduction to management information system Hardware and software used for information systems, transaction processing, office automation. Decision making process, concepts of information, humans as information processors, system concepts, organisational structure and management concepts. Support for planning and controlling. Organisation and management of the information resources function. Text/ References : 1.Management Information and System , Davis and Olson, Mcgraw Hill. 30 April, 2004 19 B.Tech (Information Technology) IT-326 Natural Language Processing Credits 4 (3-1-0) Introduction Origin, imposition, representation, role of knowledge, use of prolog for Natural Language Processing (NLP), Finite State Transition Networks(FSTN), notation, representation and traversal of FSTN in Prolog, Finite State Transducers(FST), implementation in Prolog, limitation of SM. Recursive and Augmented Transition Networks (RTN) Modeling recursion, representation, traversal, implementation in Prolog, push down transducers, implementation, advantage and limitations of RTN, augmented transition networks. Grammar and Parsing Grammar as knowledge representation, words, rules, structures, representation in Prolog, subcategorization, definite clause grammars, classes of grammars and languages, top down and bottom up parsing, comparison strategies, BFS and DFS, storing intermediate results, ambiguity, determinism and lookahead. Well formed Sub-string tables and Charts Well formed substring tables, active charts, rules of chart parsing, initialization, rule invocation, house keeping, implementation of top down and bottom up chart parsers, search strategy, alternative rule invocation, implementing flexible control, efficiency. Features and the Lexicon Feature theoretic syntax, feature structures as graphs, feature structures in Prolog, subsumption and unification, the status o rules, implementing PATR in Prolog, chart parsing with feature- based grammars, representation of lexical knowledge, implementing a lexicon in Prolog, DAGs versus terms Semantics Compositionality, meaning as reference, translation to a meaning representation language, computational semantics as feature instantiation, transitive verbs and quantification, ambiguity, preferences and timing, building semantic checking in to the grammar. Question answering and Inference Question answering, evaluating DBQ formulae, standard logical inference, implementing forwards inference in Prolog, the pathological nature of logical inference, primitives and canonical forms, classes and inheritance, plausible inference and defaults Books/References 1)Gerald Gazdar and Chris Mellish: Natural Language Processing in Prolog, Addison Wesley 2)Allen James: Natural Language Understanding, Benjamin Cummins 3)Briscoe, Edward J., Boguraev and Branimir K.: Computation Lexicography for Natural Language Processing, Longman/Wiley 4)Schwartz, Steven C.: Applied Natural Language Processing, Petrocelli 5)Winograd, Terry: Understanding Natural Language, Academic Press. 30 April, 2004 20 B.Tech (Information Technology) IT-328 e-Commerce Credits 4 (3-1-0) Introduction and concepts: networks and commercial transactions, the Internet environment, online commerce solutions. A generic business model for e-commerce. Security technologies: Introduction to cryptography, key distribution and clarification. Architecture for e-commerce: online commerce environment, servers and commercial environments, strategies, techniques and tools. Electronic payment methods: Secure online transaction models, digital payment system, cyber cash, digital currencies. Protocol for the public transport of private information: security protocols, secure socket layer. Open issues: legal and technical issues. Text & References: 1.Electronic e-commerce II Edition: Pete Loshin, Paul A Murphy, Jaico book. 2.The Business of e-commerce: Paul May, Cambridge University Press. 30 April, 2004 21 B.Tech (Information Technology) IT-330 Graph Theory Credits 4 (3-1-0) Intoroduction to graphs. Review of DFS. Applications of DFS – Topological Sort, Connected components, Articultaion Points. Euler graphs, detection of cycles in graph. Max-flow Min-cut theorem. Algorithms for computing maximum flows in graphs. Algorithms for computing the minimum cut in a graph. Edge and vertex connectivity of graphs and menger's theorem. Maximum matching, Planar graphs and algorithms for checking for planarity. Edge and vertex coloring of graphs. Independent sets and perfect graphs. Texts/References: 1.Rivest, Cormen – Introduction to Algorithms 2.West, Graph Theory 3.Narsingh Deo:Graph Theory with Application to Engineering and Computer Science , Prentice-Hall. 4.Narsingh Deo: Combinatorial Algorithms: Theory and Practice, Prentice-Hall. 30 April, 2004 22 B.Tech (Information Technology) IT-332 Information Theory and Coding Credits 4 (3-1-0) Mathematical Theory of Foundation Of Information Theory in Communication system. Measures of Information- Self information, Mutual Information, Average Information, entropy and its properties. Source Model and Coding, channels Model and Coding. Problems of unique decipherable Codes, condition of Instantaneous codes, Code word length, Kraft Inequality. Noiseless Coding Theorem. Construction of codes: Shannon Fano, Shannon Binary and Huffman codes. Discrete Memory less channels: Classification of channels, calculation of channel capacity. Decoding scheme- the ideal observer. The fundamental theorem of Information theory. Error Correcting Codes: Minimum distance principle. Relation between distance and error correcting properties of codes, The Hamming bound. Parity check Coding. Bounds on the error correcting ability of Parity Check Codes. Text /References 1.Information theory and Reliable Communication by R.G.Gallager 2.Information Theory by Robert Ash 3.An Introduction to Information Theory by F. M. Reza 4.Error correcting codes by W.W. Peterson and E. J. Weldon 30 April, 2004 23 B.Tech (Information Technology) IT-401 GUI Programming Credits: 4 (3-0-2) Architecture of GUI Applications: Model-GUI Separation, N-Tier Architectures, GUI as Frontend to Transactions (Forms-based GUIs) GUI Design Patterns: Modal Dialog, Inspector (Properties of Selected Element), Wizard (Step-by-Step), Palette/Roll-Up, Explorer (Tree/Table Combination) Windowing Systems: Microsoft Windows, X Window, MacOS GUI Frameworks: Java Swing, Microsoft Foundation Classes Components: Java Beans, ActiveX Controls Development Environments & GUI Builders: Principles, Application, Restrictions, Evaluation Texts/References: 1. B. Scneiderman, Designing the User Interface, Addison Wesl;ey, III ed. 2. Susan Weinschenk, GUI Design Essentials. 3. Barfield L, The User Interface: Concepts & Design , Addison Wesley, 1993 4. Cox K & Walker D, User Interface Design , Prentice Hall, 1993 5. Preece, Rodgers, Sharp, Benion, Holland and Carey, Human Computer Interaction, Addison Wesley 6. Dix A, Finlay J, Abowd G and Beale R, Human-Computer Interaction , 3rd Edition. Prentice Hall, 2003 7. Preece J, Rogers Y, Sharp H Interaction Design: beyond human-computer interaction , Wiley, 2002. 30 April, 2004 24 B.Tech (Information Technology) IT-403 AI and Neural Networks Credits: 4 (3-0-2) Overview of AI, Problems, Problem space and searching techniques, Definition production system, Control strategies, Heuristic search techniques. Knowledge representation: Representation, mappings, approaches and issues, Predicate logic, prepositional logic, Resolution, Procedural and declarative knowledge, forward and backward reasoning, Matching, Semantic nets. Learning and learning systems: Introduction to Hopfield networks, introduction to neural networks, learning in neural networks, applications of neural networks, Recurrent network., Back propogation Algorithm. Introduction to AI languages: PROLOG and LISP. Text & References: 1.Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill. 2.Introduction to AI & Expert System: Dan W. Patterson, PHI. 30 April, 2004 25 B.Tech (Information Technology) IT-405 Information System Security Credits: 4 (3-0-2) Security issues in information systems. Public v/s private key. Mathematical preliminaries: Discrete Logarithms, Galois Fields, one-way hash functions. Case Study: DES, IDEA, RSA, Key management, Key exchange. Related issues: Privacy, Authentication, Signatures, Deniability. Introduction to hacking. Text & References: 1.Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education Asia. ISBN 981-403-589-0. 2.B Schneier, Applied Cryptography, Wiley. ISBN 0-471-11709-9 3.B Schneier, Practical Cryptography, Wiley. ISBN 0-471-11709-9 30 April, 2004 26 B.Tech (Information Technology) IT-407 Wireless Technologies Credits: 4 (3-0-2) Issues in wireless networks, wireless multiple access protocols, cellular wireless networks, channel allocation in cellular system, wireless 802.11 LAN, HyperLAN, type of wireless networks. Wireless network layer, Ad-hoc network, tunneling and encapsulation, routing protocol, global state routing, dynamic state routing, fisheye routing, ad-hoc on-demand distance vector routing, destination sequence distance vector routing, dynamic source routing. Wireless transport layer problems, solutions & protocols. Wireless application protocol, goals, issues, architecture, wireless datagram protocol, wireless transport layer security, wireless transaction protocol, wireless session protocol, wireless application environment. Introduction to Blue tooth, GSM, GPRS & CDMA technologies. Text & References: 1.Mobile communications Jochen Schiller, Pearson 2.802.11 wireless networks Matthew S.Gast, O'REILLY. 3.Wireless LANs: Davis & McGuffin, McGraw Hill 4.Mobile Communications Handbook by Jerry D. Gybson 5.Mobile Communications Handbook by Raymond Steel 6.Research papers and Internet material. 30 April, 2004 27 B.Tech (Information Technology) IT-421 3D Computer Graphics Credits: 4 (3-0-2) Review of 2-D techniques: World coordinates, 2D transformatios, Anti-aliasing 3-D techniques: Transformations in 3D Visible surface determination Illumination and shading models Texture mapping Ray tracing Fractals case studies Texts/References 1)J D Foley, A Van Dam, S K Feiner, J F Hughes and R L Phillips, Introduction to Computer Graphics, Addison-Wesley, 1994 2)D Hearn and M S Baker, Computer Graphics, 2nd Ed, Prentice-Hall, 1994 3)J D Foley and A Van Dam, Computer Graphics, Principles and Practice , 2nd Ed in C, Addison Wesley, 1996 4)A Watts, Fundamentals of Three-Dimensional Computer Graphics , Addison Wesley, 1989 30 April, 2004 28 B.Tech (Information Technology) IT-423 Network Services and Management Credits: 4 (3-0-2) Overview of Internet Technologies, Issues in next generation Internet - Routing, Multicasting, Packet Scheduling, Quality of Service etc. Admission control in Internet: Effective bandwidth, Differentiated services, Policy-based networking, Real time communications over Internet, Internet telephony, Voice over IP, Integrated services. Web QoS, Intelligent caching, Traffic measurement and characterization. Structure and protocols for Network management, agents. Directory services and protocols. Text/References: 1.Computer Networks: A Top Down Approach, Kurose and Ross, Pearson. 2.SNMP, SNMPv2, SNMPv3, and RMON 1 and 2, W. Stallings, Pearson. 3.The practice of system and network administration, T.Limocelli, Pearson. 30 April, 2004 29 B.Tech (Information Technology) IT-425 Data Mining and Warehousing Credits: 4 (3-0-2) Introduction to Decision Support Systems, Data Warehouse and Online Analytical Processing. Data Warehouse Architecture: System Processes, Process Architecture: Load Warehouse, Query, Detailed and Summarized Information. Design: Data Base Schema Facts, Dimensions and Attributes. Introduction to Data Base and Metadata. Data Warehouse Implementation. Data Mining : Introduction and need. Data Processing : Data Cleaning, Data Integration and Transformation, Data Reduction. Data Mining Primitives : Descriptive and Predicative Data Mining, Language DMQL and its Preliminary Clauses. Data Mining Methods: Association – Single and Multilevel, Characterization and Comparison, Regression Analysis, Classification and Predication. Data Mining Algorithms: Clustering, Association, Regression, Decision Trees. OLAP : OLAP Architecture, ROLAP, and MOLAP. Application and Trends in Data Mining. Text & References: 1.Data Warehousing in the Real World – Anahory and Murray, Pearson Education. 2.Data Mining – Concepts and Techniques – Jiawai Han and Micheline Kamber. 3.Building the Data Warehouse – WH Inmon, Wiley. 30 April, 2004 30 B.Tech (Information Technology) IT-427 Digital Hardware Design Credits: 4 (3-0-2) Asynchronous State Machines: Analysis and design of fundamental mode circuits. Hardware Description Languages: VHDL, Verilog Register Transfer-Level Design: Controller/datapath partitioning Built in Test: Principles, structures, signature analysis Texts/References: 1)Zwolinski M, Digital Design with VHDL, Addison Wesley Longman 2000. 2)Rushton A, VHDL for Logic Synthesis, John Wiley, 1998. 3)Abramovici M, Breuer M A and Friedman A D, Digital System Testing and Testable Design,(Revised Printing) IEEE Press, 1990 4)Wilkins B R, Testing Digital Circuits, Chapman and Hall, 1990 5)Wakerly J F, Digital Design Principles and Practices, 2nd Edn, Prentice-Hall, 1994 6)De Micheli G, Synthesis and Optimization of Digital Circuits, McGraw-Hill, 1994 30 April, 2004 31 B.Tech (Information Technology) IT-429 Performance Analysis of Computer Systems Credits: 4 (3-0-2) Performance evaluation methods, Evaluation Metrices, Analytical v/s simulation modeling, performance measurement and benchmarking, Workload modeling, random variables, commonly used distributions, Stochastic Processes Markov chains, Birth and Death Processes, Markov chain models of Computer systems, Steady- state and transient analysis Queuing models, M/M systems and their steady state analysis, Single server and multi-server queues, open and closed queuing networks Petri Net based Performance Modeling : Classical Petri Nets, Timed Petri Nets, Discrete Petri Nets, Modeling multiprocessor systems Discrete event simulation – Simulation languages, random number generation and testing, model verification and validation, analysis of simulation results, confidence intervals, variance reduction techniques, Case studies of analytical and simulation studies of computer systems Text/References : 1.Raj Jain, The Art of Computer System Performance Analysis, John Wiley 2.K.S.Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, PHI 3.Law and Kelton, Simulation Modeling and Analysis, Mcgraw Hill 4.Kant, Introduction to Computer System Performance Evaluation, Mcgraw Hill 30 April, 2004 32 B.Tech (Information Technology) IT-441 Embedded Systems and Appliances Credits: 4 (3-0-2) Embedded Systems: Introduction, hardware/software co-design, issues in deciding where to split the problem., examples of embedded systems, sensors and interfacing techniques. Real-time OS and concepts: introducing the problem domain an d tools, RTOS services/capabilities (in contrast with traditional OS), Resource Management/scheduling paradigms: static priorities, static schedules, dynamic scheduling, best effort, current best practice in scheduling (eg Rate Monotonic vs. static schedules), Real-world issues: blocking, unpredictability, interrupts, caching, examples of OSs for embedded systems (RT Linux/ VRT), selected case studies. Programming Languages for Embedded Systems: tools for building embedded systems - with case studies. Esterel is good for control applications / Handel-C is good for casting algorithms into re-configurable hardware, Embedded Software Development Methodology. Embedded microcontrollers architecture. Appliances having embedded software and internet enables services and devices. Text/References: 1.Programming for embedded systems, Prasad, Wiley. 2.Embedded microprocessor systems: Real World Design, S. Ball. 3.Embedded Systems Design: An Introduction to Processes, Tools and Techniques by Arnold S. Berger 30 April, 2004 33 B.Tech (Information Technology) IT-443 Automata Theory Credits: 4 (3-0-2) 1)Introduction Introduction to Finite State Machine, Binary counter, parity bit generator, Moore and Mealy FSMs, Equivalence, Isomorphism, Reduction of States, Regular Languages, Regular expressions, The memory required to recognize a language, Distinguishing one string from another, unions, Intersections and Complements, NFA, NFA with – transitions, Criterion for Regularity, Minimal Finite Automata, The pumping lemma, decision, problems, Finite automata, Nondeterminism and Kleen’s Theorem, Regular and Non-regular languages. 2)Context-Free Language Context – Free Grammars, Definition of CFG, example of familiar languages, unions, concatenations and closures of CFLs, Derivation Tree, Ambiguity, unambiguous CFG for algebraic expressions, Simplified forms and normal forms. Push down automata, definition, deterministic PDA, PDA to CFG and Vice Versa, Parsing. Context Free and Non Context Free Languages, Pumping lemma for CFG, Intersection and complements of CFL, Decision Problems involving CFL.

3)Turing Machines Definition, Turing Machining as Language acceptors, combining TM, computing Partial Function with TM. Recursively Enumerable and Recursive Languages, Multitape TM, Nondeterministic TM, Universal TM, Other Grammars, Unrestricted grammars and TM, Unsolvable problems, Unsolvable Decision Problems, Halting Problem, Rice's Theorem and more unsolvable problems, Post's correspondence Problem, Unsolvable problems involving CFLs, Regular Grammars, context Sensitive grammars, Linear –Bounded Automata, Chomsky Hierarchy. 4)Computability Primitive Recursive Functions, Primitive Recursive Predicates and some bounded operations, unbounded minimization and recursive functions, Godel Numbering, Non-numeric-functions. Growth rates of functions, Time and space complexity of TM, complexity Classes. P and NP. Polynomial-Time. Reductions and NP-Completeness, Cook's Theorem, other NP-Complete Problems. Computable Functions, Measuring and classifying complexity. Tractable and intractable problems. Books/Reerences: 1)John C. Martin: Introduction to Languages and the Theory of Computation, MGH. 2)Lewis & Papadimitriou: Elements of the Theory of Computation, PHI. 3)Daniel I.A. Cohen: Introduction to Computer Theory: John Wiley. 4)J.E. Hopcroft and J.D. Ullman: Introduction to Automata Theory Languages and Computation, Narosa. 30 April, 2004 34 B.Tech (Information Technology) IT-445 Speech Processing Credits: 4 (3-0-2) The speech chain: current capabilities in synthesis and recognition. Acoustic phonetics. Vocal tract physiology: voiced excitation, unvoiced excitation (bursts, frication). Acoustics of uniform tubes, of two- and three-tube models. Comparison to speech data. Synthesis: Formant synthesis (series, parallel), Articulatory synthesis, Concatenative Synthesis, Text-to-Speech (normalisation, linguistic units, rules) Articulatory parameters, shape-to-sound transformation, vocal tract imaging, revising the acoustic model. Letter-sound relations, phonology; prosody, intelligibility, quality assessment. Ear physiology. Auditory perception. Speech perception. Recognition: Template matching. (Training, distance measures, dynamic time warping), Stochastic models. (Hidden Markov models, Baum-Welch and Forward-Backward algorithms). Large-Vocabulary Recognition. (Phonemic baseforms, language models), Artificial Neural Networks. (Overview, hybrid systems). Assessing recognition performance; improving recognition performance; knowledge-based approaches, auditory models. Texts/References J N Holmes and W. Holmes, Speech Synthesis and Recognition , 2nd ed., Taylor and Francis, 2001. 1.B. Gold and N. Morgan, Speech and Audio Signal Processing, Wiley and Sons, 2000. 2.D. G. Childers, Speech Processing and Synthesis Toolboxes, Wiley and Sons, 2000. 3.J. R. Deller, J. R. Proakis, J. H. L. Hansen, Discrete-Time Processing of Speech Signals , Prentice-Hall 1993. 4.P. B. Denes and E. N. Pinson, The Speech Chain, W. H. Freeman & Co 1993. 5.S Furui, Digital Speech Processing, Synthesis and Recognition , Marcel Dekker Inc 1989. 6.D O'Shaughnessy, Speech Communications: Human & Machine , IEEE Press 1999. 7.L R Rabiner and R W Schafer, Digital Processing of Speech Signals , Prentice-Hall 1978. 8.K. N. Stevens, Acoustic Phonetics, MIT 30 April, 2004 35 B.Tech (Information Technology) IT-447 Image Analysis and Classification Credits: 4 (3-0-2) Introduction: Image Processing Fourier Transform and Z-Transform, Causality and stability, Toeplitz and Circulant Matrices, orthogonal and unitary Matrices and Kroenker product, Markov Processes, KL Transform, Mean square Estimates and Orthogonal Principles. Image sampling and quantization, Band Limited Image Sampling Versus Replication, Reconstruction of Image from samples Sampling Theorem, Image Quantization Uniform Optimal Quantizer, Properties of Mean Square Quantizer, Commander Design Visual Quantization Image Transforms: Two Dimensional Orthogonal and Unitary Transforms and their properties. One Dimensional and Two Dimensional DFT Cosine and Sine Transforms Hadamard, Slant, HARR Transforms and their properties, Wavelet transform, Hough Tranform. Image Processing: Image smoothing, Sharpening, enhancement, thinning. Image Analysis: Spatial feature extraction, Edge detection and boundary extraction Boundary, region and moment representations structures, Texture, Image Segmentation. Image Classification: Bayes classifier, k-NN, neural network classification. Clustering techniques, template matching, image convolution. Books/References 1.Anil Jain: Digital Image Processing 2.Gonzalez Woods: Image Processing 30 April, 2004 36 B.Tech (Information Technology) IT-449 Bioinformatics Credits: 4 (3-0-2) What is bio-informatics? Significance. Role of computing in bio-informatics. Techniques for bio-informatics computing – Application of probabilistic, statistical and machine learning approach to bioinformatics computing, Modeling – Markov chains, Review of Data mining and visualization, review of pattern matching techniques, Search engines and their application to bioinformatics. DNA – structure, DNA matching. From genes to genomes. Future scope of bio-informatcis. 1)Bryan Bergerson, Bioinformatics Computing , Perason Education. 2)Pierre Baldi, Bioinformatics: The Machine Learning Approach, Second Edition (Adaptive Computation and Machine Learning) , MIT Press 3)David W. Mount, Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory 4)Warren J. Ewens & Gregory R. Grant, Statistical Methods in Bioinformatics, Springer Verlag 5)Andreas D. Baxevanis & B. F. Francis Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley Interscience 30 April, 2004 37 B.Tech (Information Technology) IT-420 Distributed Systems Credits: 4 (3-0-2) Introduction: What is a distributed systems? Goals. Hardware and software concepts, design issues. Issues in Coomunication: Client-server and RPC. Synchronization: Clock synchronization, mutual exclusion, deadlocks. Load Balancing: Process allocation and algorithms for load balancing. Scheduling. Fault Tolerance: Issues and solutions. File Systems: Design and implementation. Case Study. Shared Memory: Design and implementation. Case Study. Text/References: 1.Tanenbaum and Steen: Distributed Systems: Principles and Paradigms , Pearson Education. 2.Nancy Lynch, Distributed Algorithmss, Morgan Kauffman. 3.Coulouris, Dollimore and Kindberg, Distributed Systems: Concepts and Design , Addison Wesley. 4.Mullender: Distributed Systems , Addison Wesley. 5.Tanenbaum: Distributed Operating Systems, Pearson Education. 30 April, 2004 38 B.Tech (Information Technology) IT-422 Client-Server Computing Credits: 4 (3-0-2) Evolution of PC, Introduction to LANs, PC LANs, and Mainframe Computers, PC connected to mainframes. Distributed systems and databases. Client-server computing model, client server hardware and software needs, issues in client-server computing – shared access, connectivity and security. Advantages of client-server computing. Case studies – UNIX, Windows NT. Client-server applications: Database server networking, Gateway videos – conferencing and multimedia applications. Client-server architectures: Segmentation, switched FDDI, peer-to-peer architecture. Text & References: 1.Client-Server Computing, Robert O'Reilly, O'Reilly. 30 April, 2004 39 B.Tech (Information Technology) IT-424 Soft Computing Credits: 4 (3-0-2) Introduction: Background, uncertainty and impression, Statistics and Random Processes, Uncertainty in Information, Fuzzy sets and Membership, Chance versus Ambiguity, Classical Sets – Operations, Properties, mapping to classical sets to functions; Fuzzy Sets – Operations and Properties; Sets as points in Hypercubes. Relations and Functions: Cartesian Product, Crisp relations – cardinality operations, properties, composition, Fuzzy Relations – Cardinality operations, properties, Fuzzy Cartesian Product and Composition, Noninteractive Fuzzy Sets, Tolerance and Equivalence Relations, Crisp Equivalence Relation, Crisp Tolerance Relation, Fuzzy Tolerance and Equivalence Relations, Value Assignments, Cosine amplitude, Max-Min method, other similarity methods, Membership Functions – Features, Standard forms and biyearlies, Fuzzyfication, Membership value assignments, Intuitions, Inference, Rank Ordering, Angular Fuzzy sets, Neural Networks, Genetic Algorithm, Inductive Reasoning. Lambda-Cuts for Fuzzy Sets, Lambda-cuts for fuzzy relations, Defuzzification Methods. Arithmetic and Logic: Extension Principle, Crisp functions, Mapping and Relations, Functions of Fuzzy Sets, Fuzzy Transform Practical Considerations, Fuzzy Numbers, Interval Analysis in Arithmetic, Approximate Methods of extension, Vertex Method, DSW Algorithm, Restricted DSW Algorithms, Comparisons, Fuzzy Vectors, Classical predicate logic, Tautologies, Contradictions, Equivalence, Exclusive Oral Exclusive Logical proofs, Deductive Proofs, Deductive Inferences, Fuzzy Logic, Approximate Reasoning, Fuzzy Tautologies, Contradictions, Equivalence and Logical Proofs, other forms of the implication operation, other forms of the composition operation. Books/References 1)Timothy J Ross, Fuzzy Logic with Engineering Applications, MGH. 2)Klir and Yuan, Fuzzy Sets & Fuzzy Logic-Theory and Applications, PHI. 3)Klir & Folger, Fuzzy Sets, Uncertainty and Information, PHI. 30 April, 2004 40 B.Tech (Information Technology) IT-426 Software Testing and Verification Credits: 4 (3-0-2) Basic software testing principles - Software Quality, Software testing and test management. Acceptance Testing: User acceptance testing, alpha and beta testing. Verification And Validation Functional and Non-functional system testing Static and dynamic testing, Black-box or functional testing, structural, white box or glass box testing. Integration testing, component testing. Software testing tools. Books/References: Recent papers from conferences and journals 30 April, 2004 41 B.Tech (Information Technology) IT-428 Data Engineering Credits: 4 (3-0-2) Overview of Relational DBMS and SQL. Real-time Database: Implementation and issues. Concurrency control and locking. Recovery. Transaction management. Distributed DBMS: Distribution Design Issues, Fragmentation and Allocation, Data Security, Architecture Models for Distributed Data Base System, Client - Server Systems, Peer-to-Peer Distributed Systems, Query Processing, Distributed Transactions, Concurrency Control, Reliability, Advances: Introduction to Object-Oriented Databases, Spatial databases, Temporal databases, Databases in multimedia. Text/References 1)Elmasri R and Navathe SB, Fundamentals of Database Systems, 3rd Edition, Addison Wesley,2000. This book covers most of the material on the course. 2)Connolly T, Begg C and Strachan A, Database Systems, 2nd Edition, Addison Wesley, 1999 3)Ceri Pelagatti , Distributed Database: Principles and System - (McGraw Hill) 4)Simon AR, Strategic Database Technology: Management for the Year 2000 , Morgan Kaufmann, 1995 5)Gray J and Reuter A, Transaction Processing: Concepts and Techniques , Morgan Kaufmann, 1993 6)M. Tamer Ozsu, Patrick Valduriez, Principles of Distributed Database Systems - (Pearson Education) 7)David Bill, Jane Grimson Distributed Data Base Systems - (Addison - Wesely) 8)Date CJ, An Introduction to Database Systems , 7th Edition, Addison Wesley, 1999 9)Khashafian S and Baker AB, Multimedia and Imaging Databases , Morgan Kaufmann,1996 10)McFadden FR, Hofer JA and Prescott MB, Modern Database Management 5th Edition, Addison-Wesley 1999 30 April, 2004 42 B.Tech (Information Technology) IT-440 Computer Vision Credits: 4 (3-0-2) Feature Extraction and description: parametric and non-parametric feature extraction including advance Hough transform techniques and active contour models. Image Interpretation: Syntactic and symbolic image interpretation and analysis. Image Restoration: Weiner filter. Least mean squares and extensions and maximum entropy restoration. 3D Imaging: Calibration, epipolar constraint, coordinate systems. Active and passive ranging systems. Morphology: Binary image processing and image geometry. Texts/References: 1)Nixon, M S and Aguado, A S, Feature Extraction and Image Processing Butterworth Heinmann (Newnes), 2002, Book website http://www.ecs.soton.ac.uk/~msn/book 2)Sonka, M, Hlavac, V, and Boyle R., Image Processing, Analysis and Machine Vision (2nd Ed., Thompson, 1999) 3)Jain, R., Kasturi, R., and Schunck, B. G. Machine Vision (McGraw Hill, 1996) 4)D.H. Ballard and C.M. Brown, Computer Vision, Prentice Hall, 1982. 5)S.E. Umbaugh, Computer vision and Image Processing: A Practical Approach using CVIP tools, Prentice Hall PTR, 1998. 6)Blake, A., and Isard, M.m Active Contours (Springer, 1998) 7)Rabiner L R and Gold B, Theory and Application of Digital Signal Processing (Prentice Hall, 1975) 8)Jain A K, Fundamentals of Digital Image Processing, (Prentice Hall, 1989) 9)Teuber J, Digital Image Processing (Prentice Hall, 1992) 30 April, 2004 43 B.Tech (Information Technology) IT-442 High Level Synthesis Credits: 4 (3-0-2) Various abstraction levels of synthesis, Need of high level synthesis, Overview of hardware description languages and High level synthesis of digital systems: Advantages, Data Structures used, algorithms, DFG and CDFG. Transformations in high-level synthesis, Transform based design space exploration. Design Optimisation: Design space, constraints on optimization, heuristics, simulated annealing. Scheduling – constrained, unconstrained, allocation and module binding. Trade-off in high level synthesis. Cost-function based optimization techniques. BIST: Role and significance in high level synthesis. Texts/References 1)Andrew Rushton, VHDL for logic synthesis, Wiley, ISBN 0-471-98352-X 2)Mark Zwolinski, Digital system design with VHDL, Prentice-Hall, ISBN 0-201-360362 3)Giovanni De Micheli, Synthesis and optimisation of digital circuits, McGraw Hill, ISBN 0-07016333-2 4)Sabih Gerez, Algorithms for VLSI design automation, , Wiley, ISBN 0-471-98489-2 5)John P Elliott, Understanding behvioural synthesis, , Kluwer, ISBN 0-7923-8542-X 30 April, 2004 44 B.Tech (Information Technology) IT-440 Web based Application Development Credits: 4 (3-0-2) Intoroduction to Internet and Intranet, The Server/Client Architecture of the World Wide Web, HTML, DHTML. Forms: HTML tags and production of HTML forms, Types of data that can be accepted by web forms, Getting the data back - canned solutions and transition to CGI. CGI: Introduction to CGI, CGI processing using csh, Perl – an introduction, Decoding a form step-by-step using Perl and CGI. Database design using mySQL Java Scripting, Overview of Javascript and Dynamic HTML, Javascript as a language, Javascript in action - check the fields of a form for blanks. PHP Programming Active Server Pages Web Information System : porting database applications to web, uploading, document management and web technologies, security issues Interactive web based application design Text/References : 1.John Desborough, Intranet Web Development, New Riders 2.Patrik Naughton, The Complete Reference Java, Tata Mcgraw Hill 3.Communications of the ACM, July 1998-Volume 41, Number 7 4. Stephen R. Schach, Software Engineering with Java, Tata Mcgraw Hill 30 April, 2004 45 B.Tech (Information Technology) IT-446 Critical System design Credits: 4 (3-0-2) Introduction to time critical systems, Applications, Design Issues, Characterization and classification of time-critical systems and tasks, release time, deadlines & timing constraints, reference model, priority assignment & scheduling, clock driven approach, weighted round robin approach, priority driven approaches, resources & resource access control, assumption on resources & their uses, protocols. Scheduling flexible computations and tasks with temporal distance constraints. Introduction to clock synchronization. Case studies. Text & References: 1.J.W.S.Liu: Real-Time Systems, Pearson Education Asia 2.P.A.Laplante: Real-time Systems Design and Analysis, An Engineer's Handbook, IEEE Press 3.S.T.Lavi, A.K.Agrawala: Real-time system Design, McGraw Hill 4.P.D.Laurence, K.Mauch: Real-time Microcomputer system design, An introduction, McGraw Hill 30 April, 2004 46 B.Tech (Information Technology) IT-448 Parallel Computing Credits: 4 (3-0-2) 1.Introduction Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O 2.PRAM Algorithm Parallel reduction ,Prefix sums, List ranking, Preorder tree traversal, Merging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS 3.Parallel Programming Languages Programming parallel processes, Example and application, C* programmers model, Language features, Sample program, OCCAM, programmer's model, Language constructs, Sample program, C-LINDA, Programmers model, Language constructs, Sample program 4.Mapping and Scheduling Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock. 5.Elementary Parallel Algorithms Classifying MIMD algorithms, Reduction, Hypercube SIMD model, Shuffle-Exchange SIMD model, 2-D Mesh SIMD model, UMA Multiprocessor model, Broadcast, Prefix sums 6.Matrix Multiplication Sequential matrix multiplication, Algorithms for processor array, Algorithms for multiprocessors, Algorithms for multicomputers 7.Sorting Enumeration sort, lower bound on parallel sorting, Odd-even transposition sort. Bitonic merge, Quick sort based algorithms, Random read and random write. Books/References 1.Michael Quinn: Parallel Computing-Theory and Practice, MGH. 2.Ed. Afonso Ferreira and Jose' D. P. Rolin, Parallel Algorithms for irregular problems - State of the art, Kluwer Academic Publishers. 3.Selim G. Akl, The Design and Analysis of Parallel Algorithms, PH International. 4.Brassard and Bratley, Fundamentals of Algorithms, PHI, New Delhi 30 April, 2004 47 PG2022-23.pdf CompaniesCOMPUTER SCIENCE AND ENGINEERING Amazon 3 Bajaj Auto 1 Bel Ghaziabad 6 CDOT 1 Galgotia university 1 GLA University 1 HCL 3 Hitachi Energy 1 IBM 1 Itron 2 Mangalam Cement Marvell 2 Mercedes Benz 4 Nokia 1 Oracle 1 P P Savani University 1 Short Hills 1 Span Idea 1 Tata Motors 1 Tera Data 2 Truminds 1 Grand Total 35PG Total Offers by the Companies PG2021-22.pdf S.No.Name College ID Company Package Company Package Company Package 12020PIS5649 JAGRITI MAURYA Ingnious 7 22020PIS5647 ALISHA RANJAN Iquati 9.5 32020PIS5665 KUMAR SAHAB mediatek 16.65 42020PCP5584 SHREYA CHOWDHURY mediatek 30 52020pis5645 KARAN GUPTA Deloitte 8.1 62020pis5669 SATYANSH MISHRA Micron 18.65 72020pcp5536 KARTIKEY JAIN Tata Digital 10.5 82020pis5657 SHUBHAM SHARMA SCA 12 92020pis5667 AKUL KRISHNAN K Optum 14.7 MAQ Software 10 102020pis5655 AMANDEEP Optum 14.7 MAQ Software 10 112020pis5644 NISHANT CHAUDHARY MAQ Software 10 122020pcp5576 RAJAT KUMAR Evosys 6 132020pcp5594 RAVI KUMAR Optum 14.7 142020pcp5546 AVINASH Optum 14.7 152020pcp5572 DHEERAJ YADAV Optum 14.7 152020pcp5572 DHEERAJ YADAV Optum 14.7 162020pcp5605 KUMARI RASHMI VERMA Optum 14.7 172020pcp5516 AREEN GAUR Optum 14.7 182020pcp5551 PRIYANKA LUBAL Optum 14.7 192020PCP5507 PULKIT CHANDEL Optum 14.7 202020PIS5654 PANYAM MEENAKSHI Optum 14.7 212020PIS5661 DEEPAK YADAV Optum 14.7 222020PCP5577 SHADAB KHAN Optum 14.7 232020PCP5580 DEEPAK SINGH PAL LnT Infotech 9.5 Capgemini 7.5 242020pcp5573 SHIVAM KUMAR LnT Infotech 9.5 252020PCP5587 DEEKSHA RATNAWAT Wissen Technology 11 262020PCP5582 SINCHIT BATHAM Parul University 5.04Dassault systemes 10.5 272020pis5670 SAURABH JAYASWAL Microchip 11 282020PIS5676 SAURABH SINGH Mini Orange 12 292020PIS5680 PALLAVI MOHAN WATURE Mini Orange 8 302020PCP5528 ADHITESH CHAUHAN Sapnidea 7 312020pcp5520 KAMAKHYA BANSAL Samsung 14.5IIFL 9 322020PIS5678 NIDHISH KUMAR IIFL 9congnizant 6.5 332020PIS5503 JYOTISHREE KANHAR IIFL 9 S.No.Name College ID Company Package Company Package Company Package 342020pcp5575 ROHIT KUMAR IIFL 9 352020PCP5511 KHUSHBOO KUMAR Genpect 11.4Factspan 7.5Innominds 6 362020pis5659 GOPALJI SINGH Qualcomm 29.1 372020PIS5650 BHUPENDRA KUMAR SAHU Tartan 12Deloitte 8.1 382020PCP5532 TOSHI RAWKA Mercedes-Benz 15 392020pis5498 VINODKUMAR SHIRGURI Qualcomm 29.1Kantar 7.15 402020PIS5663 ARVIND OKRAM Niyo Solutions 20Rebel Foods 12 412020PIS5672 SIDDHARTHA SINGH Cdot 13itron 14Capgemini 7.5 422020PCP5598 ADITYA KUMAR SINGH Cdot 13 PG2020-21.pdf S.No.Name College ID Company Package Company Package 12019pcp5028 SAKSHI PARASHAR Paytm 9 22019PCP5048 HARSHAL KAUSHIKBHAI KA. PATEL Maq Software 9 32019pcp5150 GHARAT SNEHAL RAJENDRA Halliburton 11 4 2019PCP5154 SHUBHANSHU KUMAR MISHRA Samsung Research Institute 13 CDOT 14.65 52019PCP5173 KULDEEP Adani Enterprises Ltd. 8 62019pcp5280 SHALIN KUMAR DEVAL MTX 14

72019PCP5282 RAHUL KUMAR CHAUBEY Micron 12.1 82019pcp5283 MANISH SUTHAR Snapdeal 10 92019pcp5333 SHABNAM ALI Nokia 7.5 102019PCP5420 SHIVAM SHARMA quovantis 3.35 112019PCP5422 SHIVENDRA SINGH BEL 10 122019PCP5456 AARADHANA SAHU Spanidea 5 132019pcp5460 ANKUSH KUMAR Samsung sds 12 142019PCP5471 SHIVAM SHARMA Adani Group 8 152019pcp5496 MOHAMMED ZABEER ALI Oracle 11.5 162019pcp5499 DEEPALI SINGH Nokia 7.5 172019pcp5505 RAJESH BISWAS miniOrange 12 182019pis5006 SAKSHI SHREE Nokia 7.5 182019pis5006 SAKSHI SHREE Nokia 7.5 192019PIS5182 ARISH Oracle 11.5 202019pis5351 OJASVI KHEMANI Oracle 11.5 212019pis5365 TUSHAR GAUTAM Deloitte 8.1 222019pis5384 KIRTI DUBEY Sciative Solutions 7 232019PIS5386 ASHOK RATHORE Sagacious IP 4.2 242019PIS5389 MANISH TOMAR BEL 10 252019pis5403 SUMEDH RANJAN BHAGAT Nokia 7.5 262019PIS5404 ROBIN SINGH Adani Group 8 272019pis5406 DHIRAJKUMAR SEKHANI Maq Software 9 282019PIS5414 KAJAL MEENA India Mart 10 292019PIS5417 KSHITIJ AGARWAL Interra Systems 9 302019PIS5472 SUSHIL KUMAR Spanidea 5 e2enetworks 5.5 312019pis5478 SHRUTI SAINI Maq Software 9 322019pis5479 RAHUL LAHRE Halliburton 11 332019PIS5490 DINESH SAINI Spanidea 5 342019PIS5498 DEEPIKA JASSAL Lava International 7 352019PIS5522 DEEKSHA NEELAM Oracle 11.5 362019PIS5525 MOHAN SINGH BEL 10 372019PIS5407 RATHOD RAHUL SANJAYBHAI e2enetworks 5.5 382019PIS5489 SAURABH SAGAR e2enetworks 5.5 392019pis5494 PRACHI SHRIKRUSHNA SUPE Research Wire 5 PG2019-20.pdf S.No.Name College ID Company Package Company Package 1Shweta Patidar 2018PCP5018 Deloitte 8.1 2Ram Vaishnav 2018PCP5047 Philips 11 3Sneha 2018PCP5055 MAQ Software 9 4neha kumari 2018PCP5070 Intel 17 5Kapil Mangal 2018PCP5112 Nokia 7.5 6Lilesh Jinger 2018pcp5123 BEL 10.34Oracle 9.5 7Mahendra Kumar Meena 2018pcp5186 Parul University 5 8Sonam Vyas 2018PCP5210 Nokia 7.5 9Vishal Teotia 2018PCP5212 Oracle 9.5 10Rishabh Sahu 2018PCP5344 Nokia 7.5 11Chandramani Adil 2018PCP5420 BEL 10.34Accops 8 12Mohammad Iqbal 2018PCP5500 Nokia 7.5 13Sai Sreekar 2018PIS5024 Walmart Labs 20.67 14Prateek Sharma 2018PIS5157 Societe Generale 13.13 15Pooja Kumari 2018PIS5159 Philips 11 15Pooja Kumari 2018PIS5159 Philips 11 16Pooja Goswami 2018PIS5352 BEL 10.34 17Prerana Kajla 2018PIS5368 Philips 11 18shivankshi khandelwal 2018PIS5393 Wissen 11 19Rashmi Raj 2018PIS5418 Ericsson Global 6.5 20Kawaldeep Kaur 2018PIS5431 Societe Generale 13.13 21 Vaibhav Kumar Srivastava 2018PIS5435 PVPSIT 5.4 22Anu Ayyappan 2018pis5474 BEL 10.34Oracle 9.5 23KARIMPANAPUITCHAYIL ANU AYYAPPAN 2018PIS5474 BEL 10.34 24PIYUSH MISHRA 2018PIS5487 MINI ORANGE 6 25Ram Vaishnav 2018PCP5047 BEL 10.34 26Shubham Joshi 2018PCP5099 BEL 10.34 UG2022-23.pdf Companies COMPUTER SCIENCE AND ENGINEERING 26 Miles Club Global Pvt. Ltd.1 Academor 1 Adani 1 Airtel 4 Amazon 2 Apple 2 Arcesium 1 Bright Champs 2 Carrier 1 CDOT 2 Celigo 1 Confluence Creditq 2 decision point 1 DEShaw 2 Deutsche 1 Eurofins 1 Ganit 1 Gap 4 Goldman Sachs 3 housing.com 1 IDBI 2 Informatica 3 Intuit 2 JPMC 2 Jubilant 3 Junglee Games 1 live your best life 1 magicbricks 2 Mercedes Benz 1 Micron 3 MMT 3 Nav Back Office 1 NHA 2 Niyo 1 Optum 8 Oracle 3 Paisabazaar 3 People Strong 1 Policybazaar 1 Q3

Technologies 1 Quadeye 1 Reliance Jio 1 Salesforce 8UG Total Offers by the Companies Samsung 3 Tata Motors 1 Truminds 1 UBS 2 Vodafone 1 Wells Fargo 11 wooqer 1 Zuora 1 Grand Total 109 UG2021-22.pdf S.No.Name College ID Company Package Company Package Company Package 12018ucp1460 DHRUV GOYAL Arcecium 37 Lowe's 19.34 22018UCP1386 DEVANSHI MITTAL Apple 60 32018UCP1700 ABHINAV AGGARWAL Apple 60 42018UCP1298 MOHIT MISHRA My Park Plus 16Apple 52018UCP1136 ROHIT KUMAR SAHU JPMC 14 UBS 10 62018UCP1438 KESHAV SONI JPMC 14 72018ucp1140 HARSHA Salesforce 35.37 JPMC 14 82018UCP1658 NIDHI HEMANT MITKARI JPMC 14JohnDheere 11 92018UCP1444 PRANSHU VYAS DeShaw 38.5 102018ucp1388 PRATEEK SHARMA Deutsche Bank 19.6 112018ucp1329 S KRISHNA KISHORE Deutsche Bank 19.6 122018ucp1489 MAYANK KALSAN Micron 17.75 132018UCP1691 SOMYA GUPTA Apple 64 John Dheere 11 142018UCP1349 TANMAY GUPTA Quadeye 20.4 152018ucp1385 TARUN KUMAR MISHRA Quadeye 20.4 2018ucp1385 TARUN KUMAR MISHRA Quadeye 20.4 162018ucp1411 PRANAY KANJOLIA Flipkart 26.57 172018UCP1325 NITIN SINGH BHADORIYA Salesforce 35.37 182018UCP1581 VAIBHAV AGARWAL Salesforce 35.37 192018UCP1464 NANDINI ROY Flipkart 26.57 202018ucp1154 AKASH SHARMA Flipkart 26.57 21 2018UCP1319 PARMAR ABHISHEK SANGHARSHBHAI Oracle 29.2 22 2018ucp1744 AKSHIT AGARWAL Oracle 29.2 23 2018ucp1466 PRATEEK MAHESHWARI Amazon 44 Oracle 29.2 24 2018ucp1097 RISHABH Amazon 44 Oracle 29.2 25 2018ucp1491 VINUSH VISHWANATH Oracle 29.2 262018UCP1398 ABHISHEK NARAIN DAS BHATIA Amazon 44 272018UCP1323 KARAN MAURYA Amazon 44 282018UCP1471 GUNJAN SHEKHAWAT Amazon 44 292018UCP1465 SONAL AGRAWAL Apple 64 JPMC 14 302018ucp1448 MOKSH AHUJA Amazon 32.16 Goldman Sachs 23 312018ucp1173 DEEPAK Barclays 11.73 322018ucp1436 RAHUL AMARWAL Barclays 11.73 332018ucp1456 AATESH Barclays 11.73 S.No.Name College ID Company Package Company Package Company Package 342018ucp1505 ASHUTOSH SONI Barclays 11.73 352018ucp1737 TRIYA BYADWAL ACKO 16 Fractal Analytics 10.5 362018UCP1497 TAVISH VIJAY Amazon 32.16 372018ucp1455 ANAND KUMAR Cevent 13.62 382018UCP1827 GAURAV SAINI Truminds 11 392018ucp1712 ABDULLAH JAMAL Paytm 16 402018ucp1265 SANSKAR SONI Paytm 16 412018ucp1287 AKSHAT SINGLA Paytm 16 422018ucp1270 RISHI ROSHAN SINGH Paytm 16 432018UCP1474 ADARSH KUMAR Celigo 16.5 442018UCP1451 NEETIN KUMAR Celigo 16.5 452018UCP1672 KAPIL KANSAL Sudrania 30 462018UCP1601 ANURAG JAIN Sudrania 30 472018UCP1478 DESHPRIYA Sudrania 30 Oracle 16 482018UCP1556 HEMANT BAJAJ Sudrania 30 2018UCP1556 HEMANT BAJAJ Sudrania 30 492018UCP1360 SHUBHAM MODI Oracle 16 502018UCP1502 SATYAJIT ROY Oracle 16 512018UCP1030 NITESH SHARMA IXIGO 22 522018UCP1490 YASH JAIN IXIGO 22 532018UCP1673 DIVYA KRIPLANI IXIGO 22 542018UCP1405 NIKHIL SAIN IXIGO 22 55 2018UCP1482 HEET VINOD SURANA LoadShare 17.5 56 2018UCP1620 PURVA DAGA LoadShare 17.5 57 2018UCP1479 SIDDHARTH SINGH LoadShare 17.5 58 2018UCP1427 SHUBHAM MEENA LoadShare 17.5 592018UCP1498 HIMANSHU VERMA Magicbricks 10 602018UCP1513 ANKIT

DOOT Magicbricks 10 612018UCP1421 SHUBHAM YADAV Magicbricks 10 622018ucp1459 SHUBHAM JAIN paisabazaar 14 Deloitte 8.1 632018ucp1449 TANUJ AGARWAL Mini Orange 10 Deloitte 8.1 642018UCP1389 NAVDEEP SINGH DHARIWAL Rebel Foods 12 652018UCP1317 DEVAL Airtel 14.75 662018UCP1509 ADITYA KUMAWAT Airtel 14.75 S.No.Name College ID Company Package Company Package Company Package 672018UCP1797 RACHIT GUPTA Box8 19 682018UCP1495 YERUBUNTI HIMA SOWJANYA Digit 7 692018UCP1472 DHWANI NILESH AGRAWAL Mathworks 21.8 Optum 14.31 702018ucp1354 PRIYANKA KUMARI Optum 14.31 712018ucp1416 YASHWANT LOHAR Samsung R&D; 15.5 Optum 14.31 722018ucp1674 KESHAV GARG Samsung R&D; 15.5 Optum 14.31 73 2018ucp1414 VIJAY SWAMI AU Bank 10 Pristyn Care 5.5 742018ucp1485 BAL KRISHNA SEHRA People Strong 12 752018ucp1305 ANUJ KUMAR KANOJIA HashedIn by Deloitte 8 762018UCP1423 Aditya Tulsiyan HashedIn by Deloitte 8 772018ucp1481 SAMYAK JAIN MAQ Software 9 782018ucp1655 CHIRAG DUA Synopsys 18.92 MAQ Software 9 792018ucp1696 DHARMENDER Robomq 9 802018ucp1514 SUNITA LnT Infotech 9 812018ucp1204 SANDEEP KUMAR LnT Infotech 9 2018ucp1204 SANDEEP KUMAR LnT Infotech 9 822018ucp1400 HARSHA MAJHI LnT Infotech 9 832018ucp1500 HARDIK SINGHAL Airtel 14.75 LnT Infotech 9 842018ucp1328 ABHINAY CHIRANJILAL MEENA LnT Infotech 9 852018UCP1437 MAYANK SOLANKI Publicis Sapient 10 862018UCP1348 ACHALA RAM Nav Back Office 13 872018UCP1470 AMARNATH SAHU Samsung R&D; 15.5 Netcracker 12 882018UCP1484 ATIV KUMAR Indiamart 14 892018UCP1453 SULAKSHANA CHOUHAN Cogoport 10 902018UCP1507 SUJEET KUMAR SHARMA Physics Wallah 14 Icici Bank 11 912018UCP1813 ADNAN KHAN Leena AI 15 GAP 9 Deloitte 8.1 922018UCP1782 ROHIT KUMAR Physics Wallah 14 932018ucp1382 DEV MILAN MEHTA Lava 10.5 942018ucp1295 KAMAL Samsung R&D; 15 Digit 7 952018UCP1410 PRADEEP DUKIYA Tecture 6India Business ventures 5 962018ucp1503 SHASHIKANT MOURYA Samsung SDS 10 972018ucp1678 JANHVI GAUR Prism Johnson 7.5 982018ucp1789 PIYUSH VERMA Aakash 7.25 UG2020-21.pdf S.No.Name College ID Company Package Company Package 12017ucp1001 AAKASH GOPAL VACHHANI Fidelity Investments 12.93 22017ucp1002 YAMINI KALYANI EDIGA Capgemini 6.8 32017ucp1003 AKASH SRIVASTAV Fidelity Investments 12.93 42017UCP1007 SAMIR AMITKUMAR GUPTA UBS 10 52017ucp1009 AMISH RAJ Fidelity Investments 12.93 62017ucp1011 BHUVANAGIRI VENKATA SRIVIDYA Apple 29.53 72017ucp1027 NIKHIL SHARMA LnT InfoTech 9 82017ucp1028 SHREYA MODI Apple 29.53 92017UCP1029 HARSHIT SONI Deutsche Bank 19.81 102017ucp1032 PURVANSH GOURH Deutsche Bank 19.81 112017ucp1036 ABHINAV BANSAL Walmart 20.67 122017ucp1040 RISHAV KUMAR CDOT 14.65 Wissen Technology 11 132017ucp1041 SUNIL DHAYAL Barco 13Jio Platforms 6.5 142017UCP1061 SALONI GOYAL Sales Force 40 152017UCP1063 ABHISHEK GUPTA miniOrange 12Nav Backoffice 7.5 162017UCP1077 AMAN DUTTA Jio Platforms 5.75 172017ucp1082 RAVI NAPIT miniOrange 12NOKIA 7 182017ucp1101 AMIT AGARWAL ServiceNow 25Q3Technologies 8 192017ucp1103 PRIYANSHI AJMERA John Deere 11 202017ucp1117 YASHVENDAR Adani Enterprises Ltd. 8

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GAP 9Tredence 6.5 6Akshita Agrawal 2016ucp1023 Fidelity 12.93 7Akshay Rawat 2016UCP1026 Cubastion Consulting 7.19 8Devendra Purohit 2016UCP1029 White Hat Jr 9 9Birat Adhikari 2016UCP1033 Publicis Sapient 10 10Pulkit 2016UCP1090 Samsung 13 11Rishabh Kalakoti 2016UCP1098 ServiceNow 25 12Ashish Goyal 2016ucp1100 Walmart Labs 19.27 13Abhishek Tibrewal 2016UCP1103 Oracle 9 14Mukul Kumar 2016UCP1116 Airtel 14 15Shivanshu Vyas 2016UCP1121 Amazon India 28.75 16Jaideep Sharma 2016UCP1126 Lowe's 19.17 17Prashant Kumar 2016UCP1132 L&T; Infotech 9 18Sankhya Kumar Mitra 2016UCP1145 People Strong 6.6 19M. Satish Reddy 2016ucp1180 JP Morgan 14 20Ronak Gadia 2016ucp1185 JP Morgan 14 21Meedimale Yashwanth Reddy 2016ucp1216 Walmart Labs 19.27 22Suraj Kumar 2016UCP1220 Publicis Sapient 10 23Rohit Kumar bairwa 2016UCP1295 Samsung 13 24Kapil Saini 2016UCP1297 ServiceNow 25 25Sugam 2016UCP1305 Oracle 9 26G Jahnavi VS 2016UCP1332 Oracle 9 27Matli Mohan Tejeswar Reddy 2016UCP1338 Fidelity 12.93 28Gaurav Bansal 2016UCP1345 Airtel 14 29Shubham 2016UCP1350 QuadEye Security 17 30Shreya Jain 2016UCP1360 Societe Generale 13.13GAP 9 31Amit Singh Jadaun 2016UCP1363 Walmart Labs 19.27 32Varun Kumar Verma 2016UCP1368 Societe Generale 13.13 S.No.Name College ID Company Package Company Package 33MD Saifullah 2016UCP1369 Societe Generale 13.13 34Himnshu yadav 2016UCP1372 Samsung 13 35Pankaj Tanwar Banna 2016UCP1381 Wissen 11PaisaBazaar 9 36Sanjay Kumar 2016UCP1382 PharmEasy 13.5 37Shubham Arora 2016ucp1388 JP Morgan 14 38Bhagwana Ram 2016UCP1389 Societe Generale 13.13 39Aviral Mongra 2016UCP1392 Fidelity 12.93 40Priyanshu Singh 2016UCP1393 Intellipaat 5.4 41Priyanshu Singh 2016UCP1393 White Hat Jr 9 42Rahul Jangir 2016UCP1396 Wipro 6.5 43Kashyap Kumar Vishwakarma 2016ucp1400 Fidelity 12.93 44Aashish Goel 2016ucp1404 Salesforce 30.82 45Pooja Yadav 2016UCP1406 Nokia 7 46Balwant Singh 2016ucp1411 Toshiba 8Tally Solutions 7 47Rahul Kumar 2016UCP1412 ServiceNow 25 48Jagriti Aggarwal 2016ucp1413 Walmart Labs 19.27 49Uditi Arora 2016ucp1415 Goldman Sachs 22 50Anmola kumari 2016ucp1422 Goldman Sachs 22 51Gauri 2016UCP1425 Publicis Sapient 10 52Pratibha Choudhary 2016UCP1426 Oracle 9 53Ashish Pandey 2016UCP1432 Capgemini 6.8 54Ajit Kumar Rai 2016UCP1433 NAV Back Office 7.5 55Preet Yadav 2016UCP1436 Societe Generale 13.13 56Shweta Mehrolia 2016UCP1438 Lowe's 19.17GAP 9 57Deepanshu Vijay 2016UCP1439 Nucleus software 6.5 58Awadhesh Kumar 2016UCP1441 Incture 8 59Tarishi Jain 2016ucp1443 Salesforce 30.82 60Aditya Sinha 2016ucp1447 JP Morgan 14 61Arvind Kumar 2016UCP1448 Incture 8 62Adit Mathur 2016UCP1454 Oracle 9 63Siddhant Gupta 2016UCP1455 Samsung 13 64Aditya Bansal 2016ucp1456 Fidelity 12.93 S.No.Name College ID Company Package Company Package 65Bhawana Sankhla 2016UCP1457 IBM 7.25Capgemini 6.8 66Aryan Sharma 2016ucp1458 Walmart Labs 19.27 67Sumit Kumar 2016ucp1459 Walmart Labs 19.27 68Shivani Khandelwal 2016UCP1462 Salesforce 30.82 69Harsh Bansal 2016ucp1468 Fidelity 12.93 70Khusboo Choudhary 2016UCP1469 Deutsche Bank 14.3 71Shambhawi Varchasva 2016ucp1470 Commvault 24JP Morgan 14 72Gaurav Kabra 2016UCP1471 Salesforce 30.82 73Divya Gupta 2016ucp1472 Salesforce 30.82 74Narender Kumar Yadav

2016UCP1474 Flipkart 23.84 75Narendra Kumar 2016UCP1476 Incture 8Oracle 9 76 Surodwar Krishna 2016UCP1479 Analytics Quotient 6.5 77Aditya Raj 2016UCP1482 Flipkart 23.84 78Pankaj Kumar 2016UCP1564 SCA Technologies 8.3 79Lalit Kumar 2016UCP1572 Deutsche Bank 14.3 80Manoj Sheshma 2016UCP1599 Accenture 8.91 81Shubham Dubey 2016UCP1606 Fidelity 12.93 82Sakshi Maheshwari 2016ucp1617 Walmart Labs 19.27 83Ramcharan Jethu 2016UCP1633 Interra 10Aptean 10.26 84Ramavatar Choudhary 2016UCP1642 Amazon India 28.75 85Bhavishya Garg 2016UCP1644 Dassault Systems 7InfoObjects 7 86Chirag Jain 2016UCP1651 Deutsche Bank 14.3 87Ravi Khandelwal 2016UCP1653 Optum 13.17 88Swaraj Pravin Thakre 2016ucp1663 Walmart Labs 19.27 89Parvat Jakhar 2016UCP1699 Walmart Labs 19.27 90Twinkal Parmar 2016UCP1700 Philips 10 91Girish kumar 2016UCP1706 Toshiba 8 Department of Computer Science & Engineering (Academics and Time Table) ■■■■■■■ ■■■■■■■■■■■ ■■■■■■■■■■■■■ ■■■■■■■■ ■■■■■■(■■■■■■■■■■ ■■■■■■ ■■ ■■■■■■■■)Malaviya National Institute of Technology Jaipur(An Institute of National Importance) About MNIT NIT Statutes & Act Reports MNIT Newsletters Administration Committees Minutes of Meetings Others Continuing Students Prospective Students Departments Centres Research @ MNIT Facilities Office of Deans Other Central Units Media Centre Recruitment Academics & Time Table The Department offers academic programmes (Under-graduate and Post-graduate levels) in Bachelor of Technology (B.Tech.), and Master of Technology (M. Tech.), and Doctor of Philosophy (Ph. D.) degrees. B.Tech.inComputer Science and Engineering Master of TechnologyinComputer Science and Engineering Master of TechnologyinComputer Science and Information Security Doctor of Philosophy The Department offers academic programmes (Under-graduate and Post-graduate levels) in Bachelor of Technology (B.Tech.), and Master of Technology (M. Tech.), and Doctor of Philosophy (Ph. D.) degrees. The Department offers academic programmes (Under-graduate and Post-graduate levels) in Bachelor of Technology (B.Tech.), and Master of Technology (M. Tech.), and Doctor of Philosophy (Ph. D.) degrees. UG Programme Educational Objectives (PEOs) for UG Programme Programme Outcomes (POs) for UG Programme PG Archives : Time Table Related Links Malaviya National Institute of Technology JaipurJawahar Lal Nehru Marg,Jaipur-302017 (Rajasthan) INDIAwebmaster[at]mnit.ac.in Disclaimer: Copyright © 2024 Malaviya National Institute of Technology Jaipur 18773664 Information_Brochure.pdf Department of Computer Science and Technology MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Information Brochure for M.Tech CSE and CS&IS; Programme DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Department of Computer Science and Engineering Brief About the Department Department of Computer Science & Engineering came into existence in 1994. The first degree program offered by the Department was B.E. (Computer Engineering) in affiliation with the University of Rajasthan. The first batch graduated in 1998. Another degree programme B.E. (Information Tech nology) was initiated in 2001. In January 2004, first admissions to Ph.D. programme took place. In 2008, M.Tech. (Computer

Science & Engineering) programme was initiated whereas, M.Tech. (Computer Science & Information Security) was started in 2016. Facul ty at Computer Science & Engineering believes in open interaction with students who are encouraged to participate in academic, research and extra -curricular activities. Students have never misplaced trust put in them by department and have done well in aca demic and industry alike. List of Programs offered by the Department: Program Title of the program B.Tech Computer Science and Engineering M.Tech Computer Science and Engineering Computer Science & Information Security Ph.D. Computer Science and Engineering Vision To be a Centre of Excellence in Computer Science and Engineering domain and work with industry on cutting edge technology to address current and emerging challenges in global perspective for the development of society. Mission To impart quality engineering education, enhance problem solving skills, foster research and innovation, encourage entrepreneurship and mold students of integrity and ethics to provide leadership with social sensitivity for the betterment of the country an d humanity as a whole. Department of Computer Science and Engineering Course Structure and Syllabus for M.Tech CSE and M.Tech CS&IS; MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR DEPARTMENT of Computer Science and Engineering M.Tech. Computer Science and Engineering Semester. I S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CST501 Advanced Data Structures and Algorithms PC Theory 3 3 0 0 2 21CST503 Parallel and Distributed Computing PC Theory 4 3 0 2 3. 21CST502 Advanced Databases PC Theory 3 3 0 0 4. 21CST813 Department Elective – 1 PE Theory 3 3 0 0 5. 21CST814 Department Elective – 2 PE Theory 3 3 0 0 6. 21CSP504 Programming Lab -1 PC Lab 2 0 1 2 Total 18 Semester. II S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CST507 Research Methodology PC Theory 2 2 0 0 2 21CST842 Department Elective – 3 PE Theory 3 3 0 0 3. 21CST843 Department Elective – 4 PE Theory 3 3 0 0 4. 21CST844 Department Elective – 5 PE Theory 3 3 0 0 5. 21CST845 Department Elective – 6 PE Theory 3 3 0 0 6. 21CSP506 Programming Lab -2 PC Lab 2 0 1 2 7. 21CSP505 Design Lab /Computing Tools PC Lab 2 0 1 2 Total 18 Semester. III S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CSS603 Technical Documentation and Presentation PC --- 2 0 1 2 2 21CSP602 Literature Review PC --- 2 0 1 2 3. 21CSD601 Dissertation – 1 PC --- 8 0 0 16 Total 12 Semester. IV S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CSD604 Dissertation – 2 PC --- 12 0 0 24 Total 12 Total Credits: 60 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST501 Course Name : Advanced Data Structures and Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis, Recurrence equations. Advanced Data Structures: B -Trees, Binomial Heaps, Fibonacci Heaps, AVL trees, Red -black trees, B -trees, Splay trees, Interval trees; Disjoint set – union and path compression, Amortized analysis Greedy Algorithms: shortest distance, minimum spanning tree, interval scheduling, interval partitioning; Divide and Conquer: sorting, integer and polynomial mu ltiplication; Dynamic programming: Longest common subsequence. Chain of matrix multiplication, sequence alignment, Bellman Ford Convex hull and Voronoi diagrams, line segments, Optimal polygon triangulation; Primality testing, Integer factorization; Graph algorithms: Matching and Flows; Parallel algorithms: Basic techniques for sorting, searching, merging. Intractability: Independent Set, Vertex Cover, Randomized algorithms, Probabilistic algorithms. Approximate Algorithms: Vertex -cover, set -covering proble ms, Travelling Salesman problem. Complexity classes - NP-Hard and NP -complete Problems - Cook's theorem NP completeness reductions, undecidability Recommended Readings Text Books: - 1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall o f India. 2. AhoA.V , J.D Ulman: Design and analysis of Algorithms, Addison Wesley 3. Brassard : Fundamental of Algorithmics, PHI. 4. Sara Baase: Computer Algorithms: Introduction to Design and Analysis, Pearson Education. 5. Papadimitriou, Steiglitz: Combi natorial Optimization: Algorithms and Complexity, PHI 6. Motwani and Raghavan: Randomized Algorithms, Cambridge University Press 7. Vazirani: Approximation Algorithms, Springer Verlag 8. Joseph Ja'Ja': Introduction to Parallel Algorithms, Addison -Wesley 9. Kleinberg, Tardos: Algorithm Design, Addison Wesley. 10. Dexter Kozen: The Design and Analysis of Algorithms. Springer, 1992 11. SanjoyDasgupta, Christos Papadimitriou, and UmeshVazirani: Algorithms, McGraw Hill. 12. Robert Sedgewick and Kevin Wayne. Algo rithms 4/e. Addison -Wesley. 13. Robert Tarjan: Data Structures and Network Algorithms, Society for Industrial and Applied Mathematics MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST503 Course Name : Parallel and Distributed Computing Credits : 4 L - 3 T - 0 P - 2 Course Type : Core Prerequisites: Programming in C, Data Structures, Operating Systems, Computer Architecture and Organization, Computer Networks Course Contents Parallel Computing, Sequential programs, Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity on Performance, Scalability of Parallel Systems, Parallel Programming Platforms, Implicit Parallelism, SIMD & MIMD systems, Clusters, Single -Core and Multi -Core Processors, Physical Organization of Parallel Platforms, Cache Coherence, Interconnection Networks for Parallel Computers. Programming Using the Message -Passing Paradigm - MPI Principles of Message Passing Programmin g; Building blocks (Sending and Receiving Operations); Communication Library calls; Collective communication and Computation library calls, Programming Shared Address Space Platforms – OpenMP, Directive Parallel Programming; The OpenMP programming Model (C oncurrent Tasks, Synchronization Constructs, Data Handling); Open libraries; OpenMP -Environment Variables; Parallel Programs, Matrix Computations, Matrix Vector Multiplication, Matrix - Matrix Multiplication, Solving system of Linear Equations; Parallel I mplementation of Sparse Matrix Computations with Vector; Sorting algorithms, Issues in Sorting on Parallel Computers; Bubble Sort and its Variants, Quicksort; Parallelizing Quicksort; Sequential and Parallel Implementation of all -pairs of Shortest Paths Al gorithms; Sequential & Parallel Search Algorithms; Depth -First Search Algorithms; Best - First Search Algorithms, Programming on Multi -Core Systems with GPU accelerators An Overview of Brief History of GPUs; An Overview of GPU Programming; An Overview of GP U Memory Hierarchy Features; An Overview of

CUDA enabled NVIDIA GPUs, Introduction to CUDA C, Parallel Programming using OpenACC, CUDA APIs, CUDA Libraries for Numerical and Non -Numerical Computations; The OpenCL – Heterogeneous Programming; OpenCL Librari es, The OpenCL Memory Model, Execution Model; Platform and Devices; An Overview of OpenCL API; An Overview of MapReduce, An Overview of MapReduce Programming, An Overview of Hadoop Architecture /Execution (Master/slave, Namenode/Datanode); Hadoop Distr ibuted File System (HDFS), An Overview of Hadoop Components, Hadoop – Control Flow and Data Flow; An overview of Hive (Distributed Data Warehouse); Hbase (Distributed Column based database, PIG –(Data Flow Language); Recommended Readings Text Books: - 1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Second Edition Pearson Education – 2007 2. Peter Pacheco, An Introduction to Parallel Programming, Morgan Kaufman Publishers, Elsevier (2011) 3. Jason Sanders, Edw ard Kandrot, CUDA By Example – An Introduction to General -Purpose GPU Programming, Addison Wesley (2011) 4. RohitChnadra, Leonardo Dagum, Dave Kohr, DrorMaydan, Jeff McDonald, Ramesh Menon, Parallel Programming in OpenMP, Academic Press (2001) 5. Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, (2011), Heterogeneous Computing with OpenCL McGraw -Hill, Inc. Newyork 6. Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw -Hill International Ed (2003) 7. Aru C Murthy, Vinod Kumar Vavilapalli, Doug Eadline, Joseph Niemiec, and Jeff Markham, Apache Hadoop YARN Moving beyond MapReduce and Batch Processing with Apache Hadoop 2, Addison Wesley, 2014 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST502 Course Name : Advances in Databases Credits : 3 L - 3 T - 0 P - 0 Course Type : Core Prerequisites: Basic course in Database Management Systems Course Contents Query Processing and Optimization – Implementation of Database operations, External Sorting, Size Estimations, Equivalence Rules, Heuristic -based Optimization, Materialized Views, Incremental View Maintenance. Transaction Processing - Concurrency Control Management, Serializability, Two -phase Lock Protocol, Deadlock Prevention and Detection, Timestamp -based Ordering Protocol, Log -based Recovery Management. Modern Database Systems - Database System Architectures, Distributed Database Systems, Parallel Data bases, Times in Databases, Multimedia Databases Distributed Databases - Data Storage, Global Catalog, Distributed Transaction Processing, Two -Phase Commit Protocol, Distributed Query Processing. Recommended Readings Text Books: - 1. Silberschatz ,Korth, Sudarshan : Database System Concepts, McGraw Hill. 2. Elmasri and Navathe : Fundamentals of Database Systems, 3rd Edition, Addison MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP504 Course Name : Programming Lab – 1 Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: Course Contents Programming exercises and experiments in Algorithms Dynamic programming and Approximate Algorithms. Combinatorial algorithm s, Randomized algorithms, Graph algorithms: Parallel algorithms: Basic techniques for sorting, searching, merging Programming exercises and experiments in Parallel and

Distributed Computing. Parallel processing terminology, Pipelining Vs Data parallelism, multi -threaded architectures. Parallel reduction, Prefix sums, List ranking, preorder tree traversal, Merging two sorted lists Distributed and shared memory, Hadoop and MapReduce Programming exercises and experiments in Advanced Data structure and database . Advanced Lists, Segment Tree,Trie,Binary indexed tree. Self -Balancing BSTs, N -ary Tree. Disjoint Set, Suffix Array and Tree. Recommended Readings Text Books: - 1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India 2. N. Deo: Graph Theory with Application to Engineering and Computer Science, Prentice -Hall 3. Ghosh, Moona and Gupta, Foundations of parallel processing, Narosa publishing. 4. Ed. Afonso Ferreira and Jose' D. P. Rolin, Parallel Algorithms for irregular pr oblems - State of the art, Kluwer Academic Publishers MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST507 Course Name : Research Methodology Credits : 2 L - 2 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents Unit I: Data Structures and Algorithms: Review of Data Structures, and most commonly used algorithms in Computer Science and Engineering – Sorting, DFS/BFS, Pattern Searching. Unit II: Linear Al gebra: Vectors - linear vector spaces, linear independence, norms and inner products, Basis and dimension, Matrices, Matrix operations, Inverse of a matrix Orthogonalization, Properties of determinants, Eigenvalues and eigenvectors, SVD and pseudo inverse, KL or hotelling transform. Unit III: Transforms Signals and representation, Convolution, Frequency Transforms, Properties of Fourier Transform, DFT, DCT and FFT, Introduction to wavelets, applications in Computer Science and Engineering Unit III: Probab ility and Statistics Statistics: Introduction to statistical analysis, hypothesis testing – null and alternate, statistical tests – chi- square, ANOVA, data validation Probability models and axioms, Bayes' rule, discrete and continuous random variables, P robability distributions: normal distribution and properties, conditional, marginal and joint probability distribution, PRNG (pseudo random number generators) - randomness tests, introduction to information theory and cryptography: an Introduction Unit IV: Machine Learning: Linear and non -linear regression, supervised learning – neural network, binary decision diagram, SVM, k -NN, unsupervised learning – Clustering, Hidden Markov Models, Introduction to deep learning. Unit V: Case Studies in Research Domain s of CSE. Recommended Readings Text Books: - 1. Gilbert Strang: Linear Algebra, MIT Cambridge Press. 2. Sheldon Ross: First Course in Probability, Pearson. 3. Mark Girolami, Simon Rogers: First Course In Machine Learning, CRC Press. 4. Anirban Das Gupta: Probability and Statistics for Machine Learning, Springer. 5. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, second ed, Springer 6. Ian Goodfellow: Deeplearning, MIT Cambridge Press. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP506 Course Name : Programming Lab – 2 Credits : 2 L - 1 T - 0 P - 3 Course Type : Elective Prerequisites: Programming Sk ills, Data Structures, Computer Networks Course Contents 1) Programming exercises and experiments in Operating Systems a. Kernel compilation and configuration, kernel modules, system calls and in -line assembly. b. Memory management, process management and scheduling c. Interrupts and interrupt handlers, synchronization etc. 2) Programming exercises and experiments in Advanced Database management systems. a. Cloud Databases: MongoDB/Cassandra etc. b. Transaction Processing: Practice on transaction process ing 3) Programming assignments on NetSim and Libalium Recommended Readings Text Books: - 1. Stevens, W. R., “Unix Network Programming: Vol. II”, 2nd Ed., Pearson Education 2. Daniel P.Bovet, Marco Cesati, O`Reilly , “Understanding the Linux Kernel” Thir d Edition, 2005 3. Robert Love , “Linux Kernel Development”, Pearson Education, Third Edition, 2010 4. LAN Trainer user Manual. 5. Lee chao, “Cloud Database Development and Management”, CRC Publisher, 2013 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAI PUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP505 Course Name : Design Lab / Computing Tools Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: Students must have prior programming experience in C/C++ or any language; mathematics through differential equations, and numerical analysis Course Contents Operating Systems and Unix Environments: features of UNIX/Linux for scientific and technical compu ting; languages, compilers, debuggers, performance tools, make files, build systems, shell scripting, file management, source code control. Research Documentation and Simple Data Visualization: tools for generating research and code documentation: LATEX, D oxygen, plotting tools. Software Best Practices: software design cycle, regression testing, defensive programming, verification, code coverage Scientific Libraries: availability of common math libraries and usage for scientific computing.High performance C omputing (HPC): Tool and techniques. Recommended Readings Text Books: - 1. Eric S. Raymond, The Art of Unix Programming, Addison -Wesley 2003 2. Heister, T. and Rebholz, L. G., Introduction to Scientific Computing for Scientists and Engineers. De Gruyter Press, 2015. 3. John Levesque, High Performance Computing: Programming and Applications Electives Courses for PG -CSE 1. 21CST802 Advanced Computer Networks 2. 21CST824 Network on Chip 3. 21CST803 Advances in Compiler Design 4. 21CST804 Android Programming 5. 21CST806 Computer Vision 6. 21CST807 Cyber Physical Systems 7. 21CST808 Data Analytics 8. 21CST809 Data Compression 9. 21CST810 Data Mining 10. 21CST812 Deep Learning 11. 21CST815 Distributed Systems 12. 21CST816 E-Commerce 13. 21CST817 Hardware Software Codesign 14. 21CST818 Image Analysis 15. 21CST819 Information Retrieval 16. 21CST820 Internet of Things 17. 21CST822 Natural Language Processing 18. 21CST823 Nature Inspired Algorithms 19. 21CST825 Network Performance Modelling 20. 21CST826 Neural Networks 21. 21CST827 Parallel Processing & Algorithms 22. 21CST828 Parallelizing Compiler 23. 21CST830 Quantum Computing 24. 21CST831 Real Time Systems 25. 21CST832 Robotics and Control 26. 21CST801 5G Technology 27. 21CST834 Selected Topics in Operating System 28. 21CST833 Selected Topics in Computing 29. 21CST835 Social Media Mining 30. 21CST836 Social Network Analysis 31. 21CST837 Software Project Management 32. 21CST838 Software Testing and Validation 33. 21CST840 VLSI Algorithms 34. 21CST841 Wireless Sensor Networks 35. 21CST821 Machine Learning 36. 21CST829 Pattern Recognition 37. 21CST805 Big Data Analytics 38. 21CST811 Data Visualization 39. 21CST839 System on Chip 40. 21CSL760 Program Analysis

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST802 Course Name : Advanced Computer Networks Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Wireless networking: Bluetooth, 802.11 standards Information theory, bandwidth, multiple access Wireless Terahertz Networks 5G and 6G communication Intelligent Transportation Systems Emerging networking technologies: Host configuration and service discov ery principles Future routing architectures IPv6 deployment scenarios and challenges, IPv6 transition/integration Advanced IP multicast, including IPv6 multicast and SSM Software -defined networking Delay - tolerant networking Future home network architecture s IP network management and monitoring. Social Networks Recommended Readings Text Books: - 1. Tanenbaum A S and Wetherall D J (2010). Computer Networks. 2. Hagen S, (2006). IPv6 Essentials. 3. Recent publications on the relevant fields MALAVIYA NATI ONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST824 Course Name : Network on Chip Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Computer Architecture, Logic System Design Course Contents The Concept of route packet not wires for On -Chip Interconnection Networks, Topology and design architecture of Network -on-Chip, Area and power trade off NoC protocols, Routing and Flow Control me chanism, Verification of Communications in Networks -on-Chips. Application Mapping on Network -on-Chip, Resource Allocation for QoS On -Chip Communication, routing techniques in different 2D/ 3D NoC topology, performance evaluation in terms of throughput, latency, gitter. Signal Integrity and Reliability of Network -on-Chip, Testing of Network -on- Chip Architectures, Test and Fault Tolerance for NoC Infrastructures, Reconfigurable Network -on-Chip Design, Security in NoCs. Energy and Power estimation techniques Network -on-Chips Recommended Readings Text Books: - 1. Giovanni De Micheli, Luca Benini, DavideBertozzi, Networks on Chips:Technology and Tools, Morgan Kaufmann, 2006. 2. Fayez Gebali, HaythamElmiligi, Mohamed Watheq El -Kharashi, Networkson - Chips: Theory and Practice, CRC Press, 2017. 3. SudeepPasricha, NikilDutt, On -Chip Communication Architectures: System on Chip Interconnect, Morgan Kaufmann, 2010. MALAVIYA NATIONA L INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST803 Course Name : Advances in Compiler Design Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic course in Compile r Design Course Contents Modern Compiler Design – Structure of Compilers for Modern Programming Languages, Cross Compiler, Just -In-Time (JIT) and Adaptive Compilation, Runtime System Architectures. Parser Development - LR Parsers and LR Grammars – Design and Implementation, Parser and Ambiguity, Conflict Resolution, Lex and Yacc Tools. Optimizing Compiler - Control -flow Analysis, Control -flow Graphs, Basic Blocks, Data -flow Analysis Methods, Dependence Analysis, Global Optimizations, Loop Optimizations, Pe ephole Optimization and Optimal Code Generation, Data Dependence Analysis in Loops, Loop Scheduling. Recommended Readings Text Books: - 1. Aho, Lam, Sethi and Ullman: Compilers – Principles, Techniques and Tools, Pearson Education 2. Steven Muchnick : A dvanced Compiler Design &

Implementation, MorganKaufmann 3. Holub: Compiler Design in C, Prentice Hall India. 4. Keith Cooper and Linda Torczon : Engineering a Compiler, Morgan Kaufmann. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST804 Course Name : Android Programming Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Basics: Review of Java Programming, Setting up and configuring Android Studio setup, Android Emulator Hello Android example, AndroidManifest.xml, R.java file, Activity, Fragment, Layout Manager - Relative Layout, Linear Layout, Table Layout, Grid Layout. A ctivity, Intent & Fragment: Activity Lifecycle, Activity Example, Intent – implicit and explicit, Intent filters, Fragment Lifecycle, Fragment Example, UI Widgets – buttons (toggle, switch, image), check box; Android Menu: Option Menu, Context Menu, Popup Menu; View. Android Service: lifecycle, example, Data Storage, Shared Preference, SQLite, Content Provider, Android Notification Adding functionality: Multimedia API, Speech API, telephony API, Location API Sensors: Sensor API, Working with WiFi, Working w ith Camera, Motion Sensor, Position Sensor; Android Graphics App development project. Recommended Readings Text Books: - 1. Official Android Website MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST806 Course Name : Computer Vision Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction, Pixels and Filters, Image pyramids and Fourier transform, Hough transform, Edge detection, RANSAC, Feature detectors, Harris, Feature descriptors, Corner detection and matching, 2D transformations, Image homographs, Camera models, camera cali bration, radiometry, color, shading, Bag of words, SIFT, SURF, Segmentation, Image indexing and search, Nearest Neighbor Match, Object Recognition, Face recognition, Differential motion: Optical flow, Feature Tracking & Motion Layers, Performance Evaluatio n Recommended Readings Text Books: - 1. Computer Vision: Algorithms and Applications, by Richard Szeliski 2. Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce. 3. Computer Vision: Models, Learning, and Inference by, Simon J. D. Prince, Cambridge University Press. 4. Concise Computer Vision: An Introduction Into Theory and Algorithms, by ReinhardKlette, Springer MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST807 Course Name : Cyber Physical Systems Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Characteristics of Cyber -Physical Syst ems (CPS) Cyber -Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS, Industry 4.0, AutoSAR, IIOT implications, Building Automation, Medical CPS CPS physical systems modeling and formalisms: CPS - Platform components - CPS HW platforms - Processors, Sensors, Actuators, CPS Network - WirelessHart, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks. Principles of Dynamical Systems - Dynamical Systems and Stability, Controller Design Techniques and Performance under Packet drop and Noise CPS implementation issues - From features to automotive software components, Mapping software components to ECUs, CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, and building real -time networks for CPS Safe Reinforcement Learning: Robot motion control, Autonomous Vehicle control Gaussian Process Learning, Smart Grid Demand Response , Building Automation Secure Deployment of CPS: Secure Task mapping and Partitioning, State estimation for attack detection, Automotive Case study : Vehicle ABS hacking, Power Distribution Case study : Attacks on SmartGrids Recommended Readings Text Books: - 1. "Introduction to Embedded Systems – A Cyber –Physical Systems Approach" - E. A. Lee, SanjitSeshia 2. "Principles of Cyber -Physical Systems" - Rajeev Alur MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST808 Course Name : Data Analytics Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Fundamentals of Learning, Basic Programming skills, Course Contents Introduction: Data Analytics, Big Data, Current lands cape of perspectives - Skill sets needed; Statistical Inference -Populations and samples, Statistical modeling, Probability: Probability theory, conditional probability; probability distributions, fitting a model. Basic Analysis Techniques, Basic analysis t echniques, Statistical hypothesis generation and testing, Chi -Square test, t -Test, Analysis of variance, Correlation analysis, Maximum likelihood test Exploratory Data Analysis (EDA) and the Data Science Process: Basic tools (plots, graphs and summary stat istics) of EDA - Philosophy of EDA - The Data Science Process, Data Visualization - Basic principles, ideas and tools for data visualization. Python for common data analysis: libraries like NumPy, Pandas matplotlib, and seaborn. Data wrangling and manageme nt:Accessing database, CSV, and JSON data, Data cleaning and transformations, APIs and other tools for scraping the Web, Data Management : knowledge of SQL such as MySQL, NoSQL like MongoDB, Cassandra etc. Python for Data cleaning and transformations using Pandas and Sklearn. Mining Social -Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs. Recommended Readings Text Books: - 1. Trevor H astie Robert Tibshirani Jerome Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction, 2nd Edn, Springer, 2014 2. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014. 3. Jiawe i Han, MichelineKamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011. 4. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST809 Course Name : Data Compression Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Object Oriented Analysis and Design Course Contents Introduction: Compression techniques, lossless compression, lossy compression, measures of performance, modeling and coding. Mathematical preliminaries - Overview, introduction to information theory, models, physical models, probability models, Markov mode ls. Basic Coding Schemes: Statistical Methods - Shannon -Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding. Arithmetic Coding (Encoding, Decoding, Adaptive Coding). Dictionary Methods - LZ77, LZ78, LZW Algorithms. Case study of lossless compression standards. Lossless Compression standards: zip, gzip, bzip, unix compress, GIF, JBIG. Image and Video Compression: Discrete Cosine Transform, JPEG. Wavelet Methods - Discrete Wavelet Transform, JPEG 2000. Motion Compensation, Temporal and Spatial Predicti on. MPEG and H.264. Audio Compression: Digital Audio, WAVE, FLAC, MPEG -1/2 Audio Layers. Recommended Readings Text Books: - 1. Khalid Sayood. 2012. Introduction to Data Compression (4th ed.). Elsevier 2. David Salomon, Giovanni Motta. 2010. Handbook of Data Compression. Springer, London MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST810 Course Name : Data Mining Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to data mining: Motivation and significance of data mining, data mining functionalities, interestingness measures, classification of data mining system, major issues in data mining. Data pre -processing: Need, data summarization, data cleaning, data integration and transformation, data reduction techniques – Singular Value Decomposition (SVD), Discrete Fourier Transform (DFT), Discrete Wavelet Transform ((DWT), data discretization and concept hierarchy generalization. Mining frequent patterns, a ssociations and correlations: Basic concepts, efficient and scalable frequent itemset mining algorithms, mining various kinds of association rules – multilevel and multidimensional, association rule mining versus correlation analysis, constraint based asso ciation mining. Classification and prediction: Definition, decision tree induction, Bayesian classification, rule based classification, classification by backpropagation and support vector machines, associative classification, lazy learners, prediction, ac curacy and error measures. Cluster analysis: Definition, clustering algorithms partitioning, hierarchical, density based, grid based and model based; Clustering high dimensional data, constraint based cluster analysis, outlier analysis – density based and distance based. Data mining on complex data and applications: Algorithms for mining of spatial data, multimedia data, text data; Data mining applications, social impacts of data mining, trends in data mining. Recommended Readings Text Books: - 1. Han, J . and Kamber, M., “Data Mining - Concepts and Techniques”, 3rd Ed., Morgan Kaufmann Series . 2. Ali, A. B. M. S. and Wasimi, S. A., “Data Mining - Methods and Techniques”, Cengage Publishers. 3. Tan, P.N., Steinbach, M. and Kumar, V., “Introduction to Data Mining”, Addison Wesley – Pearson 4. Pujari, A. K., “Data Mining Techniques”, 4th Ed., Sangam Books. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST812 Course Name : Deep Learning Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Course Overview: Introduction to Deep Learning and its Applications. Introduction to Statistical Learning: Multi -Layer Perceptron, Back P ropagation, Linear Regression, etc. Convolutional Neural Networks: Convolution, pooling, Activation Functions, Back propagation of CNN, Weights as templates, Translation invariance, Training with shared parameters. CNN Architecture Design and Discussion: A lexNet, VGG, GoogLeNet, ResNet, Capsule Net, etc. Loss Functions and Optimization: Optimization, stochastic gradient descent, dropout, batch normalization, etc. Sequential Modelling: Recurrent and Recursive

Nets, RNN, LSTM, GRU, Image captioning, visual qu estion answering, etc. Visualization and Understanding: Visualizing intermediate features and outputs, Saliency maps, Visualizing neurons, Cam -Grad, etc. Generative Models: VariationalAutoencoders, Generative Adversarial Networks like pix2pix, CycleGAN, et c Deep Reinforcement Learning: Reinforcement Learning (RL) Background, Policy gradients, hard attention Q -Learning Deep Learning Applications: Object Detection: RCNN, Fast RCNN, Faster RCNN, YOLO, Retina Net, SSD, etc. Semantic Segmentation: DeepLabV3, PS P Net, etc. Adversarial Attacks on CNN Recommended Readings Text Books: - 1. Ian Goodfellow and YoshuaBengio and Aaron Courville, “Deep Learning,” MIT Press. 2. Michael A. Nielsen, “Neural Networks and Deep Learning,” Determination Press, 2015. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST815 Course Name : Distributed Systems Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to Distributed Systems, OS and Advanced OS, various distributed systems, Trends in Distributed System and challenges, Networking: network protocols, point -to-point communication. Introduction – Clocks, events and process states – Synchronizing physical clocks - Logical time and logical clocks – Global states,Limitations, Lamport’s logical clock, vector clock, causal ordering, global state, Cuts. Distributed Mutual Exclusion: Lamport, Recart -agrawala, and Maekawa’s algorithms; Suz uki-kasami broadcast algorithm, and Raymond’s tree based algorithm , Elections algorithms , Transactions and Concurrency Control – Transactions -Nested transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic Commit Distributed transactions: two phase commit, three -phase commit, ACID/BASE models Techniques of Inter process Communication: the API for internet protocols – External data representation and Multicast communication, Sun RPC: programming and implementation, Network virtua lization: Overlay networks. Case study: MPI Remote Method Invocation And Objects: Remote Invocation – Introduction – Request -reply protocols – Remote procedure call – Remote method invocation. Case study: Java RMI – Group communication – Publish -subscribe systems – Message queues – Shared memory approaches – Distributed objects – Case study: Enterprise Java Beans -from objects to components. Distributed Deadlock Detection: Resource Vs. Communication deadlock, Replication, Strategies to handle deadlock, Ho -Ramamoorthy, Path -Pushing, Edge -Chasing, Diffusion Computation -based algorithms. Agreement Protocols: System model, Classification of agreement problems, Solutions to Byzantine Agreement (BA) problems.Distributed Scheduling: Issues in Load Distribution, Com ponents of a load distribution algorithm, Load Distribution Algorithms, V -system, Sprite, and Condor. Network file systems: design, NFS, AFS (scale), DFS & CIFS (cache control), CODA (redundancy) Google File System (GFS), Hadoop Distributed File System (HD FS)Distributed Shared Memory: Algorithms for implementing DSMs, Memory Coherence, and Coherence Protocols, IVY Process Management: Process Migration: Features, Mechanism – Threads: Models, Issues, Implementation. Resource Management: Introduction - Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach Recovery: Classification of failures, Synchronous and

Asynchronous Check pointing and Recovery. Fault Tolerance: Commit Protocols, Voting Protocols, Failu re Resilient Processes. Protection and Security: Access Matrix Model, Implementation of access matrix, Unix, and Amoeba. Case study -Distributed systems Recommended Readings Text Books: - 1. Andrew S. Tanenbaum, Maarten Van Steen, “Distributed Systems Pr inciples and Paradigm,” 2nd Edition, Pearson 2. George Coulouris, Jean Dollinmore, Tim Kindberg, Gordon Blair “Distributed Systems - Concepts and Design,” 5th Edition, Pearson 3. M. Singhal& N. Shivaratri, “Advanced Concepts in Operating Systems: Distributed , Database and Multiprocessor Operating Systems”, Tata McGraw Hill, 2015 4. John Bloomer, “Power Programming with RPC,” O’Reilly & Associates, Inc 5. Advanced Programming in the Unix Environment by W. Richard Stevens, Addison -Wesley, 6. Liu M.L., “Distribu ted Computing, Principles and Applications”, Pearson Education, 7. Distributed Systems - An Algorithmic approach by Sukumar Ghosh MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST816 Course Name : E -Commerce Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: knowledge of Digital Market, Basics of Computer Network and security Course Contents Introduction: Definition of Electronic Commerce, tech nology and prospects, incentives for engaging in electronic commerce, needs of E -Commerce, E -Commerce Infrastructure, advantages and disadvantages, Impact of E -commerce on business, E -Commerce Models. Network Infrastructure for E - Commerce. Internet and In tranet based E -commerce: Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication. Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile Information device. Web Security: Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls. Encryption: Encryption techniques, Symmetric Encryption: Keys and data encryption standard, Triple encryption, Secret key encryption; Asymmetric encryption: public and private pair key encryption, Digital Signatures, Virtual Private Network. Customer Service Expectations of the E -commerce Exp erience, Electronic Payments: Overview, The SET protocol, Payment: Smart card, credit card, magnetic strip card, E -Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E- Commerce Law, Forms of Agreement, Govt. policies and Age nda Recommended Readings Text Books: - 1. Turban, “Electronic Commerce 2004: A Managerial Perspective”, Pearson Education 2. Pete Lohsin , John Vacca “Electronic Commerce”, New Age International 3. Bajaj and Nag, “E -Commerce the cutting edge of Business”, TMH 6 4. Laudon, “E -Commerce: Business, Technology, Society”, Pearson Education MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST817 Course Name : Hardware Software Codesign Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Logic System Design/ Digital Logic Design Course Contents Codesign overview, device Modeling and methodologies of system design, Hardware software partitioning and scheduling, Co simulation, synthesis and verifications, Architecture, Interface and reconfiguration, System on chip, Application specific processors (DSP), Codesign tools and case studies Recommended Readings Text Books: - 1. A Practical Introduction to Hardware/Software Codesign, Patrick Schaumont,Springer, 2009, ISBN 978 -1-4419 -5999 -7 2. Specification and Design of Embedded Systems Daniel D. Gajski , Frank Vahid, S. Narayan, & J. Gong, Prentice Hall, 1994 3. Hardware / Software Co -Design: Principles and Practice,JStaunstrup and Wayne Wolf, Prentice Hall, 1994. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Compu ter Science & Engineering Course Code : 21CST818 Course Name : Image Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Image Preliminaries & Image Processing: Overview, Computer imaging systems, Human visual system, image model, etc. Geometric transformations: Translation, rotation, scaling and shearing. Frequency transformation: Discrete Fourier transform (DFT), fast Fourier transform (FFT), short - time Fourier transform (STFT), Multi -resolution Expansions: Wavelet Transforms in 1 -D and 2 - D. The Fast Wavelet Transform Wavelet Packets Transform. Feature Extraction and Dimension Reduction Color, Texture, Shape and structure Features in spatial an d frequency domains, Corner Detection, Hough Transform, Principal Component Analysis, Linear Discriminant Analysis, Feature Reduction in Input and Feature Spaces. Image Segmentation. Gray -level thresholding, Supervised vs. Unsupervised thresholding, Binari zation using Otsu's method, Locally adaptive thresholding, Color -based segmentation, Region oriented segmentation, Use of motion in segmentation, Spatial techniques, Frequency domain techniques. Features Based Image Matching:Scale Space Image Processing, D ifferent Feature descriptors: Key Point Detection, SIFT descriptor SURF descriptor Bag of Visual Words approach, Geometric consistency check, Vocabulary tree Panoramic Imaging, Template Matching, Mono Panorama, Stereo Panorama. Recommended Readings Text Books: - 1. J G Proakis and D G Manolakis, "Digital Signal Processing," Pearson, Fourth edition 2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Prentice Hall, 3rd Edition, 2007. 3. Bishop, Pattern Recognition and Machine Learning 4. Dud a, Pattern Classification MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST819 Course Name : Information Retrieval Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to Information Retrieval: The nature of unstructured and semi -structured text. Inverted index and Boolean queries. Text Indexing, Storage and Compression: Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings, lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n -gram indexes, real -world issues. Retrieval Models: Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and que ry expansion. Rocchio. Performance Evaluation: Evaluating search engines. User happiness, precision, recall, F -measure. Creating test collections: kappa measure, interjudge agreement. Text Categorization and Filtering: Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting. Text Clustering: Clustering versus classification. Partitioning methods. k -means clustering. Mixture of Gaussians model. Hierarchical agglomerative clustering. Clustering terms using documents. Advanced Topics: Summarization, Topic detection and tracking, Personalization, Question answering, Cross language information retrieval. We b Information Retrieval: Hypertext, web crawling, search engines, ranking, link analysis, PageRank, HITS, XML and Semantic web. Recommended Readings Text Books: - 1. Manning, Raghavan and Schutze, Introduction to Information Retrieval, Cambridge University Press. 2. Baeza -Yates and Ribeiro -Neto, Modern Information Retrieval, Addison -Wesley. 3. SoumenChakrabarti, Mining the Web, Morgan -Kaufmann 4. David A. Groosman, Information Retrieval, Algorithm and Heuristics, Springer MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST820 Course Name : Internet of Things Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Networks, Wireless Communication Course Contents Introduction: Internet of Things and Connected Products, IoT paradigm, Smart objects, Goal orientation, Convergence of technologies; Business Aspects of the Internet of Things. Internet and “Things”: Layers, Protocols, Packets, Services, Performance parame ters of a packet network and applications: Web, Peer -to-peer, Sensor networks, and Multimedia. Hardware and Software: Hardware components, Microcontrollers and Software; Operating Systems. Protocols and Platforms -IoT Communication Protocols, Transport Pro tocols, Application Protocols; Cloud computing for IoT. Services and Attributes: Data creation, Data gathering and Data dependency; Robustness, Scaling, Privacy, Security, Trust. Designing & Developing IoT applications: Introduction, IoT Design Methodology , Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages Application: Implications for the society, IoT case study. Recommended Readings Text Books: - 1. The Intern et of Things: Key Applications and Protocols, David Boswarthick, Olivier Hersent, and Omar Elloumi, Wiley 2. Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley. 3. Latest research articles MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST822 Course Name : Natural Language Processing Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Data structures and algorithms, and strong programming skills Course Contents Introduction to NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguit y. The role of machine learning. Brief history of the field. N -gram Language Models. The role of language models. Simple N -gram models. Estimating parameters and smoothing. Evaluating language models. Part Of Speech Tagging and Sequence Labeling Lexical s yntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). Neural Networks and LSTM Introduction to perceptron and backpropagation, LSTM Recurrent Neural Networks Syntactic parsing Grammar formalisms and treebanks. Efficient parsing for context -free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs).

Lexicalized PCFGs. Neural shift -reduce dependency parsing Semantic Analysis Lexical semantics and word -sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing. Information Extraction (IE) Named entity recognition and relation extraction. IE using sequence labeling. Machine Translation (MT) Basic issues in MT. Statistical translation, word alignment, phrase -based translation, and synchronous grammars. Advanced Language Processing Advance language modeling (including LDA), other applications like summarization, question answering Recommended Readings Text Books: - 1. Speech and Language Processing: An Introduction to Natural Language MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST823 Course Name : Nature Inspired Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Programm ing languages, Data structures and Algorithms Course Contents Introduction to Algorithms, Optimization, Search for optimality, computational intelligence, Nature Inspired solutions and characteristic, Nature inspired Metaheuristics and its brief history, Analysis of Optimization Algorithms, Nature Inspired Algorithms, parameter Tuning and control Constrained and unconstrained optimizations, Random Walks and Optimizations, evolutionary strategies and Evolutionary Algorithms (EA), Simulated Annealing (SA) Al gorithm and its behavior, Genetic Algorithms(GA) - genetic operator, parameters, fitness functions, genetic programming and convergence analysis, GA variants, Differential Evolution (DE), various Applications. Swarm Intelligence optimization, Particle Swarm Optimization(PSO) Algorithm, Ant Colony Optimization (ACO) Algorithms, Artificial Bee Colony ACO) optimization algorithms, Cuckoo Search (CS) Algorithms, Intelligent Water Drop Algorithm (IWD), Bat Algorithms(BA), Firefly Algorithms(FA) Framework for self -tuning algorithms, Dealing with constraints, constraints handling, fitness functions ,multi -objective optimization techniques and its applications , Hybrid algorithms, Ways to Hybridize Recommended Readings Text Books: - 1. Nature -Inspired Optimization Algorithms – by Xin -She Yang (Author), June 30, 2016 2. Mathematical Foundations of Nature -Inspired Algorithms, Xin -She Yang, Xing -Shi He, Springer; 1st ed. 2019 edition 3. Nature -Inspired Metaheuristic Algorithms: Second Ed ition, Xin -She Yang, Luniver Press 4. Introduction to Evolutionary Computing, A. E Eiben and J. E. Smith, Second Printing, Springer, 2007 5. Evolutionary Algorithms in Engineering Applications, Editors: DipankarDasgupta and ZbigniewMichalewicz, Springer -Verlag, 1997 6. D. E. Goldberg, Genetic Algorithms in search, Optimization and Machine Learning, Pearson India , 7. Optimization Techniques and Applications with Examples By Xin -She Yan, wiley publisher MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST825 Course Name : Network Performance Modelling Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to Network Modeling: Network modeling, Computer Network as a discrete event system, Modeling and measurement tools, Network performance metrics – first order and second order metrics, Network capacity, Difference between throughput and capacit y Network Calculus: Models for data flows, arrival curves and service curves, Greedy shapers, Basic min -plus and max - plus calculus, min -plus and max -plus systems, Optimal smoothing, FIFO systems and aggregate scheduling, Time varying shapers, Systems with losses, Case studies – (1) Analyzing spanning tree based data forwarding using network calculus, (2) Bound on loss rate Stochastic Scheduling and Resource Allocation: Stochastic scheduling, dynamic resource allocation, Dynamic programming models for stocha stic scheduling, Queuing networks – open loop and closed loop networks, Jackson networks, Network fairness – proportional and max -min fairness, Markov process and its application for analyzing network resource allocation and fairness, available bandwidth e stimation, Case studies – (1) TCP/IP flow and congestion control, (2) Modeling dynamic routing and scheduling as a queuing network problem, (3) Analysis of IEEE 802.11 channel access using two dimensional Markov process. Network Games: Introduction to game theory, Zero sum games, Nash equilibrium, Pareto optimality, Cooperative and Non -cooperative games, General network games – resource sharing games, routing games, congestion games, Mechanism design, Case studies – (1) Selfish routing in networks and price of anarchy, (2) Oblivious routing, (3) Network resource allocation games Protocol Analysis: Modeling discrete event system using petri -nets, basics of petri nets, stochastic petri nets, queuing petri nets, properties of petri nets, structural analysis of petri nets, Petri net modeling tools – simQPN, Case studies – (1) Wireless channel model using stochastic petri net, (2) Data center network throughput analysis using queuing Petri Nets Recommended Readings Text Books: - 1. "Routing, Flow, and Capacity Design in Communication and Computer Networks", Micha■Pióro, DeepankarMedhi, ISBN: 0125571895, Publisher: Morgan Kaufmann 2. The Network Calculus Book by Jean -Yves Le Boudec and Patrick Thiran is available for free download:http://ica1www.epfl.ch/PS_files/ NetCal.htm 3. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" Morgan Kaufman Publishers 4. Dimitri P. Bertsekas and Robert G. Gallager, "Data Networks" : Materials are available at http://web.mit.edu/dimitrib/www/datanets.html 5. "Network Optimization: Continuous and Discrete Models", D. Bertsekas 6. Research Publications - will be discussed and distributed time to time MALAVIYA NATIONAL INSTITUTE OF TE CHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST826 Course Name : Neural Networks Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential. Course Contents Introduction to Neural Architecture, McCulloch -Pitts networks, Learning Rules, Perceptrons, Regression and least mean square algorithm, Multilayer perceptrons, Back propagation: generalized delta rule, limitations, modifications – momentum, variable learning rate, conjugate gradient. Radial -basis function networks, Support vector Machines, Unsupe rvised learning and self-organization, Boltzmann machines and deep networks, Convolutional networks, Recurrent networks, Associative Memories, Adaptive Resonance Theory, Applications of Neural Networks. Recommended Readings Text Books: - 1. Simon Haykin : Neural Networks: A Comprehensive Foundation, Pearson MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST827 Course Name : Parallel Processing &

Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to parallel computing. Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O. The PRAM Shared -Memory Model, Distri buted -Memory or Graph Models, Circuit Model and Physical Realizations PRAM and Basic Algorithms, PRAM Submodels and Assumptions, Data Broadcasting, Semigroup or Fan -In Computation, Parallel reduction, Prefix sums, List ranking, Preorder tree traversal, Mer ging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS. Thread and process level parallel architectures: MIMD, multi -threaded architectures. Distributed and shared memory MIMD architectures. Dyn amic interconnection networks.Mapping and scheduling: Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock. Parallel programming and parallel algori thms: Programming models, parallel programming on multiprocessors and multicomputers. Parallel algorithm structure, analyzing parallel algorithm. Elementary parallel algorithms, Matrix algorithms, sorting, Graph algorithms. Parallel Algorithm Complexity, Asymptotic Complexity, Algorithm Optimality and Efficiency, Complexity Classes, Parallelizable Tasks and the NC Class, Parallel Programming Paradigms, Solving Recurrences Sorting and Selection Network: Design of Sorting Networks, Batcher Sorting Networks , Mesh -Base Architectures: Sorting on a 2D Mesh or Torus, Routing on a 2D Mesh or Torus, Numerical 2D Mesh Algorithms, Low -Diameter Architectures: Hypercubes and Their Algorithms, Sorting and Routing on Hypercubes Recommended Readings Text Books: - 1. J. Jaja, An Introduction to Parallel Algorithms, Addison Wesley, 1992. 2. F. T. Leighton, Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kaufmann Publishers, San Mateo,California,1992 3. BehroozParhami, Introduction t o Parallel Processing, Algorithms and Architecture, kluwer academic publishers,2002ed MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST828 Course Name : Parallelizing Compiler Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic course in Compiler Design Course Contents Introduction – Compilation for parallel machines and automatic detection of parallelism, structure of a parallelizing compiler. Dependence Theory and Practice - Types of dependences, data and control dependencies, dependence analysis, direction vectors, loop carried and loop independent dependences, tests for data dependence and their applicability, con struction of data dependence and control dependence graphs. Parallel Code Generation - Automatic extraction of parallelism, representation of iteration spaces of nested loops, loop based transformations such as loop distribution, loop coalescing, loop int erchange and cycle shrinking transformation. Interprocedural Analysis and Optimization - aliasing information, summary data flow analysis, interprocedural constant propagation, interprocedural data dependence analysis and parallelization of call statement s. Recommended Readings Text Books: - 1. Randy Allen, Ken Kennedy: Optimizing compilers for modern architectures. Morgan Kaufmann 2. Steven Muchnick : Advanced Compiler Design & Implementation, Morgan Kaufmann.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST830 Course Name :Quantum Computing Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Conte nts Introduction to quantum computing, Relevant Linear algebra for quantum computing, Postulates of quantum mechanics, Classical computing, Quantum circuits, Quantum Fourier Transform Quantum search algorithms, Physical realization of quantum computers. Quantu m noise, Quantum operations, quantum information and quantum channel Recommended Readings Text Books: - 1. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press. 3. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific . MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST831 Course Name : Real Time Systems Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction : Definition, Typical Real Time Applications; Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models f or Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency. (7 hours) Real Time Scheduling: Common Approaches to Real Time Scheduling: Clock Driven Approach, W eighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective -Deadline -First (EDF) and Least -Slack -Time -First (LST) Algorithms, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Pri ority Driven and Clock Driven Systems. (8 hours) Resources Access Control: Effect of Resource Contention and Resource Access Control (RAC), Non - preemptive Critical Sections, Basic Priority -Inheritance and Priority -Ceiling Protocols, Stack Based Priority -Ceiling Protocol, Use of Priority -Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple -Unit Resources, Controlling Concurrent Accesses to Data Objects. (8 hours) Multiprocessor System Environment :Multiproces sor and Distributed System Model, Multiprocessor Priority -Ceiling Protocol, Schedulability of Fixed - Priority End -to-End Periodic Tasks, Scheduling Algorithms for End -to-End Periodic Tasks, End - to-End Tasks in Heterogeneous Systems, Predictability and Valid ation of Dynamic Multiprocessor Systems, Scheduling of Tasks with Temporal Distance Constraints. (9 hours) Real Time Communication : Model of Real Time Communication, Soft and Hard RTCommunication systems , Priority -Based Service and Weighted Round -Robin Service Disciplines for Switched Networks, Medium Access Control Protocols forBroadcast Networks, Internet and Resource Reservation Protocols, Real Time Protocols, Communication in Multicomputer System. An Overview of Real Time Operating Systems and Databa ses: Features of RTOS, UNIX as RTOS, POSIX Issues, Temporal Consistency, Concurrency Control. (8 hours) Recommended Readings Text Books: - 1. Real Time Systems: Theory and Practice – Mall Rajib, Pearson Education, 2009 2. Real -Time Systems: Scheduling, Analysis, and

Verification – Albert M. K. Cheng, Wiley, 2002. 3. H. Kopetz, "Real time systems: Design Principles for distributed embedded applications", Springer Publications, 2011. 4. Douglass, Real Time UML: Advances in the UML for Real -Time Systems, 3/ e, Addison - Wesley, 2004. 5. Awad, Kuusela& Ziegler, Object -Oriented Technology for Real Time Systems: A Practical Approach Using OMT and Fusion, l/e, Pearson Education, 1996. 6. Ward & Mellor, Structured Development for Real -Time Systems, Vol. III: Impleme ntation Modeling Techniques, Prentice Hall, 1986. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST832 Course Name : Robotics and Control Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to robotics -origin of automation, Classification of robots, Rotations and translation of vectors, Transformations and Euler angle representations, Homogeneous transformations, Problem s, Trajectory planning, Actuators, Velocity and position sensors. Range, proximity, touch sensors, Control of Robot Manipulators: PD control, Nonlinear Control, Stability, Lyapunov's Direct Method, Adaptive Control, Robot Vision, Image segmentation, Templa te matching, Polyhedral objects, Shape analysis, Grasping and industrial automation Recommended Readings Text Books: - 1. M. Spong, S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control Wiley (2006) 2. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", 3. Craig. J. J. "Introduction to Robotics - mechanics and control", Addison - Wesley, 1999 4. Nagrath Gopal "Co ntrol Systems Engineering -Principles and Design" New Age Publishers 5. K. Ogata, "Modern control engineering", Pearson 2002. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST801 Course Name : 5G TECHNOLOGY Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction and Key Specs of 5G Technologies, Opportunities and Challenges in mmWave MIMO Communication, Channel Models for m mWave MIMO Systems, Hybrid Signal Processing for mmWave MIMO, Digital and AnalogBeamforming, Hybrid RF/ BB Precoder and Combiner Design for mmWave MIMO, Hybrid Transceiver Architectures for mmWave MIMO, Sparse Signal Processing and Channel Estimation for m mWave MIMO, Optimal Design of Beams and Sensing Matrix for Channel Estimation. Overview of Sub 6GHz Multiple Antenna, MIMO and MU-MIMO Technologies, Signal Processing for MIMO Systems, Optimal Power Allocation and Precoding for MIMO, Introduction to 5G Ma ssive MIMO Systems, Key Features of Massive MIMO and Advantages over Point -to-Point and MU -MIMO, Signal Processing Operations for Massive MIMO in UL and DL,Massive MIMO Channel Model – Large/ Small Scale Fading, Properties of Random Vectors and Massive MIMO Analysis, Analysis of Spectral Efficiency in Massive MIMO Systems and Power Scaling, Pilot Design and Channel Estimation in Massive MIMO Systems Transmitter and Receiver Schemes with Imperfect CSI, Spectral Efficiency Analysis of Massive MIMO with Imperf ect CSI, Power Scaling in Massive MIMO with Imperfect CSI and Comparison with Perfect CSI, Multi -Cell Massive MIMO Model, Channel Estimation with Pilot Reuse and Pilot Contamination. New Modulation Schemes for 5G - Spatial Modulation (SM), Space

Shift Keyin g (SSK) and Optimal Receiver, Generalized Spatial Modulation (GSM), Spectral Efficiency Comparison of GSM with Conventional V -BLAST. Introduction to Non - Orthogonal Multiple Access (NOMA) Technology, Efficiency of NOMA wrto Conventional Orthogonal Multiple Access (OMA), Fixed NOMA Protocol for UL/ DL – Performance Analysis, Ordered NOMA Protocol and Performance Analysis, Comparison with Fixed NOMA, Optimal Power Allocation for NOMA Systems Overview of Multicarrier Modulation , Introduction to OFDM and MIMO OFDM Transceiver Design, Motivation for Filter Band Multi Carrier (FBMC) Technology in 5G, System Model for FBMC and Signal Processing, Offset QAM (OQAM) Modulation and Transceiver Design, MIMO -FBMC System – Transmit/ Receive Signal Processing, Introducti on to Full -Duplex Technology, Key Features and Advantages of Full Duplex Systems, Linear/ Non -Linear Self -Interference and Analog, Digital Cancellation Stages Introduction to 5G New Radio (NR) Standard, Introduction to 5G NB -IoT Technology, Overview of LT E- Cat M1 and Cat NB 1 Standards/ Systems 5G advanced concepts : Softwareization, virtualization, NFV, VNFV, 5G Slicing and etc Machine Type Communication(MTC) : Use cases and categorization, MTC Requirements, Fundamental techniques for MTC, Massive MTC, Ultra - reliable low -latency MTC, D2D Communication: from 4G to 5G, Radio resource management for mobile broadband D2D, Multi -hop D2D, communications for proximity and emergency services, Multi -operator D2D communication. 5G Radio Access Technologies: Acce ss design principles for multi -user communications, Multi -carrier with filtering, Non -orthogonal schemes for efficient multiple access, Radio access for dense deployments, Radio access for V2X communication, Radio access for massive machine -type communicat ion. Recommended Readings Text Books: - 1. Asif Osseiran, Jose F.Monserrat and Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016. 2. Jonathan Rodriquez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015 3. Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, “5G System Design – Architectural and Functional Considerations and Long Term Research”, Wiley, 2018 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST834 Course Name : Selected Topics in Operating System Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Operating Systems Course Contents Introduction: I ntroduction and Background, Power of abstractions, Hardware resources, OS Functionalities, Managing the CPU and Memory. OS -Structure: Commercial OS, Monolithic structure, DOS like -structures. SPIN Approach to extensibility, Logical Protection Domains, Customized OS, Mechanism for events. Exokernel and MicroKernel: Approach to extensibility, Default core services in Exokernel, Secure Binding, Memory Management, L3 MicroKernel Approach, Potentials for Performance Loss, Strikes against Microkernel, Address Spa ce Switches, Thread switches and IPC. Virtualization: Introduction, Platform Virtualization, Hypervisors, Full Virtualization, Para Virtualization. Memory Virtualization: Memory Subsystem recall, Shadow page table. VM oblivious page sharing, Memory Allocat ion Policies. CPU Virtualization and Device Virtualization: Control and Data transfer in Action, Disk IO Virtualization Protection & Security: Potential Security violations, External versus Internal Security, Policies and Mechanisms, Protection Domain, Des ign Principles for Secure Systems, Access Matrix Model & its Implementation., Case Studies: Unix Operating system, Hydra Kernel, Amoeba, Andrew. Recommended Readings Text Books: - 1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, 9th Edition, Wiley 2. Virtualization Essentials by Matthew Portnoy, Second Edition 3. Advanced Concepts In Operating Systems by Singhal, Tata McGraw -Hill Education 4. Daniel Bovet and Marco Cesati, Understanding the Linux Kernel, 3rd Edition, O' Reilly Media, 2008. 5. https://in.udacity.com/course/advanced -operating -systems --ud189/ MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST833 Course Name : Selected Topics in Computing Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Programming in C / Python, Operating Systems, Database Management Systems, Computer Networks, Computer Architecture Course Contents Topics will be announced by the Course Instructor at the beginning of the course depending on the emerging and evolving architectures. However, a sample list of topics are given for 2020 -21 as below: Cluster and Grid Computing, Cloud Computing Big Data Ana lytics, Data Science, Data Lakes Internet of Things, 5G and beyond Software Defined Networks, Network Function Virtualization Quantum Computing, Block Chain Recommended Readings Text Books: - 1. Request for Comments, Red Books, White Papers 2. Research Papers on various aspects as decided by the Instructor 3. Lecture Notes of the Instructor 4. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, Addison -Wesley Professional, 2016 5. Kai Hwang, Min Chen, Big -Data Analytics fo r Cloud, IoT and Cognitive Computing, Wiley - Blackwell, 2017 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST835 Course Name : Social Media Mining Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Online Social Networks (OSNs): Introduction - Types of social networks (e.g., Twitter, Facebook), Measurement and Collection of Social Network Data, Social Networks - Basic Structure and Measures, Basics of Text Processing over Social Data, Entity linking and entity resolution for Social data. Characteristics of OSNs: Information Diffusion, Experimental studies over OSNs, Sampling, Fundamentals of Social Data Analytics: Topic Models, Random Walks, Heterogeneous Information Networks Applied Social Data An alytics: Recommendation Systems, Community identification and link prediction. Advanced Topics: Online experiments for Computational Social Science, Big Data Sampling Recommended Readings Text Books: - 1. Matthew A. Russell. Mining the Social Web: Data Mining Facebook, Twitter, Linkedin, Google+, Github, and More, 2nd Edition, O'Reilly Media 2. Jennifer Golbeck, Analyzing the social web, Morgan Kaufmann 3. Charu Aggarwal (ed.), Social Network Data Analytics, Springer 4. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, Social Media Mining An Introduction, Cambridge University Press MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST836 Course Name : Social Network Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Network Models:

Properties of Real -World Networks: Degree Distribution, Clustering Coe■cient, Average Path Length. Random Graphs , Small -World Model, Preferential Attachment Model, Modeling of Real -World Networks using Random Graphs, Small -World Model and Preferential Attachment Model Network Measures: Centrality: Degree Centrality, Eigenvector Centrality, Katz Centrality, PageRank, Centrality, Closeness Centrality, Group Centrality. Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence. Community Analysis: Community Detection, Community Detection Algorithms: Member -Based Community Detection, Group -Based Community Detection. Community Evolution: How Networks Evolve, Community Detection in Evolving Networks. Community Evaluation: Evaluation with Ground Truth, Evaluation without Ground Truth . Recommendation: Classical Recommendation A lgorithms: Content -Based Methods, Collaborative Filtering (CF), Extending Individual Recommendation to Groups of Individuals, Recommendation Using Social Context, Evaluating Recommendations: Evaluating Accuracy of Predictions, Evaluating Relevancy of Recom mendations Graph Representation Learning, Knowledge Graphs and Meta Paths, Graph Convolutional Networks, Link Prediction, Influence Maximization & Outbreak Detection. Recommended Readings Text Books: - 1. Networks, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg. 2. Networks: An introduction by Mark Newman. 3. The Development of Social Network Analysis" by Linton C Freeman 4. Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. Social media mining: an introduction. Cambridge University Press MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST837 Course Name : Software Project Management Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Software Engineering, Computer Programming (C/Java/Python/C++), Microsoft Excel Course Contents Software Project Concepts : Software Project Categorization, Stakeholders, Software project Activities, Practices & Standards, Selecting Process Models (Spiral, Incremental, Prototyping, RAD, Agile). Estimation & Evaluation techniques,Cost Benefit Analysis, Risk Analysis for Projec t Evaluation, Program management, Project effort and cost estimation; Basis of estimation, Estimation method categorization, SLOC, Function Point Analysis, COCOMO, Putnam's work. Estimation using FP. Project Planning: Stepwise planning, Activity based appr oach (WBS), Sequencing and Scheduling of Activities, Critical Path Method. Risk Analysis and Management: Risk Identification, Projection, Risk Identification, Projection, Risk Refinement, Risk Monitoring and Management Schedule and Cost Monitoring: Collect ing Data & Reporting, Graphical Visualization techniques, Cost Monitoring, Earned Value analysis, Requirements management, Change Control. Contract Management: Types of Contracts, Stages in Contract Placement, Typical Terms of a Contract, Contract Manageme nt and Acceptance. Software Configuration Management (SCM), SCM Tools, Project Reviews Testing and Software Reliability, Metrics, ISO and CMMI, Project Scheduling & Tracking, Software Quality Assurance, Software Configuration Management Recommended Rea dings Text Books: - 1. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", 6th Edition, Tata McGraw Hill, 2017. 2. PankajJalote, Software Project Management in Practice. 3. Roger S. Pressman, Software Engineering 4. Royce, “Software Proj ect Management”, Pearson Education, 1999. 5. Robert K. Wysocki, Effective Software Project Management, Wiley, 2009. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST838 Course Name : Software Testing and Validation Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Software engineering, basic computer programming skills Course Contents Testing Environment and Test Processes: Software Testing Environment, Overview of Software Testing Process, Organizing for Testing, Developing the Test Plan, Verification Testing, Analyzing and Reporting Test Results, Acceptance Testing. Levels of Testing, Unit Testing, Integration Testing, Defect Bash Elimination. System Testing, Usability and Accessibility Testing, Configuration Testing, Compatibility Testing. Functional and Non -functional system testing, Compliance Testing, Load Testing, Performance Tes ting and Security Testing. Static and dynamic testing, Black -box or functional testing, Equivalence partitioning, BVA, structural, White box or glass box testing, Mutation Testing, Data flow testing. Test Automation: Software Testing Tools, Software Test A utomation, Debugging, Case study. Recommended Readings Text Books: - 1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education 2. A.P. Mathur, Foundations of Software Testing, Pearson publications 3. NareshChauhan , “Software Testing Principles and Practices ” Oxford University Press , New Delhi . 4. Ilene Burnstein, “ Practical Software Testing”, Springer International Edition. 5. RenuRajani, Pradeep Oak, “Software Testing – Effective Methods, Tools an d Techniques”, Tata McGraw Hill. 6. William Perry, “Effective Methods of Software Testing”, Third Edition, Wiley Publishing MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21C ST840 Course Name : VLSI Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Logic synthesis & verification: Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High -level synthesis. VLSI Algorithms Partitioning: Problem formulation, classification of partitioning algorithms, Group migration algorithms, simul ated annealing & evolution, other partitioning algorithms. Placement, floor planning & pin assignment: Problem formulation, simulation base placement algorithms, other placement algorithms, constraint -based floorplanning, floor planning algorithms for mixe d block & cell design. General & channel pin assignment. Global Routing: Problem formulation, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches. Detailed routing: problem formulation, classification of routing algorithms, single layer routing algorithms, two -layer channel routing algorithms, three -layer channel routing algorithms, and switchbox routing algorithms. Over the cell routing & via minimization: two layers over the cell routers, constrained & unconstrained via minimization Compaction: problem formulation, one -dimensional compaction, two dimension -based compaction, hierarchical compaction. Recommended Readings Text Books: - 1. NaveedSherwani, “Algorithms for VLSI Physical Design Automation”, 3rd Edition, 2005, Springer International Edition 2. S.H. Gerez, “Algorithms for VLSI Design Automation”, 1999, WILEY Student Edition, John

Wiley & Sons (Asia) Pvt. Ltd. 3. ChristophMeine l& Thorsten Theobold, “Algorithms and Data Structures for VLSI Design”, KAP, 2002. 4. Rolf Drechsheler : “Evolutionary Algorithm for VLSI”, Second edition MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Scienc e & Engineering Course Code : 21CST841 Course Name : Wireless Sensor Networks Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction: Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor n etworks, unique constraints and challenges, advantages of adhoc/sensor network, driving applications, issues in adhoc wireless networks/sensor network, data dissemination and gathering, Historical Survey of Sensor Networks Basic Architectural Framework:Tra ditional layered stack, Cross -layer designs, Sensor network architecture, Physical Layer, Basic Components, Hardware Platforms: Motes, Sensor Devices, Types of Sensors, Sensor's Specification MAC Protocols : Fundamentals of MAC protocols - Low duty cycle p rotocols and wakeup concepts - Contention Based protocols - Schedule -based protocols - SMAC - BMAC - Traffic -adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol. Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table -driven, on -demand, hybrid, flooding, hierarchical, and power aware routing protocols. Sensor network security: Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks. Programming in WSNs: Challenges and limitation s of programming WSNs, Introduction to TinyOS, -Programming in Tiny OS using NesC, Emulator TOSSIM, Open research issues Recommended Readings Text Books: - 1. Feng Zhao, Leonidas Guibas, “ Wireless Sensor Network”, Elsevier, 1st Ed. 2004 (ISBN: 13 - 978-1-55860 -914-3) 2. Kazem, Sohraby, Daniel Minoli, TaiebZnati, “Wireless Sensor Network: Technology, Protocols and Application”, John Wiley and Sons 1st Ed., 2007 (ISBN: 978 -0-471-74300 -2). 3. Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, “Wire less Sensor Network”, Springer 1st Ed. 2004 (ISBN: 978 -4020 -7883 -5). 4. E. H. Callaway, Jr. E. H. Callaway, Wireless Sensor Networks Architecture and Protocols:, CRC Press , 2009 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST821 Course Name : Machine Learning Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic understanding of probability and statistics, linear algebra an d calculus. A basic knowledge of programming (preferably Python) is essential. Course Contents Advanced linear Algebra (e.g., SVD). The learning problem – learning versus design, types of learning - supervised, unsupervised, reinforcement and other views o f learning.LinearModeling: A least squares approach, linear modeling, making predictions, vector/matrix notation, linear regression, nonlinear response from a linear modelz. Generalization and over -fitting. The Bayesian approach to machine learning: exact posterior, marginal likelihoods Probability based learning: Bayes theorem, Bayesian prediction, conditional independence and factorization, the Naive Bayes model.Error based learning: simple linear regression, multi variable linear regression with gradient descent Logistic regression – gradient descent, non linear transformations the Z space. Similarity based learning: nearest neighbor, k - nearest neighbors, efficient distance computations: the KD trees Information based learning: learning and trees, Classi fication and regression trees. Ensemble methods, Boosting, Bagging, Random forests. Neural networks – the perceptron, Multilayer perceptron, activation functions, gradient descent, deriving back propagation. Multi -task and transfer learning, Deep -learning. Linear discriminant analysis (LDA), Principal component analysis (PCA)SVM - optimal separation, the margin and support vectors, a constrained optimization problem, kernels – polynomial, radial basis, sigmoid Performance Measures and Evaluation – for categ orical targets, prediction scores, multinomial targets, continuous targets. Clustering – the general problem, hierarchical and partitional clustering, K -means clustering. Recommended Readings Text Books: - 1. Learning from Data, Yaser S Abu -Mostafa, AML books 2. Machine learning, Marsland, CRC press 3. An Introduction to Machine Learning, KubatMiroslav, Springer 4. Fundamentals of Machine Learning for predictive data analytics, John D Kelleher, MIT Press MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST829 Course Name : Pattern Recognition Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: An undergraduate level understanding of probability, statistics and linear algebra is assumed. A basic knowledge of Python is essential. Course Contents The classification process: features, training and learning, approaches to classification Non metric methods: Information, Entropy and Impurity, decision tree classifier - ID3, C4.5. Discriminant functions: linear discriminant functions, piece -wise linear discriminant functions, generalized discriminant functions. Statistical pattern recognition: measured data and measurement errors, probability theory, conditional probability and Bayes rule, Naive Bayes classifier, Continuous random variables, The multiva riate Gaussian, Covariance matrix and MahalanobisdistanceParametric learning: Bayesian decision theory, discriminant functions and decision boundaries, MAP (Maximum A Posteriori Estimator)Non Parametric learning: Histogram estimator and Parzen windows, k -NN classification, Artificial Neural Networks, Kernel Machines, SVM. Feature extraction and selection: reducing dimensionality, feature selection - Inter/Intra class distance, Feature extraction: Principal component analysis, Linear discriminant analysis.Un supervised learning: Clustering, K - Means clustering, Fuzzy c -Means clustering, (Agglomerative) Hierarchical clustering Estimating and Comparing Classifiers: No free lunch, Bias and variance trade -off, cross -validation and resampling methods, Measuring cl assifier performance, Comparing classifiers - ROC curves, McNemar's test, other statistical tests Recommended Readings Text Books: - 1. Pattern Classification, Duda Hart, Wiley 2. Pattern Recognition and Classification, Geoff Dougherty, Springer 3. Statis tical Pattern Recognition, Andrew R Webb, Wiley 4. Pattern Recognition and Machine Learning, Christopher Bishop, Springer 5. Pattern Recognition and Image Analysis, Earl Gose, Johnsonbaugh, PHI MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department /Centre : Department of Computer Science & Engineering Course Code : 21CST805 Course Name : Big Data Analytics Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Overview of Database Management Systems, Introduction to Big Data, Introduction to distributed file system, Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics. Apache Hadoop & Hadoop Eco -System, Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data S erialization. Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, Name -Node, Secondary Name -Node, and Data -Node, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup, SSH & Hadoop Configuration – HDFS Administering, Monitoring & Maintenance. Pig, Pig Latin Language, Hive Introduction, Hive queries. Spark Introduction. Cassandra CQL query language and CQL data model: Key space, Table definition, Column, and Data Types. Mongo DB Cluster analysis, K -means algorithm, Naïve Bayes, Parallel k -means using Hadoop, parallel particle swarm algorithm using MapReduce, case studies on big data mining. Parallel swarm Intelligence. Recommended Readings Text Books: - 1. Dan Sulliva ,NoSQL for Mere Mortals 1st Edition., Pearson Publishers, 2014 2. Pramod J. Sadalage, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition, Pearson Publishers,ISBN -13: 978-0321826626, 2017. 3. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies (The MIT Press) 4. John D. Kelleher, Brendan Tierney, Data Science (MIT Press Essential Knowl edge series). MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST811 Course Name : Data Visualization Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Modern Visualisation tools and techniques, Create multiple versions of digital visualizations using various software packages; Identify appropriate data visualization techniques given particular requirements imposed by the data; App ly appropriate design principles in the creation of presentations and visualizations; Analyse, critique, and revise data visualizations Information overload and issues in decision making Design of visual encoding schemes to improve comprehension of data and their use in decision making Use of Tableau - Data visualization tool for data analysts, scientists, statisticians, etc. to visualize the data and get a clear opinion based on the data analysis, Comparing classifiers - ROC curves, McNemar's test, other statistical tests. Recommended Readings Text Books: - 1. A first course Sosulski, K. (2018). Data Visualization Made Simple: Insights into Becoming Visual. New York: Routledge. 2. The Visual Display of Quantitative Information (2nd Edition). E. Tufte. G raphics Press, 2001. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST839 Course Name : System on Chip Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Transaction -Level Modeling& Electronic System -Level Languages, Hardware Accelerators, Media Instructions, Co -processors, System -Level Design Methodology ,High -Level Synthesis (C - to-RTL), Hardware Synthesis and Architect ure Techniques Source -Level Optimizations. Scheduling Resource, Binding and Sharing. Recommended Readings Text Books: - 1. De Micheli, editor Special Issue on Hardware/Software Co -design Proceedings of IEEE, Vol 85, No. 3, March 1997 2. D. D. Gajski, F. Vahid, S. Narayan, J. Gong :Specification and Design of Embedded Systems, Prentice Hall, Englewood Cliffs, NJ, 1994 3. J. Staunstrup and W. Wolf, editors: Hardware/Software Co -Design: Principles and Practice Kluwer Academic Publishers, 1997 4. G. DeMichel i, R. Ernst, and W. Wolf, editors, Readings in Hardware/Software Co -Design, Academic Press, 2002. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSL760 Course Name : Pro gram Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to analysis tools: debugging, disassembly, emulators, virtualization Introduction: Program Representation, Syntactic Analysis, Program Semantics, Static and dynamic analysis, Syntactic Analysis, Dataflow Analysis and Abstract Interpretation , Interprocedural analysis, Context -sensitive, Pointer analysis, Call Graph Construction, slicing and profiling, Control Flow Analysis, Dynamic Analysis for Data Race Detection Model Checking, Symbolic execution, Program Repair, Hoare Logic, SMT solver s Recommended Readings Text Books: - 1. Pierce, Benjamin C. Types and Programming Languages. MIT Press, 2002. 2. Winskel, Glynn. The Formal Semantics of Programming Languages: An Introduction. MIT Press, 1993. 3. Nielson, Nielson, and Hankin. Principles of Program Analysis. Springer, 2010. 4. Baier, and Katoen. Principles of Model Checking. MIT Press, 2008. 5. Chlipala, Adam. Certified Programming with Dependent Types: A Pragmatic Introduction to the Coq Proof Assistant. MIT Press, 2013. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR DEPARTMENT of Computer Science and Engineering M.Tech. Computer Science and Information Security Semester. I S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CST523 Cryptography PC Theory 3 3 0 0 2 21CST521 Advanced Data Structures and Algorithms PC Theory 3 3 0 0 3. 21CST522 Computer and Network Security PC Theory 4 3 0 2 4. 21CST854 Department Elective – 1 PE Theory 3 3 0 0 5. 21CST855 Department Elective – 2 PE Theory 3 3 0 0 6. 21CSP524 Programming Lab -1 PC Lab 2 0 1 2 Total 18 Semester. II S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CST526 Research Methodology PC Theory 2 2 0 0 2 21CST872 Department Elective – 3 PE Theory 3 3 0 0 3. 21CST873 Department Elective – 4 PE Theory 3 3 0 0 4. 21CST874 Department Elective – 5 PE Theory 3 3 0 0 5. 21CST875 Department Elective – 6 PE Theory 3 3 0 0 6. 21CSP525 Design Lab PC Lab 2 0 1 2 7. 21CSP527 Security Tools Lab PC Lab 2 0 1 2 Total 18 Semester. III S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CSS623 Technical Documentation and Presentation PC --- 2 0 1 2 2 21CSP622 Literature Review PC --- 2 0 1 2 3. 21CSD621 Dissertation – 1 PC --- 8 0 0 16 Total 12 Semester. IV S.No. Course Code Course Title Course Category Type Credit L T P 1. 21CSD624 Dissertation – 2 PC --- 12 0 0 24 Total 12 Total Credits: 60 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST523 Course Name : Cryptography Credits : 3 L - 3 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents Number theory: Prime numbers, GCD, Euclidean Algorithm, Extended Euclidean Algorithm, Fermat's theorem, Euler's theorem, Chinese remainder theorem, Discrete logarithms, Primality testing algorithms, Probability, Bays

Theorem. Introduction to Information s ecurity and cryptography, Basic terminology and concepts, Classical Cryptographic techniques and their cryptanalysis, Shannon perfect secrecy, One Time Pad, Pseudo random generators, Semantic security, indistinguishability based Security. Stream ciphers a nd RC4, Various types of attacks, Chosen -Plaintext Attack. Chosen -Ciphertext Attack etc. Block Ciphers: Data Encryption Standard (DES), Advanced Encryption Standard (AES), DES attacks, Modes of operations One -way function, trapdoor one -way function, Publi c key cryptography, RSA cryptosystem, Diffie -Hellman key exchange algorithm, ElGamal Cryptosystem Cryptographic hash functions, secure hash algorithm, Message authentication, digital signature, RSA digital signature. Recommended Readings Text Books: - 1. William Stallings, Cryptography and Network Security: Principles and Practice, Prentice Hall 2. Douglas R. Stinson, Cryptography: Theory and Practice, Chapman and Hall 3. J. Katz and Y. Lindell, Introduction to Modern Cryptography, CRC press 4. N. Koblit z, Number Theory and Cryptography, Springer, 2001 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST521 Course Name : Advanced Data Structures and Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis, Recurrence equations. Advanced Data Structures: B -Trees, Binomial Heaps, Fibonacci Heaps, AVL trees, Red -black trees, B -trees, Splay trees, Interval trees; D isjoint set – union and path compression, Amortized analysis. Greedy Algorithms: shortest distance, minimum spanning tree, interval scheduling, interval partitioning; Divide and Conquer: sorting, integer and polynomial multiplication; Dynamic programming: Longest common subsequence. Chain of matrix multiplication, sequence alignment, Bellman Ford. Convex hull and Voronoi diagrams, line segments, Optimal polygon triangulation; Primality testing, Integer factorization; Graph algorithms: Matching and Flows; Parallel algorithms: Basic techniques for sorting, searching, merging. Intractability: Independent Set, Vertex Cover Randomized algorithms, Probabilistic algorithms. Approximate Algorithms: Vertex -cover, set -covering problems, Travelling Salesman problem. N Complexity classes - NP-Hard and NP -complete Problems - Cook's theorem NP completeness reductions, undecidability. Recommended Readings Text Books: - 1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India. 2. AhoA.V , J.D Ulm an: Design and analysis of Algorithms, Addison Wesley 3. Brassard : Fundamental of Algorithmics, PHI 4. Sara Baase: Computer Algorithms: Introduction to Design and Analysis, Pearson Education. 5. Papadimitriou, Steiglitz: Combinatorial Optimization: Algori thms and Complexity, PHI. 6. Motwani and Raghavan: Randomized Algorithms, Cambridge University Press 7. Vaizirani: Approximation Algorithms, Springer Verlag 8. Joseph Ja'Ja': Introduction to Parallel Algorithms, Addison -Wesley 9. Kleinberg, Tardos: Algorit hm Design, Addison Wesley. 10. Dexter Kozen: The Design and Analysis of Algorithms. Springer, 1992. 11. SanjoyDasgupta, Christos Papadimitriou, and UmeshVazirani: Algorithms, McGraw Hill. 12. Robert Sedgewick and Kevin Wayne. Algorithms 4/e. Addison -Wesle y. 13. Robert Tarjan: Data Structures and Network Algorithms, Society for Industrial and Applied Mathematics. MALAVIYA

NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST522 Course Name : Computer and Network Security Credits : 4 L - 3 T - 0 P - 2 Course Type : Core Prerequisites: None Course Contents Introduction (a) Security(b) Malware(c) OWASP top ten and other major security issues in the world(d) CVE and other information(e) Introduce various type of security areas Software and OS Security: Common Bugs, Buffer Overflow, Runtime Defences against memory safety vulnerabilities, program verification and other vulnerabilities, Principles in OS Security; Mechanisms for confining bad code, Mechanisms for confining bad code : isolation, sandboxing, SFI and Virtualization, Trusted Computing Network and Web Security: Secure web site design (SQL injection, XSS, etc.), Browser Security, Security problems in network protocols: TCP/IP, DDoS Attacks, Network worms and bot -nets: attacks and defences, DNS and BGP security, Network defence tools – Firewall and In trusion Detection. Future Networks Security: Introduction - The Security in Existing wireless Networks, Upcoming wireless networks and challenges, Thwarting and malicious behaviour – Naming and addressing, security association and secure neighbour discover y, secure routing in multichip wireless networks and privacy protection. Mobile OS Security and Privacy: Android, IOS security challenges, processor security, privacy, anonymity and censorship and other security issues according to the current situations a nd future requirements Recommended Readings Text Books: - 1. Security in Computing (3rd edition) 2. Research publications on security MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP524 Course Name : Programming Lab 1 Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: Programming skills required Course Contents Programming exercises and experiments in Computer Networks and Security. a. Experiments on LAN Trainer Kit: Performance study of data link layer protocols, implementation and testing Network Layer routing protocols, understanding the steps involved in RC4 algorithm encryption b. Programming exercises using sockets c. Design and implementation of a Data Sniffer Programming exercises and experiments in Advanced Data Structures a. Primality testing b. Recursive algorithms c. Sorting algorithms d. Heaps, priority queues, and binary search trees e. Red-black trees f. Graph based algorithms g. String matching algorithms Programming on advanced data structures by choosing the right data representation formats based on the requirements of the problem and selecting the right algorithmic paradigm (such as greedy, dynamic programming, divide a nd conquer etc.). Implement the basic cryptographic algorithms: a. Euclidean and Extended Euclidean algorithm for finding the Greatest Common Divisor of two large integers. b. Chinese remainder theorem. c. Modular polynomial arithmetic d. Diffie - Hellman Key exchange protocol Implement the advanced cryptographic algorithms: Congruence of squares. Finding a congruence of squares modulo n to factor n. Construction of Finite Field of characteristic 2. Computations in elliptic curve over a finite field Recommended Readings Text Books: - 1. Menezes, P.C. van Oorschot, S.A. Vanstone: Handbook of Applied Cryptography: CRC Press, 1996. 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, “Introduction to Algorithms (3rd Edition)”, T. Publisher: MIT Press. 3. Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2008. 4. Abhijit Das and C.E.VeniM adhavan, Public -key Cryptography: Theory and Practice, Pearson, 2009.Bottom of Form 5. Introduction to Modern Cryptography, Jonathan Katz and Yehuda Lindell. 6. LAN Trainer user Manual MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST526 Course Name : Research Methodology Credits : 2 L - 2 T - 0 P - 0 Course Type : Core Prerequisites: None Course Contents Unit I: Data Structures and Algorithms: Review of Data Structures , and most commonly used algorithms in Computer Science and Engineering – Sorting, DFS/BFS, and Pattern Searching. Unit II: Linear Algebra: Vectors - linear vector spaces, linear independence, norms and inner products, Basis and dimension, Matrices, Matri x operations, Inverse of a matrix Orthogonalization, Properties of determinants, Eigenvalues and eigenvectors, SVD and pseudo inverse, KL or hotelling transform. Unit III: Transforms Signals and representation, Convolution, Frequency Transforms, Propertie s of Fourier Transform, DFT, DCT and FFT, Introduction to wavelets, applications in Computer Science and Engineering Unit III: Probability and Statistics Statistics: Introduction to statistical analysis, hypothesis testing – null and alternate, statistic al tests – chi-square, ANOVA, data validation Probability models and axioms, Bayes’ rule, discrete and continuous random variables, Probability distributions: normal distribution and properties, conditional, marginal and joint probability distribution, PR NG (pseudo random number generators) - randomness tests, introduction to information theory and cryptography: an Introduction Unit IV: Machine Learning: Linear and non -linear regression, supervised learning – neural network, binary decision diagram, SVM, k -NN, unsupervised learning – Clustering, Hidden Markov Models, Introduction to deep learning. Unit V: Case Studies in Research Domains of CSE. Recommended Readings Text Books: - 1. Gilbert Strang: Linear Algebra, MIT Cambridge Press. 2. Sheldon Ross: Fi rst Course in Probability, Pearson. 3. Mark Girolami, Simon Rogers: First Course In Machine Learning, CRC Press. 4. Anirban Das Gupta: Probability and Statistics for Machine Learning, Springer. 5. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, second ed, Springer 6. Ian Goodfellow: Deeplearning, MIT Cambridge Press. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP525 Course Name : Design Lab Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: Students must have prior programming experience in C/C++ or any language; mathematics through differential equations, and numerical analysis Course Contents Operating Systems and Unix Enviro nments: features of UNIX/Linux for scientific and technical computing; languages, compilers, debuggers, performance tools, make files, build systems, shell scripting, file management, source code control. Research Documentation and Simple Data Visualizatio n: tools for generating research and code documentation: LATEX, Doxygen, plotting tools. Software Best Practices: software design cycle, regression testing, defensive programming, verification, code coverage Scientific Libraries: availability of common ma th libraries and usage for scientific computing. High performance Computing (HPC): Tool and techniques operating Systems and Unix Environments: features of UNIX/Linux for scientific and technical computing; languages, compilers, debuggers, performance tool s, make files, build systems, shell scripting, file management, source code control. Research Documentation and Simple Data Visualization: tools for generating research and code documentation: LATEX, Doxygen, plotting tools. Software Best Practices: softwa re design cycle, regression testing, defensive programming, verification, code coverage Scientific Libraries: availability of common math libraries and usage for scientific computing. High performance Computing (HPC): Tool and techniques. Recommended R eadings Text Books: - 1. Eric S. Raymond, The Art of Unix Programming, Addison -Wesley 2003. 2. Heister, T. and Rebholz, L. G., Introduction to Scientific Computing for Scientists and Engineers. De Gruyter Press, 2015. 3. John Levesque, High Performance Com puting: Programming and Applications MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CSP527 Course Name : Security Tools Lab Credits : 2 L - 0 T - 1 P - 2 Course Type : Core Prerequisites: NIL Course Contents Etherreal/ Wireshark real time network analyzer, packet sniffing techniques ,TCPDump, Safety control using Metasploit , Vulnerability assessment using Nessus tool, Intrusion detection using Snort, Wireless safety tools, Network tracking using Nagios, Kali Linux tools, Hardware and software security tools Recommended Readings Text Books: - 1. On line resources Electives Courses for CS -IS 1. 21CST802 Advanced Computer Networks 2. 21CST804 Android Programming 3. 21CST848 Biometrics 4. 21CST850 Cloud Security 5. 21CST851 Cyber Security 6. 21CST852 Data Compression 7. 21CST853 Deep Learning 8. 21CST856 Digital Forensics 9. 21CST857 Embedded System Security 10. 21CST858 Internet of Things 11. 21CST871 Wireless Security 12. 21CST859 Intrusion Detection 13. 21CST861 Nature Inspired Algorithms 14. 21CST862 Network Performance Modelling 15. 21CST863 Pattern Recognition 16. 21CIL736 Program Analysis 17. 21CST864 Public Key Infrastructure and Trust Management 18. 21CST865 Quantum Cryptography 19. 21CST866 Security Analysis of Protocols 20. 21CST821 Machine Learning 21. 21CST867 Selected Topics in Cryptography 22. 21CST868 Social Network Analysis 23. 21CST869 Software Testing and Validation 24. 21CST870 VLSI Algorithms 25. 21CST849 Blockchain Technologies MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST802 Course Name : Advanced Computer Networks Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Wireless networking: a. Bluetooth, 802.11 standards b. Information theory, bandwidth, multiple access c. Wireless Terahertz Networks d. 5G and 6G communication e. Intelligent Transportation Systems Emerging networking technologies: a. Host configuration and service discovery principles b. Future routing architectures c. IPv6 deployment scenarios and challenges, IPv6 transition/integration d. Advanced IP multicast, including IPv6 multicast and SSM e. Software -defined networki ng f. Delay -tolerant networking g. Future home network architectures h. IP network management and monitoring i. Social Networks Recommended Readings Text Books: - 1. Tanenbaum A S and Wetherall D J (2010). Computer Networks. 2. Hagen S, (2006). IPv6 Essentials. 3. Recent publications on the relevant fields MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre :

Department of Computer Science & Engineering Course Code : 21CST804 Course Name : Android Programming Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Basics: Review of Java Programming, Setting up and configuring Android Studio setup, Android EmulatorHello Android example, Android Manifest.xml, R.java file, Activity, Fragment, Layout Manager - Relative Layout, Linear Layout, Table Layout, Grid Layout A ctivity, Intent & Fragment: Activity Lifecycle, Activity Example, Intent – implicit and explicit, Intent filters, Fragment Lifecycle, Fragment Example, UI Widgets – buttons (toggle, switch, image), check box; Android Menu: Option Menu, Context Menu, Popup Menu; View Android Service: lifecycle, example, Data Storage, Shared Preference, SQLite, Content Provider, Android Notification Adding functionality: Multimedia API, Speech API, telephony API, Location API Sensors: Sensor API, Working with WiFi, Working with Camera, Motion Sensor, Position Sensor; Android Graphics App development project Recommended Readings Text Books: - 1. Official Android Website MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST848 Course Name : Biometrics Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: A basic knowledge of statistics, linear algebra, and programming is expected. Course Contents Introduction: Person recognit ion, Biometric systems, Biometric functionalities, biometrics system errors, the design cycle of biometric systems. Fingerprint recognition: friction ridge patterns, fingerprint acquisition, feature extraction and matching, palm prints. Face recognition: image acquisitions, face detection, feature extraction and matching, handling pose, illumination and expression variations Iris recognition: image acquisition, Iris segmentation, Iris normalization, Iris encoding and matching, Iris quality assessment tec hniques Additional Biometric Traits: Ear, Gait, Hand geometry, Soft biometrics Multibiometrics: sources of multiple evidence, fusion levels: sensor, feature, score, rank and decision level fusion. Security of biometric systems: adversary attacks, attack s at user interface, attacks on biometric processing, attacks on template database. Recommended Readings Text Books: - 1. Introduction to Biometrics, Anil K Jain Arun Ross, Springer 2. The Science of Biometrics, Ravindra Das, Springer 3. Practical Biometrics, Julian Ashbourn, Springer MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST850 Course Name : Cloud Security Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Computer Networks, Operating System Course Contents Introduction of Cloud Computing: Taxonomy and related technologies, Essential Characteristics, Service and Deployment Models. Virtualization: Types of Virtualizati on and Hypervisors, Virtualization at Storage, Compute and Network, Hypervisors (Types and Case studies), Virtual Machine Provisioning, Virtual Machine Migration. Architectures:Standards, Orchestration, Provisioning, Portability, Interoperability, Federate d Cloud, Security: CIA Triad, Vulnerabilities in Cloud, Threats to Infrastructure, Data and Access Control;Identity Management; Multi Tenancy Issues; Attack taxonomy; Intrusion Detection, VM Specific attacks, VM Introspection, Management; Trusted Cloud I nitiative of Cloud Security Alliance (CSA). Forensics: NIST Forensics Reference Architecture, Forensic Science Challenges, Architectural

Issues, Evidence Collection and Analysis, Anti -Forensics, Incident Response, Standards and Framework Recommended Rea dings Text Books: - 1. K. Hwang, G. C. Fox, and J. Dongarra, Distributed and Cloud Computing, 1st ed.: Morgan Kaufmann, 2011 2. R. Buyya, J. Broberg, and A. M. Goscinski, Cloud Computing: Principles and Paradigms: Wiley -Blackwell, 2011 3. S. Dinkar and G. Manjunath, Moving to the Cloud: Developing Apps in the New World of Cloud Computing Syngress Media, U.S., 2012. 4. W. Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, 1st ed.: Addison -Wesley Professional, 2015. 5. T. Erl, Z. Mahm ood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture: Prentice Hall/PearsonPTR, 2014. 6. R. L. Krutz and R. D. Vines, Cloud Security - A Comprehensive Guide to Secure Cloud Computing, Wiley Publishing, 2010 7. T. Mather, S. Kumaraswamy, and S. Latif, Cloud Security and Privacy - An Enterprise Perspective on Risks and Compliance, O Reilley Publishers, 2009. 8. V. (J. R.) Winkler, G. Speake, P. Foxhoven, Securing the Cloud: Cloud Computer Security Techniques an d Tactics, Syngress, 2011. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST851 Course Name : Cyber Security Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: NIL Course Contents Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats, Need for a Comprehensive Cyber Security Policy. Cyber Security Safeguards (Overview): Access control, Audit, Authentication, B iometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management. Network Security & Web Security: Security Issues in TCP/IP, which includes TCP, DNS, Routing (basic problems of security in TCP/IP, IPsec, BGP Security, DNS Cache poisoning, etc), Network Defense tools such as Firewalls, Filtering, DNSSec, NSec3, Distributed Firewalls, Web Application Security: Cross -Site Scripting Attacks, Cross -Site Request Forgery, SQL Injection Attacks Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti - Malware software, Network based Intrusion detection Systems, N etwork based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation. Cyber Forensics: Introduction to Cyber Forensics, Handling Preliminary Investigatio ns, Controlling an Investigation, Conducting disk - based analysis, Investigating Information -hiding, Scrutinizing E -mail, Validating Email header information, Tracing Internet access, Tracing memory in real -time. Security in Mobile Platforms: Android vs. ioS security model, threat models, information tracking, rootkits, Threats in mobile applications, analyzer for mobile apps to discover security vulnerabilities, Viruses, Spywares, and keyloggers and malware detection. Cyberspace and the Law Recommended Readings Text Books: - 1. Latest research papers, journals and articles 2. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and SunitBelapure. 3. Cybersecurity Essentials By Charles J. Brooks, Christoph er Grow, Philip Craig, Donald Short · 2018 4. Cybersecurity: Attack and Defense Strategies: Infrastructure Security with Red Team and Blue Team

TacticsBook by ErdalOzkaya and Yuri Diogenes MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Cent re : Department of Computer Science & Engineering Course Code : 21CST852 Course Name : Data Compression Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Object Oriented Analysis and Design Course Contents Introduction: Compression techniques, lossless compression, lossy compression, measures of performance, modeling and coding. Mathematical preliminaries - Overview, introduction to information theory, models, physical models, probability models, Markov mode ls. Basic Coding Schemes: Statistical Methods - Shannon -Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding. Arithmetic Coding (Encoding, Decoding, Adaptive Coding). Dictionary Methods - LZ77, LZ78, LZW Algorithms. Case study of lossless compressio n standards. Lossless Compression standards: zip, gzip, bzip, unix compress, GIF, JBIG. Image and Video Compression: Discrete Cosine Transform, JPEG. Wavelet Methods - Discrete Wavelet Transform, JPEG 2000. Motion Compensation, Temporal and Spatial Predi ction. MPEG and H.264. Audio Compression: Digital Audio, WAVE, FLAC, MPEG -1/2 Audio Layers. Recommended Readings Text Books: - 1. Khalid Sayood. 2012. Introduction to Data Compression (4th ed.). Elsevier. 2. David Salomon, Giovanni Motta. 2010. Handbook of Data Compression. Springer, London. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST853 Course Name : Deep Learning Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Course Overview: Introduction to Deep Learning and its Applications. Introduction to Statistical Learning: Multi -Layer Perceptron, Back Propagation, Linear Regres sion, etc.Convolutional Neural Networks: Convolution, pooling, Activation Functions, Back propagation of CNN, Weights as templates, Translation invariance, Training with shared parameters.CNN Architecture Design and Discussion: AlexNet, VGG, GoogLeNet, Res Net, Capsule Net, etc. Loss Functions and Optimization: Optimization, stochastic gradient descent, dropout, batch normalization, etc.Sequential Modelling: Recurrent and Recursive Nets, RNN, LSTM, GRU, Image captioning, visual question answering, etc. Vis ualization and Understanding: Visualizing intermediate features and outputs, Saliency maps, Visualizing neurons, Cam -Grad, etc. Generative Models: VariationalAutoencoders, Generative Adversarial Networks like pix2pix, CycleGAN, etc. Deep Reinforcement Lea rning: Reinforcement Learning (RL) Background, Policy gradients, hard attention Q -Learning Deep Learning Applications: Object Detection: RCNN, Fast RCNN, Faster RCNN, YOLO, Retina Net, SSD, etc., Semantic Segmentation: DeepLabV3, PSP Net, etc. Adversaria l Attacks on CNN. Recommended Readings Text Books: - 1. Ian Goodfellow and YoshuaBengio and Aaron Courville, “Deep Learning,” MIT Press. 2. Michael A. Nielsen, “Neural Networks and Deep Learning,” Determination Press, 2015. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST856 Course Name : Digital Forensics Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Operating Systems, Computer Networks & Security Course Contents File System Forensics: Duplicating hard disks for "dead analysis”, reading hidden data on a disk's Host Protected Area (HPA), Direct versus BIOS access, dead versus live acquisition, Disk partitions - DOS, Apple, and GPT partitions, BSD disk labels, Sun Volume; multiple disk volumes - RAID and disk spanning; Analyzing FAT, NTFS, Ext2, Ext3, UFS1, and UFS2 file systems, Finding evidence: File metadata, recovery of deleted files, Using The Sleut h Kit (TSK), Autopsy Forensic Browser, and related open source tools Web Forensics: network -based evidence in Windows and Unix environments, Reconstructing Web browsing, email activity, Tracing domain name ownership and the source of e -mails System Forensi cs: Windows Registry changes, Duplicating and analyzing the contents of PDAs and flash memory devices Electronic document, computer image verification and authentication. Recommended Readings Text Books: - 1. Brian Carrier. File System Forensic Analysis, Addison Wesley. 2. Chris Prosise, Kevin Mandia. Incident Response and Computer Forensics, McGraw Hill. Course Technology. 3. Linda Volonino, Reynaldo Anzaldua, and Jana Godwin. Computer Forensics: Principles and Practices, Prentice Hall. 4. Keith J. Jone s, Richard Bejtlich, and Curtis W. Rose. Real Digital Forensics: Computer Security and Incident Response, Addison Wesley. 5. Vacca, John R., Computer Forensics Computer Crime Scene Investigation, Charles River Media. 6. Nelson, Phillips, Enfinger, Steuart. Guide to computer Forensics and Investigation MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST857 Course Name : Embedded System Security Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Security Flaws and Attacks in Embedded systems: Code injection, Invasive and Non invasive physical and logical attacks Defenses Against Code Injection Attacks: Methods using Address Obfuscation and Software Encryption, Anomaly Detection. Safe Languages, C ode Analyzers Compiler, Library, and Operating System Support for embedded systems. security, Control Flow Checking, IP Protection: Encryption of IP Cores, additive and Constraint -Based watermarking. Implementation of DES 3DES, AES, RC4, MD5, RSA algo rithms Recommended Readings Text Books: - 1. Security in Embedded Hardware MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST858 Course Name : Internet of Things Credit s : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Computer Networks, Wireless Communication Course Contents Introduction: Internet of Things and Connected Products, IoT paradigm, Smart objects, Goal orientation, Convergence of technologies; Business Aspects of the Internet of Things.Internet and “Things”: Layers, Protocols, Packets, Services, Performance paramet ers of a packet network and applications: Web, Peer -to-peer, Sensor networks, and Multimedia. Hardware and Software: Hardware components, Microcontrollers and Software; Operating Systems. Protocols and Platforms -IoT Communication Protocols, Transport Prot ocols, Application Protocols; Cloud computing for IoT. Services and Attributes: Data creation, Data gathering and Data dependency; Robustness, Scaling, Privacy, Security, Trust. Designing & Developing IoT applications: Introduction, IoT Design Methodology , Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages Application: Implications for the society, IoT case study. Recommended Readings Text Books: - 1. The Intern et of Things: Key

Applications and Protocols, David Boswarthick, Olivier Hersent, and Omar Elloumi, Wiley 2. Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley. 3. Latest research articles MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST871 Course Name : Wireless Security Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Computer Network s Course Contents Foundations of Wireless Security: Wireless as a necessity, advantages and disadvantages, information security and wireless LANs, wireless LAN standards and types, Wireless LAN vulnerabilities. Risks and Threats of Wireless: Social Engin eering, phishing, search engine scanning, Denial -of-service, malicious code, War driving, rogue access points, RFID. Wireless Security Models: Wireless Security Basics, Equivalent Privacy Standard (WEP), Extensible Authentication Protocol (EAP), Wi -Fi Pro tected Access (WPA), WPA2, 802.11i, attacks on WEP, EAP, WPA, 802.11i. Designing a secure wireless network: Basic principles of security design - layering, limiting, diversity, obscurity, simplicity; network segmentation, hardware placement, wireless device security. Wireless security Policy: policy overview, risk assessment, designing security policy, impact analysis, wireless security policy areas, types of wireless security policies. Recommended Readings Text Books: - 1. Wireless Security Handbook, by A aron E. Earle, Auerbach Publications 2. CWSP Guide to Wireless Security, by Mark Ciampa, 1st Edition. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST859 Course Name : Intrusion Detection Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction - Intrusion Detection System (IDS), Intrusion Prevention System (IPS), Unauthorized access – buffer overflow, packet fragmentation, out -of-spec packets Review of Network protocol – TCP/IP, Intrusion detection through tcpdump. IDS and IPS – Arch itecture and internals. Malicious and non -malicious traffic, IP headers, TCP, UDP and ICMP protocols and header formats, Header information to detect intrusion, logs and their analysis, IDS through reaction and response Intrusion analysis – data correlatio n, tools, SNORT - A case study. Recommended Readings Text Books: - 1. Matt Fearnow, Stephen Northcutt, Karen Frederick, and Mark Cooper. Intrusion Signatures and Analysis, SAMS. 2. Carl Endorf, Gene Schultz, Jim Mellander, Intrusion Detection and Prev ention, McGraw Hill. 3. Paul E. Proctor. The Practical Intrusion Detection Handbook, Prentice Hall. 4. Stephen Northcutt and Judy Novak. Network Intrusion Detection, SAMS. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST861 Course Name : Nature Inspired Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Data structures Course Contents Introduction to Algorithms, Optimization, Search for optimality, computational intelligence, Nature Inspired solutions and characteristic, Nature inspired Metaheuristics and its brief history, Analysis of Optimization Algorithms, Nature Inspired Algorithms , parameter Tuning and controlConstrained and unconstrained optimizations, Random Walks and Optimizations, evolutionary strategies and Evolutionary Algorithms (EA), Simulated Annealing (SA) Algorithm and its behavior, Genetic Algorithms(GA) - genetic operat or, parameters, fitness functions, genetic programming and convergence analysis, GA variants, Differential Evolution (DE), various Applications. Swarm Intelligence optimization, Particle Swarm Optimization(PSO) Algorithm, Ant Colony Optimization (ACO) Alg orithms, Artificial Bee Colony ACO) optimization algorithms, Cuckoo Search (CS) Algorithms, Intelligent Water Drop Algorithm (IWD), Bat Algorithms(BA), Firefly Algorithms(FA) Framework for self -tuning algorithms, Dealing with constraints, constraints hand ling, fitness functions ,multi -objective optimization techniques and its applications , Hybrid algorithms, Ways to Hybridize. Recommended Readings Text Books: - 1. Nature -Inspired Optimization Algorithms – by Xin -She Yang (Author), June 30, 2016 2. Mathematical Foundations of Nature -Inspired Algorithms, Xin -She Yang, Xing -Shi He, Springer; 1st ed. 2019 edition 3. Nature -Inspired Metaheuristic Algorithms: Second Edition, Xin -She Yang, Luniver Press 4. Introduction to Evolutionary Computing, A. E Ei ben and J. E. Smith, Second Printing, Springer, 2007 5. Evolutionary Algorithms in Engineering Applications, Editors: DipankarDasgupta and ZbigniewMichalewicz, Springer -Verlag, 1997 6. D. E. Goldberg, Genetic Algorithms in search, Optimization and Machine Learning, Pearson India 7. Optimization Techniques and Applications with Examples By Xin -She Yan, wiley publisher MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST862 Course Name : Network Performance Modelling Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to Network Modeling: Network modeling, Computer Network as a discrete event system, Modeling and measurement tools, Network performance metrics – first order and second order metrics, Network capacity, Difference between throughput and capacit y Network Calculus: Models for data flows, arrival curves and service curves, Greedy shapers, Basic min -plus and max - plus calculus, min -plus and max -plus systems, Optimal smoothing, FIFO systems and aggregate scheduling, Time varying shapers, Systems with losses, Case studies – (1) Analyzing spanning tree based data forwarding using network calculus, (2) Bound on loss rate Stochastic Scheduling and Resource Allocation: Stochastic scheduling, dynamic resource allocation, Dynamic programming models for stoc hastic scheduling, Queuing networks – open loop and closed loop networks, Jackson networks, Network fairness – proportional and max -min fairness, Markov process and its application for analyzing network resource allocation and fairness, available bandwidth estimation, Case studies – (1) TCP/IP flow and congestion control, (2) Modeling dynamic routing and scheduling as a queuing network problem, (3) Analysis of IEEE 802.11 channel access using two dimensional Markov process. Network Games: Introduction to g ame theory, Zero sum games, Nash equilibrium, Pareto optimality, Cooperative and Non -cooperative games, General network games – resource sharing games, routing games, congestion games, Mechanism design, Case studies – (1) Selfish routing in networks and pr ice of anarchy, (2) Oblivious routing, (3) Network resource allocation games Protocol Analysis: Modeling discrete event system using petri -nets, basics of petri nets, stochastic petri nets, queuing petri nets, properties of petri nets, structural analysis of petri nets, Petri net modeling tools – simQPN, Case studies – (1) Wireless channel model using stochastic petri net, (2) Data center network throughput analysis using queuing Petri Nets Recommended Readings Text Books: - 1. "Routing, Flow, and Capaci ty Design in Communication and Computer Networks", Micha■Pióro, DeepankarMedhi, ISBN: 0125571895, Publisher: Morgan Kaufmann 2. The Network Calculus Book by Jean -Yves Le Boudec and Patrick Thiran is available for free download:http://ica1www.epfl.ch/PS_fil es/NetCal.htm 3. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" Morgan Kaufman Publishers 4. Dimitri P. Bertsekas and Robert G. Gallager, "Data Networks": Materials are available at http://web.mit.edu/dimitrib/w ww/datanets.html 5. "Network Optimization: Continuous and Discrete Models", D. Bertsekas 6. Research Publications - will be discussed and distributed time to time MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST863 Course Name : Pattern Recognition Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: An undergraduate level understanding of probability, statistics and linear algebra is assumed. A basic knowledge of Python is essential. Course Contents The classification process: features, training and learning, approaches to classification Non metric methods: Information, Entropy and Impurity, decision tree classi fier- ID3, C4.5. Discriminant functions: linear discriminant functions, piece -wise linear discriminant functions, generalized discriminant functions. Statistical pattern recognition: measured data and measurement errors, probability theory, conditional pr obability and Bayes rule, Naive Bayes classifier, Continuous random variables, The multivariate Gaussian, Covariance matrix and MahalanobisdistanceParametric learning: Bayesian decision theory, discriminant functions and decision boundaries, MAP (Maximum A Posteriori Estimator)Non Parametric learning: Histogram estimator and Parzen windows, k -NN classification, Artificial Neural Networks, Kernel Machines, SVM. Feature extraction and selection: reducing dimensionality, feature selection - Inter/Intra class d istance, Feature extraction: Principal component analysis, Linear discriminant analysis. Unsupervised learning: Clustering, K - Means clustering, Fuzzy c -Means clustering, (Agglomerative) Hierarchical clustering. Estimating and Comparing Classifiers: No fre e lunch, Bias and variance trade -off, cross -validation and resampling methods, Measuring classifier performance, Comparing classifiers - ROC curves, McNemar’s test, other statistical tests. Recommended Readings Text Books: - 1. Pattern Classification, Dud a Hart, Wiley 2. Pattern Recognition and Classification, Geoff Dougherty, Springer 3. Statistical Pattern Recognition, Andrew R Webb, Wiley 4. Pattern Recognition and Machine Learning, Christopher Bishop, Springer 5. Pattern Recognition and Image Analysis, Earl Gose, Johnsonbaugh, PHI MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CIL736 Course Name : Program Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Introduction to analysis tools: debugging, disassembly, emulators, virtualization Introduction: Program Representation, Syntactic Analysis, Program Semantics, Static and dynam ic analysis, Syntactic Analysis, Dataflow Analysis and Abstract Interpretation, Interprocedural analysis, Context -sensitive, Pointer analysis, Call Graph Construction, slicing and profiling, Control Flow Analysis, Dynamic Analysis for Data

Race Detecti on Model Checking, Symbolic execution, Program Repair, Hoare Logic, SMT solvers Recommended Readings Text Books: - 1. Pierce, Benjamin C. Types and Programming Languages. MIT Press, 2002. 2. Winskel, Glynn. The Formal Semantics of Programming Language s: An Introduction. MIT Press, 1993. 3. Nielson, Nielson, and Hankin. Principles of Program Analysis. Springer, 2010. 4. Baier, and Katoen. Principles of Model Checking. MIT Press, 2008. 5. Chlipala, Adam. Certified Programming with Dependent Types: A P ragmatic Introduction to the Coq Proof Assistant. MIT Press, 2013. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST864 Course Name : Public Key Infrastructure and Trust Management Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Public key infrastructure - components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross - certification. Repository, Certification Authority (CA) and Registr ation Authority (RA), trusted third party, digital certificates PKI services – authentication, non -repudiation, privilege management, privacy, secure communication. Key management – certificate revocation list, root CA, attacks on CA, key backup. PKI sta ndards – SSL, LDAP, IPSec, X.500, X.509, S/MIME Trust models – strict v/s loose hierarchy, four corners distribution. Certificate path processing – path construction and path validation. Recommended Readings Text Books: - 1. AshutoshSaxena, Public Key In frastructure, Tata McGraw Hill 2. Carlisle Adams, Steve Lloyd. Understanding PKI: Concepts, Standards, and Deployment Considerations, Addison Wesley. 3. John R. Vacca. Public Key Infrastructure: Building Trusted Applications and Web Services, AUERBACH. 4. MessaoudBenantar, Introduction to the Public Key Infrastructure for the Internet, Pearson Education. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST865 Course Name : Quantum Cryptography Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Preliminaries: Quantum Information Theory, Quantum Information Theory, Unconditional Secure Authentication and Entropy. Quantum Key Distribution: Quantum Channel, Public Channel, QKD Gain, Finite Resources, Adaptive Cascade: Introduction, Error Correction and the Cascade Protocol, Adaptive Initial Block -Size Selection, Fixed Initial Block -Size, Dynamic Initial Block - Size. Attack Strategies on QKD Protocols: Attack Strategies in an Ideal Environment, Individual Attacks in an Realistic Environment. QKD Syst ems, Statistical Analysis of QKD Networks in Real-Life Environment: Statistical Methods, Results of the Experiments, Statistical Analysis. QKD Networks Based on Q3P : QKD Networks, PPP, Q3P, Routing and Transport. Quantum - Cryptographic Networks from a Pro totype to the Citizen. The Ring of Trust Model, Model of the Point of Trust Architecture, Communication in the Point of Trust Model, Exemplified Communications, A Medical Information System Based on the Ring of Trust. Recommended Readings Text Books: - 1. Quantum Cryptography and Secret -Key Distillation, Gilles van Assche, Cambridge University Press, 2006. 2. Paul Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press (2007). 3. Michael A. Nielsen and Is aac L. Chuang, Quantum

Computation and Quantum Information, Cambridge University Press (2000). MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST866 Course Name : Security Analysis of Protocols Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Cryptographic background; Authentication, Key establishment and IP security; Denial of service; Anonymity and MIX netw orks; Fairness and contract signing, Privacy and protection of individual information;Wireless security (mobile phones, WiFi); Protocol analysis tools: Finite -state checking; Infinite -state symbolic analysis; Probabilistic model checking;Game -based verifi cation; Process algebras (spi -calculus and applied pi calculus); Protocol logics (BAN, DDMP, Isabelle); Introduction to Probabilistic polynomial time calculus; Relating cryptographic and formal models. Recommended Readings Text Books: - 1. Latest repute d conference and journal articles as chosen by the instructor. 2. Maximum Security, 2nd Edition, SAMS Books by Anonymous, 1998, 3. Maximum Linux Security, SAMS Books by Anonymous, 2000, ISBN: 0 -672- 31670 -6. 4. 10 Risks of PKI: What You're not Being Told about Public Key Infrastructure, by Ellison and Schneier MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST860 Course Name : Machine Learning Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential. Course Contents Advanced linear Algebra (e.g., SVD). The learning problem – learning versus design, types of learning - supervised, unsupervised, reinforcement and other views of learning. Linear Modelling: A least squares approach, linear modeling, making predictions, vec tor/matrix notation, linear regression, nonlinear response from a linear modelz. Generalization and over -fitting. The Bayesian approach to machine learning: exact posterior, marginal likelihoods Probability based learning: Bayes theorem, Bayesian predictio n, conditional independence and factorization, the Naive Bayes model. Error based learning: simple linear regression, multi variable linear regression with gradient descent Logistic regression – gradient descent, non linear transformations the Z space. Similarity based learning: nearest neighbor, k - nearest neighbors, efficient distance computations: the KD trees Information based learning: learning and trees, Classification and regression trees. Ensemble methods, Boosting, Bagging, Random forests. Neural n etworks – the perceptron, Multilayer perceptron, activation functions, gradient descent, deriving back propagation. Multi - task and transfer learning, Deep learning. Linear discriminant analysis (LDA), Principal component analysis (PCA)SVM - optimal separati on, the margin and support vectors, a constrained optimization problem, kernels – polynomial, radial basis, sigmoid Performance Measures and Evaluation – for categorical targets, prediction scores, multinomial targets, continuous targets. Clustering – the general problem, hierarchical and partitional clustering, K -means clustering. Recommended Readings Text Books: - 1. Learning from Data, Yaser S Abu -Mostafa, AML books 2. Machine learning, Marsland, CRC press 3. An Introduction to Machine Learning, Kubat Miroslav, Springer 4. Fundamentals of Machine Learning for predictive data analytics, John D Kelleher, MIT Press 5.

Learning from Data, Yaser S Abu -Mostafa, AML books MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Co mputer Science & Engineering Course Code : 21CST867 Course Name : Selected Topics in Cryptography Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Maths Course Contents Basic Concepts: Information theoretic vs. computational security. One way functions, Pseudo randomness generators and functions, Permutations, hash functions. Private -key encryption using pseudo randomness. Private -key authentication. – Public key encrypti on (and number theory). Public key authentication. Interactive protocols: Touch of complexity theory, Interactive proof systems; 0 -knowledge proof systems,0 -knowledge authentication, Electronic cash; non -interactive zero-knowledge. Oblivious transfer: Defi nitions, constructions, and applications, Secure Multiparty computations, Database (differential) privacy. – Proofs of work – Block -chain consensus protocols. Recommended Readings Text Books: - 1. Introduction to Modern Cryptography: Principles and Protocols, by Jonathan Katz and Yehuda Lindell 2. A Graduate Course in Applied Cryptography by Dan Boneh and Victor Shoup 3. The Joy of Cryptography by Mike Rosulek. 4. OdedGoldreich: Foundations of Cr yptography Vol 1 and Vol2 MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST868 Course Name : Social Network Analysis Credits : 3 L - 3 T - 0 P - 0 Course Type : Electiv e Prerequisites: Data Structures and Algorithms Course Contents Network Models: Properties of Real -World Networks: Degree Distribution, Clustering Coe■cient, Average Path Length. Random Graphs , Small -World Model, Preferential Attachment Model, Modeling of Real -World Networks using Random Graphs, Small -World Model and Preferential Attachment Model Network Measures: Centrality: Degree Centrality, Eigenve ctor Centrality, Katz Centrality, PageRank, Centrality, Closeness Centrality, Group Centrality. Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence. Community Analysis: Community Detection, Community De tection Algorithms: Member -Based Community Detection, Group -Based Community Detection. Community Evolution: How Networks Evolve, Community Detection in Evolving Networks. Community Evaluation: Evaluation with Ground Truth, Evaluation without Ground Truth R ecommendation: Classical Recommendation Algorithms: Content -Based Methods, Collaborative Filtering (CF), Extending Individual Recommendation to Groups of Individuals, Recommendation Using Social Context, Evaluating Recommendations: Evaluating Accuracy of P redictions, Evaluating Relevancy of Recommendations Graph Representation Learning, Knowledge Graphs and Meta Paths, Graph Convolutional Networks, Link Prediction, Influence Maximization & Outbreak Detection. Recommended Readings Text Books: - 1. Network s, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg. 2. Networks: An introduction by Mark Newman. 3. The Development of Social Network Analysis" by Linton C Freeman 4. Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. Social media mining: an introduction. Cambridge University Press MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST869 Course Name : SOFTWARE TESTING &

VALIDATION Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Software engineering, basic computer programming skills Course Contents Testing Environment and Test Processes: Software Testing Environment, Overview of Software Testing Pr ocess, Organizing for Testing, Developing the Test Plan, Verification Testing, Analyzing and Reporting Test Results, Acceptance Testing. Levels of Testing, Unit Testing, Integration Testing, Defect Bash Elimination. System Testing, Usability and Accessibi lity Testing, Configuration Testing, Compatibility Testing. Functional and Non -functional system testing, Compliance Testing, Load Testing, Performance Testing and Security Testing. Static and dynamic testing, Black -box or functional testing, Equivalenc e partitioning, BVA, structural, White box or glass box testing, Mutation Testing, Data flow testing. Test Automation: Software Testing Tools, Software Test Automation, Debugging, Case study. Recommended Readings Text Books: - 1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education,. 2. A.P. Mathur, Foundations of Software Testing, Pearson publications 3. NareshChauhan , “Software Testing Principles and Practices ” Oxford Un iversity Press , New Delhi . 4. LleneBurnstein, “ Practical Software Testing”, Springer International Edition. 5. RenuRajani, Pradeep Oak, “Software Testing – Effective Methods, Tools and Techniques”, Tata McGraw Hill. 6. William Perry, “Effective Methods of Software Testing”, Third Edition, Wiley Publishing. MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST870 Course Name : VLSI Algorithms Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: None Course Contents Logic synthesis & verification: Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High -level synthesis. VLSI Algorithms Partitioning: Problem formulation, classification of partitioning algorithms, Group migration algorithms, simu lated annealing & evolution, other partitioning algorithms. Placement, floor planning & pin assignment: Problem formulation, simulation base placement algorithms, other placement algorithms, constraint -based floorplanning, floor planning algorithms for mi xed block & cell design. General & channel pin assignment. Global Routing: Problem formulation, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches. Detailed routing : problem formulation, classification of routing algorithms, single layer routing algorithms, two -layer channel routing algorithms, three -layer channel routing algorithms, and switchbox routing algorithms.Over the cell routing & via minimization: two layer s over the cell routers, constrained & unconstrained via minimization. Compaction: problem formulation, one -dimensional compaction, two dimension -based compaction, hierarchical compaction. Recommended Readings Text Books: - 1. Naveed Sherwani, “Algorith ms for VLSI Physical Design Automation”, 3rd MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR Department/Centre : Department of Computer Science & Engineering Course Code : 21CST849 Course Name : Blockchain Technologies Credits : 3 L - 3 T - 0 P - 0 Course Type : Elective Prerequisites: Network Security, Cryptography, Course Contents INTRODUCTION TO BLOCKCHAIN Distributed Ledger Technology, Decentralization, Bitcoin Network and Architecture, Block in a Blockchain, Advantages over Traditional Databa ses, Mining Mechanism, Types of Blockchain: Public, Private, Consortium, Cryptography: Elliptic Curve Cryptography, Hash Functions, Merkle Tree, Merkle Patricia Trie, Digital Signature, Wallets and Keys, User Addresses and Privacy CRYPTO CURRENCY History, Distributed ledger, Creation of Coins, Double spending, Bitcoin protocols, Transaction in Bitcoin Network, AltCoins, Ethereum, EVM, Accounts, Transactions, Gas, Fees, Smart Contracts, Eth 2.0 MINING AND CONSENSUS Definitions, Types of Mining Algorithms, Proof of Work, Proof of Stake, Proof of Burn. Sharding Chains SMART CONTRACTS ON ETHEREUM Setting up Ethereum Node using Geth Client, Smart Contracts and DApps, Truffle, Ganache CLI, Metamask, Remix, Solidity, Writing and Deploying Smart Contracts in Sol idity, Connection to Web3.js Library, Vulnerabilities in Smart Contracts, Attacks, Prevention of Attacks, Decentralized Autonomous Organization (DAO), Building an Initial Coin Offering (ICO). BLOCKCHAIN USE CASES AND APPLICATIONS Use -Cases in Cryptocurre ncy and Other Sectors like Finance, Voting System, and Healthcare, etc. Future of Blockchain. Recommended Readings Text Books: - 1. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction