

MANIPAL UNIVERSITY JAIPUR
Department of Computer Science & Engineering
B.Tech Scheme – 2019 Onwards

Year	THIRD SEMESTER						FOURTH SEMESTER					
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
II	EO2001	Economics	3	0	0	3	BB0025	Value, Ethics and Governance	2	0	0	2
	MA2101	Engineering Mathematics – III	2	1	0	3	MA2201	Engineering Mathematics – IV	2	1	0	3
	CS2101	Data Communications	3	1	0	4	CS2201	Operating Systems	3	1	0	4
	CS2102	Computer System Architecture	3	1	0	4	CS2202	Relational Database Management Systems	3	1	0	4
	CS2103	Data Structures & Algorithms	3	1	0	4	CS2203	Computer Organization	3	1	0	4
	CS2104	Object Oriented Programming	3	1	0	4	*** **	Open Elective – I	3	0	0	3
	CS2130	Data Structures & Algorithms Lab	0	0	2	1	CS2230	Operating Systems Lab	0	0	2	1
	CS2131	Object Oriented Programming Lab	0	0	2	1	CS2231	Relational Database Management Systems Lab	0	0	2	1
							CS2232	Web Technology Lab	0	0	2	1
			17	5	4	24			16	4	6	23
Total Contact Hours (L + T + P)			25			Total Contact Hours (L + T + P) + OE			23+3= 26			
III	FIFTH SEMESTER						SIXTH SEMESTER					
	CS3101	Artificial Intelligence & Soft Computing	3	1	0	4	BB0026	Organization and Management	3	0	0	3
	CS3102	Design & Analysis of Algorithms	3	1	0	4	CS3201	Software Engineering	3	1	0	4
	CS3103	Automata Theory & Compiler Design	3	1	0	4	CS3202	Information Systems Security	3	1	0	4
	CS3104	Computer Networks	3	1	0	4	CS3203	Data Science and Machine Learning	3	0	0	3
	CS31XX	Program Elective – I	3	0	0	3	CS32XX	Program Elective – II	3	0	0	3
	*** **	Open Elective – II	3	0	0	3	*** **	Open Elective – III	3	0	0	3
	CS3130	Design & Analysis of Algorithms Lab	0	0	2	1	CS3230	Software Engineering Lab	0	0	2	1
	CS3131	Artificial Intelligence & Soft Computing Lab	0	0	2	1	CS3231	Information Systems Security Lab	0	0	2	1
	CS3132	Computer Networks lab	0	0	2	1	CS3270	Minor Project	0	0	6	3
		18	4	6	25			18	2	10	25	
Total Contact Hours (L + T + P) + OE			25+3=28			Total Contact Hours (L + T + P) + OE			25+3=28			



IV	SEVENTH SEMESTER						EIGHTH SEMESTER					
	CS41XX	Program Elective – III	3	0	0	3	CS4270	Major Project				12
	CS41XX	Program Elective – IV	3	0	0	3						
	CS41XX	Program Elective – V	3	0	0	3						
	CS41XX	Program Elective – VI	3	0	0	3						
	CS41XX	Program Elective – VII	3	0	0	3						
	CS4170	Industrial Training	0	0	2	1						
			15	0	2	16						12
	Total Contact Hours (L + T + P)		15+ 2 = 17									

Programme Electives (Minor Specializations) CYBER SECURITY CS3140: Information Coding CS3143: Security and Privacy Foundation CS3240: Principles of Secure Programming CS4140: Cyber Security CS4141: Digital Forensics & Cyber Crimes CLOUD COMPUTING CS3141: Cloud Computing & Virtualization CS3241: Cloud Infrastructure Services CS4142: Cloud Computing Applications CS4143: Cloud Security and Privacy DATA ANALYTICS CS3142: Predictive Analytics CS3242: Image Processing and Pattern Analysis CS4159: Data Visualization Techniques CS4160: Fundamentals of Big Data	Programme Electives (PE5, PE6, PE7) CS4144: Information Retrieval CS4145: Computer Graphics & Multimedia CS4146: User Interface Design CS4147: Digital Image Processing CS4148: Internet of Things CS4149: Big Data Analytics CS4150: Software Defined Networks CS4151: Deep Neural Network CS4152: Social Network Analysis CS4153: Software Testing CS4154: Linux System and Shell Programming CS4155: Wireless Sensor & Adhoc Network CS4156: Mobile Computing CS4157: Natural Language Processing CS4158: Computer Vision CS4161: Advanced Data Structures CS4162: Blockchain Technologies CS4163: Explainable Artificial Intelligence CS4164: Advance Compiler Design	Open Electives CS0001: Data Science for Engineers CS0002: Programming, Data Structures and Algorithms using Python CS0003: Data Structure and Algorithms using Java CS0004: The Joy of Computing using Python CS0005: Fundamentals of Databases CS0006: Fundamentals of Cryptography CS0007: Principles of Programming Languages CS0008: Principles of Software Design CS0009: Fundamentals of Internet of Things CS0010: Principles of Machine Learning CS0051: HTML, CSS and JavaScript for Web Developers CS0052: Networking and Security in iOS Applications CS0053: Fundamentals of IoT Security CS0054: Enterprise Resource Planning CS0080: Introduction to Data Science using R CS0081: Robotic Process Automation
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end devices, Configuring DHCP server, Static routing, RIP, OSPF, VLAN and NAT. Network programming: Transmission control protocol and User datagram protocol. WLAN, Security: Security Threats and Vulnerabilities, Network Attacks, Network Attack Mitigation, Device Security. Network Utilities Commands: PING, NETSTAT, IPCONFIG, IFCONFIG, ARP, TRACE-ROUTE, NETSTAT, NSLOOKUP, PATHPING Network Utilities Tools: NMAP, Wireshark, Network Scanner, Case Study, Mini Project: Build a Small Network and Scale to Larger Networks, Troubleshooting Scenarios

References:

1. B. A. Forouzan, *TCP/IP Protocol Suite*, (5e), Tata McGraw Hill, 2013.
2. A. S.Tanenbaum, *Computer Networks*, (5e), Pearson Education, 2010.

VI SEMESTER

BB0026: ORGANISATION AND MANAGEMENT [3 0 0 3]

Meaning and definition of an organization, Necessity of Organization, Principles of Organization, Formal and Informal Organizations. Management: Functions of Management, Levels of Management, Managerial Skills, Importance of Management, Models of Management, Scientific Management, Forms of Ownership, Organizational Structures, Purchasing and Marketing Management, Functions of Purchasing Department, Methods of Purchasing, Marketing, Functions of Marketing, Advertising. Introduction, Functions of Personal Management, Development of Personal Policy, Manpower Planning, Recruitment and Selection of manpower. Motivation – Introduction, Human needs, Maslow's Hierarchy of needs, Types of Motivation, Techniques of Motivation, Motivation Theories, McGregor's Theory, Herzberg's Hygiene Maintenance Theory. Leadership - Introduction Qualities of a good Leader, Leadership Styles, Leadership Approach, Leadership Theories. Entrepreneurship-Introduction, Entrepreneurship Development, Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship, Steps for establishing small scale unit. Data and Information; Need, function, and Importance of MIS; Evolution of MIS; Organizational Structure and MIS, Computers and MIS, Classification of Information Systems, Information Support for functional areas of management.

References:

1. Koontz, Harold, Cyril O'Donnell, and Heinz Weihrich, *Essentials of Management*, (1e) Tata McGraw-Hill, New Delhi, 1978.
2. Robbins, Stephen P, and Mary Coulter, *Management*, Prentice Hall, (2e) New Delhi, 1997.
3. E. S. Buffa and R. K. Sarin, *Modern Production / Operations Management*, (8e), Wiley, 1987

4. H. J. Arnold and D. C. Feldman, *Organizational Behavior*, McGraw – Hill, 1986.
5. Aswathappa K, *Human Resource and Personnel Management*, Tata McGraw Hill, 2005.
6. William Wether & Keith Davis, *Human Resource and Personnel Management*, McGraw Hill, 1986.

CS3201: SOFTWARE ENGINEERING [3 1 0 4]

Introduction: The Evolving Role of Software, The changing nature of software, Legacy software, Software Myths. Software Engineering: A Layered Technology, a Process Framework, the Capability Maturity Model Integration (CMMI), Specialized Process Models, and the Unified Process. Agile development: Agile Process Models Software Engineering Practice, Communication Practice, Planning Practices, Modeling Practices, Construction Practice, Deployment Computer-Based Systems, The System Engineering Hierarchy, Business Process Engineering: An Overview. Product Engineering: An Overview, Data Modeling Concepts, Object Oriented Analysis, Flow-Oriented Modeling, Taxonomy of Quality Attributes, Perspectives of Quality, Quality System, Software Quality Assurance, Capability Maturity Model Observation on Estimation, The Project Planning Process, Software Scope and Feasibility, Human Resources, Empirical Estimation Model, Introduction to DevOps, Cloud Computing And Virtualization, Migration to DevOps, DevOps Tools.

References:

1. R. Pressman, *Software Engineering: A Practitioners Approach*, (8e), McGraw Hill Pubs, 2019.
2. M. Walls, *Building a Dev Ops Culture*, O'Reilly Publications, 2013.
3. J. Joyner, *Dev Ops for Beginners, Dev Ops Software Development Method guide for software developers and IT professionals*, Mihails Konoplovs, 2015.

CS3202: INFORMATION SYSTEMS SECURITY [3 1 0 4]

Introduction: Basic objectives of cryptography, Secret-key and public-key cryptography, One-way trapdoor one-way functions, Cryptanalysis, Attack models, Classical cryptography. Block ciphers: Modes of operation, DES and its variants, AES, Linear and differential cryptanalysis. Message digest: Properties of hash functions, MD2, MD5 and SHA-1, Keyed hash functions, Attacks on hash functions. Pseudorandom Number Generation Intractable problems: Integer factorization problem, RSA problem, Modular square root problem, Discrete logarithm problem, Diffie-Hellman problem, known algorithms for solving the intractable problems. Public-key encryption: RSA, ElGamal scheme, Elliptic and hyperelliptic curve cryptography, Side channel attacks, Diffie-Hellman and MQV key exchange. Digital signatures: RSA, DSA and NR signature schemes, blind and undeniable signatures. Entity authentication: Passwords, Challenge-response algorithms, Zero-knowledge protocols Transport-Level Security: Web Security Issues, Secure Sockets Layer (SSL), Transport Layer Security (TLS), Electronic Mail Security, Pretty Good Privacy (PGP), IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.

References:

1. B. A. Forouzan, D. Mukhopadhyay, *Cryptography and Network Security*, (2e), Mc-Graw Hill, 2008.
2. W. Stallings, *Cryptography and Network Security: Principles and Practice*, (5e), Prentice Hall, 2010.
3. J. Pieprzyk, T. Hardjono, J. Seberry, *Fundamentals of Computer Security*, Springer International Edition, 2003.
4. A. J. Menezes, P. C. V. Oorschot, S. A. Vanstone, *Handbook of Applied Cryptography*, CRC Press.

CS3203: DATA SCIENCE AND MACHINE LEARNING [3 0 0 3]

Data Science: Descriptive Statistics, Probability Distribution, regression analysis, ANOVA. Machine Learning: Goals, Applications of ML, developing a learning system, training data, concept representation, function approximation. Decision Tree Learning: Representing concepts as decision trees, Recursive induction of decision trees, best splitting attribute, entropy, information gain., Occam's razor, Overfitting, noisy data, and pruning. Artificial Neural Networks: Neurons and biological motivation. Linear threshold units, Perceptron, representational limitation and gradient descent training, Multilayer networks and backpropagation. Hidden layers and constructing intermediate, distributed representations, Overfitting, learning network structure, recurrent networks. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing. Support Vector Machines: Maximum margin linear separators. Kernels for learning non-linear functions. Bayesian Learning: Probability theory and Bayes rule. Naive Bayes learning algorithm, Logistic regression, Bayes nets and Markov nets for representing dependencies. Instance-Based Learning: k-Nearest-neighbor algorithm, Case-based learning,



Relevance feedback and Rocchio algorithm. Naive Bayes for text. Clustering and Unsupervised Learning: Hierarchical Agglomerative Clustering, k-means partitioned clustering, expectation maximization (EM) for soft clustering. Ensemble Learning: Bagging, boosting, and Decorate. Active learning with ensembles.

References:

1. G. James, D. Witten, T Hastie, R Tibshirani, *An introduction to statistical learning with applications in R*, Springer, 2013.
2. J. Han, M. Kamber, J. Pei, *Data Mining concepts and techniques*, (2e), Morgan Kaufmann- Elsevier, 2011.
3. T. Hastie, R. Tibshirani, J. Friedman, *The Elements of Statistical Learning*, (2e), Springer, 2009.
4. K. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
5. T. M. Mitchell, *Machine Learning*, (Indian Edition), MacGraw Hill, 2017.
6. C. Bishop, *Neural Networks for Pattern Recognition*, Oxford University Press, 2019

CS3240: PRINCIPLES OF SECURE PROGRAMMING [3 0 0 3]

Introduction of IT application and data security: Security goals, Secure system design, Secure design principles, Secure Software Development Lifecycle (SDLC), Phases of the SDLC and security considerations at each phase, Secure coding practices and guidelines, Code review and vulnerability scanning, Security testing methodologies (e.g., static analysis, dynamic analysis)

Web Application Security: Common web application vulnerabilities (e.g., injection attacks, XSS, CSRF), Input validation and output encoding, Session management, and cookie security, Web application firewalls (WAF), Secure APIs and Web Services, and Web service security (e.g., SOAP, REST)

Identity and Access Management (IAM): IAM principles and components, User authentication and authorization mechanisms, Single Sign-On (SSO), and federation.

References:

1. N. Daswani, C. Kern, A. Kesavan, *Foundations of Security, What Every Programmer Needs to Know*, Apress, 2007.
2. J. C. Foster, V. T. Liu, *Writing Security Tools and Exploits*, Syngress Publishing, 2006.
3. J. Ericson, *Hacking: The Art of Exploitation*, (2e), No Starch Press, 2008.
4. C. Anley, J. Heasman, F. Linder, G. Richarte, *The Shellcoder's Handbook: Discovering and Exploiting Security Holes*, (2e), Addison-Wiley, 2011.

CS3241: CLOUD INFRASTRUCTURE AND SERVICES [3 0 0 3]

Introduction: Clouds and Cloud Computing: Basic Concepts, Types of Services, deployment models. Classic Data Center (CDC): DBMS concepts, CDC drawbacks, CDC Management and case studies. Virtualized Data Center (VDC): Compute virtualization overview, Compute virtualization techniques, Virtual Machines, VM Resource management techniques, Virtual Infrastructure Requirements. Storage: Storage virtualization overview, Virtual Machine Storage, Virtual provisioning and automated storage tiering. Networking: VDC networking overview, VDC networking components, VLAN and VSAN technologies. Business Continuity in VDC, Fault tolerance mechanism in VDC. Cloud Security: Access control and identity management in Cloud, Governance, risk, and compliance, Security best practices for Cloud, Cloud Migration. Issues in Cloud Development: Migration etc.

References:

1. B. Jackson, K. Saurabh, *Cloud Computing*, (2e), Wiley India, 2012.
2. V. Joysula, M. Orr, G. Page, *Cloud Computing: Automating the Virtualized Data Center*, Cisco Press, 2012.
3. R. K. Buyya, *Cloud Computing: Principles and Paradigms*, Wiley Press, 2011.
4. M. Miller, *Cloud Computing*, (8e), Que Publishers, 2008.
5. Course materials from EMC² Education Services.



CS3242: IMAGE PROCESSING AND PATTERN ANALYSIS [2 1 0 3]

Image representation and properties: image processing and computer vision, image processing steps, image digitization, digital image properties, metrics, histograms, entropy, sampling and quantization, image file formats, basic relationships between pixels, physics of color, human perception, color spaces, image sensing and acquisition, monochromatic and color camera. image enhancements: grayscale transformations, brightness interpolation, histogram processing, using arithmetic/logic operations, smoothing spatial filters, sharpening spatial filters, canny edge detection, detection of corners (interest points). mathematical transforms: linearity, convolution, linear integral transform, Fourier transform, DFT, DCT, wavelet transform, SVD, PCA, smoothing frequency-domain filters, sharpening frequency domain filters. Data structure for image analysis: matrices, chains, topological data structures, relational structures, pyramid, quadtree. image restoration: various noise models, image restoration using spatial domain filtering. estimating the degradation function, inverse filtering, wiener filtering. image segmentation and representation: grey level features, edges and lines, similarity, correlation, thresholding, template matching, edge-based segmentation, region-based segmentation, representation scheme, evaluation issues, mean shift segmentation, graph cut segmentation. shape representation and description: contour-based Analysis, Connected Component Analysis, chain code, b-spline representation, region-based, moments, convex hull. image understanding: scale invariant feature transform (SIFT), histograms of oriented gradient (HOG), image morphology, dilation and erosion, skeleton.

References:

1. M. Sonka, V. Hlavac, R. Boyle, *Image Processing, Analysis and Machine Vision*, (4e), Cengage Learning India, 2015.
2. S. Jayaraman, S. Esakkirajan, T Veerakumar, *Digital Image Processing*, (2e), Tata McGraw Hill Education, 2020.
3. R. C. Gonzalez, R. E. Woods, *Digital Image Processing*, (4e), Pearson Education, 2018.
4. Prateek Joshi, *OpenCV with Python by Example*, (1e) PACKT Publishing, 2018.
5. R. C. Gonzalez, R. E. Woods, S. Eddins, *Digital Image Processing using MATLAB*, (2e), Pearson Education, 2017.

CS3230: SOFTWARE ENGINEERING LAB [0 0 2 1]

Introduction: Agile development: Agile Process Models Software, Communication Practice, Planning Practices, Modeling Practices, Construction Practice, Deployment of Computer-Based Systems, The System Engineering Hierarchy. Business Process Engineering: An Overview, Product Engineering: An Overview, Data Modeling Concepts, Object Oriented Analysis, Flow-Oriented Modeling, Taxonomy of Quality Attributes, Perspectives of Quality, Quality System, Software Quality Assurance, Capability Maturity Model Observation on Estimation using Projects, The Project Planning Process, Software Scope and Feasibility, Human Resources, Empirical Estimation Model ,Introduction To DevOps, Cloud Computing And Virtualization, Migration to DevOps, DevOps Tools, All above will be facilitated using Software Projects assigned to the students.

References:

1. R. Pressman, *Software Engineering: A Practitioners Approach*, (8e), McGrawHill Pubs, 2019.
2. M. Walls, *Building a Dev Ops Culture*, O'Reilly Publications, 2013.
3. J. Joyner, *Dev Ops for Beginners, Dev Ops Software Development Method guide for software developers and IT professionals*, Mihails Konoplovs, 2015.

CS3231: INFORMATION SYSTEMS SECURITY LAB [0 0 2 1]

Substitution and Transposition Cipher Implementation: Caesar Cipher, Playfair Cipher, Hill Cipher, Vigenere Cipher, Rail fence. Symmetric and Asymmetric Cipher Implementation: DES, RSA, Diffie-Hellman, MD5, SHA-1. Signature Schemes Implementation: Digital Signature Standard, GnuPG API. Demonstration of secure data storage: Setup of honey pot and monitoring on network using KF sensors. Installation of rootkits. Wireless audit on an access point or a router, WEP and WPA (Net Stumbler). Intrusion detection system using snort.



References:

1. B. A. Forouzan, D. Mukhopadhyay, *Cryptography and Network Security*, (2e), Mc-Graw Hill, 2008.
2. W. Stallings, *Cryptography and Network Security: Principles and Practice*, (5e), Prentice Hall, 2010.
3. J. Pieprzyk, T. Hardjono, J. Seberry, *Fundamentals of Computer Security*, Springer, 2003.

CS3270: MINOR PROJECT [0 0 6 3]

In this course student has to select a project work based on a topic of interest. Periodically the supervisor will evaluate the implementation. This work, started in sixth semester of which, the student will be evaluated internally and externally.

VII SEMESTER

CS4140: CYBER SECURITY [3 0 0 3]

Introduction to cyber security: Computer Security, threats, harm, vulnerabilities, controls, Authentication, Access Control and Cryptography, Web User Side, Browser Attacks, Web Attacks Targeting Users, Email Attacks. Security in operating system and networks: Security in Operating Systems, Security in the Design of Operating Systems, Rootkit, Network security attack, Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of Service. Security Countermeasures: Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management, Databases, Security Requirements of Databases Reliability and Integrity, Database Disclosure, Data Mining and Big Data. Privacy in Cyberspace: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security. Cyber Policies: Policies to mitigate cyber risks, Reducing Supply Chain Risks, Mitigate Risks through Human Resource Development, Information sharing Implementing a Cyber security framework, Digital Signature.

References:

1. M.S. Merkov, J. Breithaupt, *Information Security: Principles & Practices*, (2e), Pearson, 2014.
2. C.P. Pfleeger, S.L. Pfleeger, J. Margulies, *Security in Computing*, (5e), Pearson, 2015.
3. V. Sood, *Cyber Laws Simplified*, (2e) McGraw Hill, 2017.
4. N. Godbole, *Information Systems Security*, (2e), Wiley, 2017.

CS4141: DIGITAL FORENSICS & CYBER CRIMES [2 1 0 3]

Introduction to Computer Forensics: Computer crimes, evidence, extraction, preservation, overview of hardware and operating systems, structure of storage media/devices, uncovering attacks that evade detection by event viewer, task manager, and other Windows GUI tools, data acquisition, disk imaging, recovering swap files, temporary and cache files. Computer Forensic tools: Encase, Helix, FTK, Autopsy, Sleuth kit Forensic Browser, FIRE, Found stone Forensic ToolKit, WinHex, Linux and other open source tools. Mobile and Network Forensics: Collecting and analyzing network-based evidence, reconstructing web browsing, email activity, and windows registry changes, intrusion detection, tracking offenders, Mobile Network Technology, Investigations, Collecting Evidence, Interpretation of Digital Evidence on Mobile Network. Software Reverse Engineering: Defend against software targets for viruses, worms and other malware, improving third-party software library, identifying hostile codes-buffer overflow, provision of unexpected inputs. Computer crime and Legal issues: Intellectual property, privacy issues, Criminal Justice system for forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation, and deposition of legal evidence in a court of law.

References:

1. C. Altheide, H. Carvey, *Digital Forensics with Open Source Tools*, Syngress, 2011.
2. M.T. Britz, *Computer Forensics and Cyber Crime: An Introduction*, (3e), Kindle Edition, 2013.
3. S. Davidoff, J. Ham, *Network Forensics: Tracking Hackers through Cyberspace*, Prentice Hall, 2012.
4. B. Nelson, A. Phillips, F. Enfinger, C. Steua, *Guide to Computer Forensics and Investigations*, Thomson, (4e), 2009.