Teaching Scheme of B.Tech.-III (CSE) (Semester V)

Sr. No.	Course	Code	Credit	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Operating Systems (Core-9)	CS301	5	3	1	2	100	25	50	175
2	Computer Networks (Core-10)	CS303	5	3	1	2	100	25	50	175
3	Professional Ethics, Economics and Business Management	HU303	4	4	0	0	125	0	0	125
4	Institute Elective-1	-	3	3	0	0	100	0	0	100
5	Core Elective-1	CS3AA	3	3	0	0	100	0	0	100
6	Seminar	CS305	1	0	0	2	0	0	50	50
	Total		**21**	**16**	**2**	**6**	**525**	**50**	**150**	**725**
	Total Contact Hours per week			**24**						

Practical Examination Scheme (Internal 50% and External 50%)

Institute Elective-1 (CS3XX):

1	Soft Computing (CS361)	4	Signals & Systems (CS367)
2	Information Security (CS363)	5	Logic and Functional Programming (CS369)
3	Machine Learning (CS365)		

Core Elective-1 (CS3AA):

1	Data Science (CS321)	4	Information Theory & Coding (CS327)
2	Advanced Microprocessor (CS323)	5	Object Oriented Technology (CS329)
3	Parallel Processing and Architecture (CS325)		

Teaching Scheme of B.Tech.-III (CSE) (Semester VI)

Sr. No.	Course	Code	Credit	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Principles of Programming Languages (Core-11)	CS302	5	3	1	2	100	25	50	175
2	Distributed Systems (Core-12)	CS304	5	3	1	2	100	25	50	175
3	System Software (Core-13)	CS306	5	3	1	2	100	25	50	175
4	Artificial Intelligence (Core-14)	CS308	4	3	0	2	100	0	50	150
5	Institute Elective-2	-	3	3	0	0	100	0	0	100
6	Core Elective-2	CS3BB	3	3	0	0	100	0	0	100
	Total		**25**	**18**	**3**	**8**	**600**	**75**	**200**	**875**
	Total Contact Hours per week			**29**						

Practical Examination Scheme (Internal 50% and External 50%)

Institute Elective-2 (CS3YY):

1	Cryptography (CS362)	4	Image Processing (CS368)
2	Digital Forensics (CS364)	5	Adaptive Signal Processing (CS372)
3	Embedded Systems (CS366)		

Core Elective-2 (CS3BB):

1	Data Visualization (CS322)	4	Wireless Networks (CS328)
2	Natural Language Processing (CS324)	5	Optimization Methods (CS332)
3	Cloud Computing (CS326)		

neso academy playlist->
https://www.nesoacademy.org/ee/02-signals-and-systems

B.Tech. III (CSE) Semester – V
OPERATING SYSTEMS (CORE-9)
CS301

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

gate smashers playlist

https://youtube.com/playlist?list=PLxCzCOWd7aiGz9donHRrE9I3Mwn6XdP8p

1. Course Outcomes (COs):

At the end of course, students will be able to

CO1	understand the significance of operating system in computing devices, exemplify the communication between application programs and hardware devices through system calls.
CO2	compare and illustrate various process scheduling algorithms.
CO3	apply appropriate memory and file management schemes.
CO4	illustrate various disk scheduling algorithms.
CO5	design access control and protection based modules for an operating system.

2. Syllabus

- **OPERATING SYSTEM OVERVIEW** **(03 Hours)**

  Operating System(OS) Objectives, Evolution, Types, Major Achievements, Modern Operating Systems, Virtual Machines, OS Design Considerations for Multiprocessor and Multicore.

- **PROCESSES AND THREADS** **(05 Hours)**

  Process Concept, Process States, Process Description, Process Control Block, PCB as a Data Structure in Contemporary Operating Systems, Process Hierarchy, Processes vs Threads, Types of Threads, Multicore and Multithreading, Case Study: Linux & Windows Process and Thread Management and its Related System Calls.

- **CONCURRENCY: MUTUAL EXCLUSION AND SYNCHRONIZATION** **(04 Hours)**

  Principles of Concurrency, Mutual Exclusion, Semaphores, Monitors, Message Passing, Readers/Writers Problem.

- **CONCURRENCY: DEADLOCK AND STARVATION** **(04 Hours)**

  Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher's Problem, Case Study: Linux & Windows Concurrency Mechanism.

- **SCHEDULING** **(08 Hours)**

  Uniprocessor Scheduling: Long Term Scheduling, Medium Term Scheduling, Short Term Scheduling, Scheduling Algorithms: Short Term Scheduling Criteria, Use of Priorities, Alternative Scheduling Policies, Performance Comparison, Fair-Share Scheduling. Multiprocessor Scheduling: Granularity, Design Issue, Process Scheduling, Thread Scheduling, Real-Time Scheduling: Characteristics of RTOS, Real-Time Scheduling, Deadline Scheduling,

neso academy playlist->
https://www.nesoacademy.org/cs/03-operating-system

Rate Monotonic Scheduling, Priority Inversion. Case Study: Linux & Windows Scheduling.

- **MEMORY MANAGEMENT** **(05 Hours)**

  Memory Hierarchy, Static and Dynamic Memory Allocation, Overview of Swapping, Multiple Partitions, Contiguous and Non-Contiguous Memory Allocation, Concepts of Simple Paging, Simple Segmentation.

- **VIRTUAL MEMORY** **(05 Hours)**

  Virtual Memory Concepts, Paging and Segmentation using Virtual Memory, Protection and Sharing, Fetch Policy, Placement Policy, Replacement Policy, Resident Set Management, Cleaning Policy, Load Control, Case Study: Linux & Windows Memory Management.

- **I/O MANAGEMENT AND DISK SCHEDULING** **(04 Hours)**

  I/O Device, Organisation of the I/O Function, Operating System Design Issue, I/O Buffering, Disk Scheduling, RAID, Disk Cache, Case Study: Linux & Windows I/O.

- **FILE MANAGEMENT** **(04 Hours)**

  Overview of : Files & File Systems, File Structure, File Management Systems, File Organisation and Access, B-tree, File Directories, File Sharing, Record Blocking, Secondary Storage Management, File System Security, Case Study: Linux & Windows File System.

Tutorials will be based on the coverage of the above topics separately. **(14 Hours)**

Practicals will be based on the coverage of the above topics separately **(28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours= 84 Hours)

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3. <u>Tutorials:</u>

1 Assignment based on Process scheduling algorithm.

2 Questions based on Page replacement algorithm.

3 Assignment based on Banker's algorithm.

4 Assignment based on Semaphores and monitors.

5. <u>Practicals:</u>

1 Introduction to Basic and Advance commands of Linux.

2 Introduction to Shell Script and programs based on it.

3 Practical based on different Memory management scheme.

4 Practical based on different Process scheduling algorithm.

5 Practical based on different Disk scheduling algorithm.

6 Process synchronization and deadlock.

7 Practical based on file management system.

8 Practical based on input output device management.

6. Books Recommended:

1. Silberschatz, Galvin and Gagne, "Operating System Concepts", 10/E, John Wiley & Sons, 2018.
2. W. Stallings, "Operating Systems: Internals and Design Principles", 9/E, Pearson Pub., 2017.
3. W Richard Stevens, Stephen A Rago, "Advanced Programming in the UNIX Environment"; 3/E, Addison Wesley Professional, 2013.
4. Kernighan & Pike, "UNIX programming Environment", 2/E, PHI-EEE, 2001.
5. A Tanenbaum, A Woodhull, "Operating Systems - Design and Implementation", 3/E, PHI EEE, 2006.

ADDITIONAL REFERENCE BOOKS

1. Crawley, "Operating Systems - A Design Oriented Approach", 1/E, McGraw Hill, 1998.

B.Tech. III (CSE) Semester – V
COMPUTER NETWORKS (CORE - 10)
CS303

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

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1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand computer network models and services offered at different layers of network protocol stack.
CO2	apply knowledge of data communication, data transmission techniques using various transmission media to deliver error free data and communicate with multiple nodes.
CO3	analyse various routing methods to identify effective routing protocols.
CO4	evaluate network performance by means of transport and flow control protocols, Congestion Control protocols and Quality of services.
CO5	create a computer network application using modern network tools and simulation softwares.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Overview of Computer Networks and Data Communication, Computer Networking Protocols and Standards, Types of Computer Networks, Network Topology, Protocol Hierarchies and Design Issues, Interfaces and Services, Networking Devices, OSI and TCP/IP Reference Models.

- **PHYSICAL LAYER** **(06 Hours)**

  Physical Layer Design Issues, Data Transmission Techniques, Multiplexing, Transmission Media, Asynchronous Communication, Wireless Transmission, ISDN, ATM, Cellular Radio, Switching Techniques and Issues.

- **LOGICAL LINK CONTROL LAYER** **(06 Hours)**

  LLC Design Issues, Framing, Error and Flow Control, Framing Techniques, Error Control Methods, Flow Control Methods, PPP and HDLC.

- **MEDIUM ACCESS CONTROL LAYER** **(06 Hours)**

  MAC Layer Design Issues, Channel Allocation Methods, Multiple Access Protocols - ALOHA, CSMA, CSMA/CD Protocols, Collision Free Protocols, Limited Contention Protocols, LAN Architectures, IEEE -802 Standards, Ethernet(CSMA/CD), Token Bus, Token Ring, DQDB, FDDI, Bridges and Recent Developments.

- **NETWORK LAYER** **(06 Hours)**

  Network Layer Design Issues, Routing Algorithms and Protocols, Congestion Control Algorithms and QoS, Internetworking, Addressing, N/W Layer Protocols and Recent Developments.

- **TRANSPORT LAYER** **(06 Hours)**

  Transport Layer Design Issues, Transport Services, Sockets, Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Transport Layer Protocols, Real Time Transport Protocol (RTP), Stream Control Transmission Protocol (SCTP), Congestion Control, QoS and Recent Developments, Virtualization, Network Functions Virtualization(NFV), Software Defined Networks.

- **APPLICATION LAYER** **(06 Hours)**

  Client Server Model, Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP) and Recent Developments.

Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

Practicals will be based on the coverage of the above topics separately **(28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours= 84 Hours)

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3. Practicals:

1 Study network configuration commands and computer network setup.

2 Implementation of different Data Link and MAC Layer protocols.

3 Implementation of different Network Layer protocols.

4 Implementation of different Transport and Application Layer protocols.

5 Design and configure a network systems using modern network simulator softwares.

6 Implementation of Secured Socket Layer protocol.

7 Implementation of ICMP based message transmission over network.

8 Implementation of SMTP protocol for mail transfer.

4. Tutorials:

1 Problem solving on basics of data communication and networking.

2 Problem solving on framing, error control and flow control of Data link layer.

3 Problem solving on various LAN standards.

4 Problem solving on logical address, sub net masking and routing protocols of Network Layer.

5 Problem solving on congestion control, flow control and error control of transport layer.

6 Problem solving on various services provided by application layer.

5. Books Recommended:

1. William Stalling, "Data and Computer Communication", 10/E, Pearson India, 2017.
2. B. Forouzan, "Data Communication and Networking", 5/E, McGraw Hill, 2017.
3. Douglas E. Comer, "Internetworking with TCP/IP Volume – I", 6/E Pearson India, 2015.
4. Andrew S. Tanenbaum, "Computer Network", 5/E, Pearson India, 2013.
5. W. Richard Stevens, "TCP/IP Illustrated Volume - I", 2/E, Addison Wesley, 2011.

B.Tech. III (CSE) Semester – V
PROFESSIONAL ETHICS, ECONOMICS AND BUSINESS MANAGEMENT
HU303

L	T	P	Credit
4	0	0	04

Scheme

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	identify application of ethics in society and development of understanding regarding Professional ethical issues related to Computer Science and Engineering.
CO2	develop managerial skills to become future engineering managers.
CO3	develop skills related to various functional areas of management (Marketing Management, Financial Management, Operations Management, Personnel Management etc.)
CO4	build knowledge about modern management concepts (ERP, SCM, e-CRM, etc.)
CO5	develop experiential learning through Management games, Case study discussion, Group discussion etc.
CO6	apply knowledge of Economics and Business management aspects in Computer Science and Engineering.

2. Syllabus

- **PROFESSIONAL ETHICS** **(14 Hours)**

  Introduction, Approaches to Ethics, Meaning of Ethics, Major attributes of Ethics, Business Ethics, Factors influencing Ethics, Importance of Ethics, Ethics in Management, Organizational Ethics, Ethical aspects in Marketing, Mass communication and Ethics - Television, Whistle blowing, Education – Ethics and New Professional, Intellectual Properties and Ethics, Introduction to Professional Ethics, Engineering Ethics, Ethical issues related to Computer Science and Engineering.

- **ECONOMICS** **(08 Hours)**

  Introduction to Economics, Micro & Macro Economics, Applications & Scopes Of Economics, Demand Analysis, Demand Forecasting, Factors Of Production, Types Of Cost, Market Structures, Break Even Analysis

- **MANAGEMENT** **(12 Hours)**

  Introduction to Management, Features Of Management, Nature Of Management, Development of Management Thoughts – Scientific Management By Taylor & Contribution of Henry Fayol, Coordination & Functions Of Management, Centralization & Decentralization, Decision Making; Fundamentals of Planning; Objectives & MBO; Types of Business Organizations: Private Sector, Public Sector & Joint Sector; Organizational Behaviour: Theories of Motivation, Individual &

Group Behaviour, Perception, Value, Attitude, Leadership.

- **FUNCTIONAL MANAGEMENT** **(18 Hours)**

  Marketing Management: Core Concepts Of Marketing, Marketing Mix (4p), Segmentation – Targeting – Positioning, Marketing Research, Marketing Information System, Concept of International Marketing, Difference Between Domestic Marketing & International Marketing; Operations Management: Introduction to Operations Management, Types of Operation Systems, Types of Layouts, Material Handling, Purchasing & Store System, Inventory Management; Personnel Management: Roles & Functions of Personnel Manager, Recruitment, Selection, Training, Industrial Dispute, Collective Bargaining; Financial Management: Goal of Financial Management, Key Activities In Financial Management, Organization of Financial Management, Financial Institutions, Financial Instruments, Sources of Finance.

- **MODERN MANAGEMENT ASPECTS** **(04 Hours)**

  Introduction To ERP, e – CRM, SCM, RE – Engineering, WTO, IPR Etc.

(Total Contact Time: 56 Hours)

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3. Books Recommended:

1. Balachandran V.and Chandrasekaran, “Corporate Governance, Ethics and Social Responsibility”, PHI, 2nd Edition, 2011.
2. Prasad L.M., “Principles & Practice of Management, Sultan Chand & Sons”, 8th Edition,2015.
3. Banga T. R. & Shrama S.C., “Industrial Organisation & Engineering Economics”, Khanna Publishers, 25th Edition, 2015.
4. Everett E. Adam, Ronald J. Ebert, “Production and Operations Management”, Prentice Hall of India, 5th edition, 2012.
5. Kotler P., Keller K. L, Koshi A.& Jha M., “Marketing Management – A South Asian Perspective”, Pearson, 14th Edition, 2014.

ADDITIONAL REFERENCE BOOKS

1. Tripathi P.C., “Personnel Management & Industrial Relations, Sultan Chand & sons”, 21st Edition, 2013.
2. Chandra P., “Financial Management”, Tata McGraw Hill, 9th Edition, 2015.
3. Crane A. & Matten D., “Business Ethics: Managing Corporate Citizenship and Sustainability in the Age of Globalisation”, Oxford University, 2010.
4. Fritzsche D. J., “Business Ethics: a Global and Managerial Perspectives”, McGraw Hill Irwin, Singapore, 2004.
5. Mandal S. K., “Ethics in Business and Corporate Governance”, Tata McGraw Hill, 2011.

B.Tech. III (CSE) Semester – V
SOFT COMPUTING (INSTITUE ELECTIVE-1)
CS361

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the human intelligence, artificial Intelligence and the knowledge about the soft computing approaches.
CO2	apply different soft computing techniques like fuzzy logic, genetic algorithm, neural network and bio-inspired techniques, Evolutionary approaches for problem solving.
CO3	analyse the learning methods for optimizing the solution.
CO4	evaluate performance of different soft computing techniques.
CO5	design and innovate solution for real life example using bio-inspired techniques which mimic human brain abilities.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Concepts of Artificial Intelligence, Need of Machine Learning, Learning Methods, Soft Computing Approach, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Applications.

- **NEURAL NETWORK** **(12 Hours)**

  Model of Artificial Neuron, Neural Network Architectures, Weights, Activation Functions, Learning Models, Learning Rate, Bias, McCulloch Pitts Neuron, Single Layer Neural Network, Multi Layers Neural Networks, Training Algorithms, Back Propagation Method, Supervised Learning, Unsupervised Learning, Radial Basis Functions, Auto-associative Memory, Bi-directional Hetero-associative Memory, Hopfiled Network, Kohonen Self-organizing Network, Learning Vector Quantization, Simulated Annealing Network, Boltzmann Machine, Applications.

- **FUZZY SET THEORY** **(08 Hours)**

  Fuzzy Sets, Membership, Fuzzy Operations, Properties, Fuzzy Relation, Fuzzy Systems, Fuzzy Logic, Fuzzification, Fuzzy Inference, Decision Making, Fuzzy Rule based System, De-fuzzification, Applications.

- **GENETIC ALGORITHMS** **(08 Hours)**

Fundamentals of Genetic Algorithms, Chromosomes, Encoding, Selection Operator, Mutation Probability, Mutation Operator, Crossover Probability, Crossover Operator, Fitness Function, Different Variants of Genetic Algorithms, Applications.

- **NATURE INSPIRED TECHNIQUES AND HYBRID SYSTEM (08 Hours)**

Ant Colony, Particle Swarm Optimization, Integrating Neural Networks, Fuzzy Logic, and Genetic Algorithms, GA based Back Propagation Networks, Fuzzy Back Propagation Networks, Applications.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Timothy J. rd Ross, “Fuzzy Logic with Engineering Applications”, 3rd Ed., Willey, 2010.
2. B. Yagnanarayana, "Artificial Neural Networks", 1st Ed., PHI, 2009.
3. Simon O. Haykin, "Neural Networks and Learning Machines", 3/E, Prentice Hall, 2009.
4. S. Rajasekaran, G. A. VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", PHI, 2007.
5. David E. Goldberg, " Genetic Algorithms in Search, Optimization, and Machine Learning", 1st Ed., Addison-Wesley Professional, 2006.

ADDITIONAL REFERENCE BOOKS

1. S. N. Sivanandam, S. N. Deepa,“Principles of Soft Computing”, Wiley India Edition, 2010.
2. Hoffmann F., Koeppen M., Klawonn F., Roy R, “Soft Computing: Methodologies and Applications”, Springer, 2005.
3. Rafik Aziz oglyAliev, R. R. Aliev, “Soft Computing and Its Applications”, World Scientific, 2001.
4. F. Martin, Mc Neill, and Ellen Thro, “Fuzzy Logic: A Practical approach”, AP Professional, 2000.

B.Tech. III (CSE) Semester – V
INFORMATION SECURITY (INSTITUE ELECTIVE-1)
CS363

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand the concepts related to cryptography and system security.
CO2	apply the concept of security services and mechanisms from the application developers and network administrator's perspective.
CO3	analyse the security schemes for their use in different application scenarios.
CO4	evaluate and asses the computer and network systems for associated risks.
CO5	design the security schemes depending on the organisation's requirements.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Security Introduction, Characteristics of Information: Availability, Accuracy, Authenticity, Confidentiality, Integrity, Utility, Possession, CIA Traid, Reference Model of Information Assurance & Security (RMIAS), Components of an Information System: Software, Hardware, Data, People, Procedures, Networks, Securing Components, Balancing Information Security and Access, Approaches to Information Security Implementation.

- **NEED FOR SECURITY** **(04 Hours)**

  Business Needs: Protecting the Functionality, Enabling Safe Operation, Protecting Data, Safeguarding Technology Assets, Threats, Attacks: Malicious Code, Backdoors, Password Crack, Brute Force, Dictionary, DoS and DDoS, Spoofing, Man-in-the-Middle, Spamming, Sniffing, Social Engineering, Buffer Overflow, Timing Attack.

- **DIGITAL WATERMARKING AND STEGANOGRAPHY** **(04 Hours)**

  Properties of Watermarking: Embedding Effectiveness, Fidelity, Data Payload, Blind or Informed Detection, False Positive Rate, Robustness, Keys etc. Properties of Steganography: Embedding, Steganographic Capacity, Embedding Capacity, Embedding Efficiency, and Data Payload, Blind or Informed Extraction, Blind or Targeted Steganalysis, Statistical Undetectability, False Alarm Rate, Robustness, Security, Stego Key, Evaluating and Testing Steganographic Systems.

- **SECURITY RISK ASSESSMENT AND MITIGATION** **(04 Hours)**

Vulnerability, Threat and Risk, Risk Assessment and Mitigation + Quick Fixes, Introduction to BCP / DRP / Incident Management, Segregation and Separation of Duties & Roles and Responsibilities, IT ACT 2000.

- **INTRODUCTION TO SYMMETRIC KEY CRYPTOGRAPHY AND PUBLIC KEY CRYPTOGRAPHY (06 Hours)**

  Traditional and Modern Symmetric Key Ciphers, Block Ciphers and Stream Cipher, Block Cipher Modes of Operations, Security Analysis, Public Key Characteristics, PKC Applications, Public Key Requirements, RSA, Diffie-Hellman Key Agreement Protocol, Security Analysis.

- **TYPES OF ASSESSMENTS FOR INFORMATION SECURITY (04 Hours)**

  VAPT of Networks, Web Appln Audits, IT Assessments or Audits, Assessment of Network Equipment, Assessment of Security Devices (Web Filtering, Firewalls, IDS / IPS, Routers, Data Centre Assessment, Security of Application Software, SAP Security, Desktop Security, RDBMS Security, BCP / DRP assessments, Policy Reviews, Network Security & Common and Popular Tools Used.

- **OPERATING SYSTEMS SECURITY (04 Hours)**

  Windows and Linux Security, Types of Audits in Windows Environment: Server Security, Active Directory (Group Policy), Anti-Virus, Mails, Malware, End Point Protection, Shadow Passwords, SUDO Users, UNIX File Access Control, Access Control Lists in UNIX, Windows Security : Access Control Scheme, Access Token, Security Descriptors, Operating Systems Hardening.

- **CURRENT TRENDS IN INFORMATION SECURITY (04 Hours)**

  Securing Cloud Server, Standards of Information Security: Cobit, Cadbury, ISO 27001, OSSTMM, Security Laws and Policies, Privacy Breaches, Overview of Privacy Preserving Techniques.

- **WEB APPLICATION SECURITY (06 Hours)**

  Web Application Security: Common Issues in Web Apps, Basic Web Security Model, Cross Side Scripting, SQL Injection, Password Vulnerabilities, Session Hijacking, Local and Remote File Inclusion, Audit Trails, HTTPS, OWASP Security Knowledge Framework, CAPTCHA, User Authentication and Session Management for Web Apps, The Security Architecture of Web Browsers.

- **ADVANCED TOPICS (02 Hours)**

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. William Stallings, "Cryptography and Network Security – Principles and Practice", 7/E, Pearson Education, 2013.
2. William Stallings “Network security essentials: applications and standards”, 3/E, Pearson

Education, 2009.

3. Forouzan and Mukhopadhyay, “Cryptography and Network Security”, 3/E, McGraw Hill, 2015.
4. Menezes Bernard, “Network Security and Cryptography”, 1/E, Cengage Learning India, 2010.
5. Douglas Stinson, “Cryptography: Theory and Practice”, 3/E, CRC Press, 2006.

ADDITIONAL REFERENCE BOOKS

1. Menezes, Oorschot, Vanstone: “Handbook of Applied Cryptography”, CRC Press, 1996.
2. Dhiren Patel, “Information Security: Theory and Practice”, PHI, 2008.

B.Tech. III (CSE) Semester – V
MACHINE LEARNING (INSTITUE ELECTIVE-1)
CS365

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge of pattern recognition, regression, classification, clustering algorithms and statistics.
CO2	apply different classification, regression, machine learning algorithms and modelling.
CO3	analyze the data patterns and modelling for applying the learning algorithms.
CO4	evaluate the performance of an algorithm and comparison of different learning techniques.
CO5	design solution for real life problems like biometric recognition, natural language processing and its related applications using various tools and techniques of machine learning.

2. Syllabus

- **INTRODUCTION** **(09 Hours)**

  Pattern Representation, Concept of Pattern Recognition and Classification, Feature Extraction, Feature Selection, Basics of Probability, Bayes Decision Theory, Maximum-Likelihood and Bayesian Parameter Estimation, Error Probabilities, Learning of Patterns, Modelling, Regression, Discriminant Functions, Linear Discriminant Functions, Decision Surface, Learning Theory, Fisher Discriminant Analysis.

- **SUPERVISED LEARNING ALGORITHMS** **(09 Hours)**

  Linear Regression, Gradient Descent, Support Vector Machines, Artificial Neural, Networks, Decision Trees, ML and MAP Estimates, K-Nearest Neighbor, Naive Bayes, Bayesian Networks, Classification, Overfitting, Regularization, Multilayer Networks, Back-propagation, Bayes Classification, Nearest Neighbor Classification, Cross Validation and Attribute Selection, K Means Clustering, Agglomerative Hierarchical Clustering.

- **UNSUPERVISED LEARNING ALGORITHMS** **(09 Hours)**

  K-Means Clustering, Gaussian Mixture Models, Learning with Partially Observable Data, Expectation Maximization Approach. Dimensionality Reduction, Principal Component Analysis, Model Selection and Feature Selection.

- **TRANSFORM DOMAIN PATTERN ANALYSIS** **(06 Hours)**

Signal Transformation, Frequency Domain Representation of Signal, Feature Extraction and Analysis, Multiresolution Representation, Wavelet Transform, Discrete Cosine Transform.

- **APPLICATIONS** **(09 Hours)**

  Signal Processing Application, Image Processing, Biometric Recognition, Face and Speech Recognition, Information Retrieval, Natural Language Processing.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Geoff Dougherty, "Pattern Recognition and Classification: An Introduction", 1st Edition, Springer, 2013.
2. Theodoridis and K.Koutroumbas, "Pattern Recognition", 4th Ed., Academic Press, 2009.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 1st Edition, Springer, 2006.
4. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition, Wiley, 2001.
5. K. Fukunaga, "Introduction to Statistical Pattern Recognition", 2nd Edition, Academic Press, 2000.

ADDITIONAL REFERENCE BOOKS

1. Ranjjan Shinghal, "Pattern Recognition Techniques and Application", 1st Edition, Oxford university press, 2006.

B.Tech. III (CSE) Semester – V
SIGNALS AND SYSTEMS (INSTITUE ELECTIVE-1)
CS367

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge about basics signals and their classification, different types of systems, the process of sampling.
CO2	apply the Laplace transform and Z – transform for analysis of continuous-time and discrete-time signals and systems and designing the filters.
CO3	analyze system properties based on impulse response and Fourier analysis for different applications.
CO4	evaluate the laplace transform, fourier transform and Z-transform, system performance, filter performance etc.
CO5	design and innovate a solution using the knowledge about various filter design and signal processing concepts.

2. Syllabus

- **INTRODUCTION TO SIGNALS** **(06 Hours)**

  Signal Classification: Analog vs. Digital Signal, Energy, Power, Even-odd, Periodic-aperiodic, Deterministic-random Signals, Standard Signals: Unit Step, Unit Impulse, Ramp, Exponential, Sinusoids, Continuous-time Signals and Discrete Signals and their Properties, Discrete Exponential Functions and their Properties, Discrete Unit Step and Impulse Signals and their Properties.

- **INTRODUCTION TO SYSTEMS** **(08 Hours)**

  System Classifications, Analog-digital Systems, Continuous-discrete Time Systems, Linearity, Time Invariance, Memory, Linear-time-invariant Systems, Causality, System Stability, System Response: Impulse Response, Unit Step Response, Convolution.

- **SIGNAL TRANSFORMS AND SAMPLING** **(08 Hours)**

  Laplace Transform, Fourier Series and Fourier Transform, Digital Sequences, Linear Difference Equations with Constant Coefficients, Realizations, Frequency-domain Representation of Discrete-time Signals and Systems, Sampling of Continuous-time Signals: Periodic Sampling, Frequency-Domain Representation of Sampling, Reconstruction of a Band-limited Signal, Changing the Sampling Rate Using Discrete-time Processing, Quantization, Aliasing, Interpolation, Decimation.

- **Z-TRANSFORM** **(04 Hours)**

  Properties of the Z-transform, Transfer Function Representation, Inverse Z-transform, Z-transform Applied to Difference Equations, The Complex Convolution Theorem, Stability of Discrete-time Systems, Frequency Response of Discrete-time Systems.

- **DISCRETE FOURIER TRANSFORM** **(04 Hours)**

  Discrete-Time Fourier Transform (DTFT), The Discrete Fourier Series, The Fourier Transform of Periodic Signals, Discrete Fourier Transform (DFT), Properties of the DFT, System Analysis via the DTFT and DFT, Circular Convolution, Linear Convolution Using the DFT, Implementation of the DFT Using Convolution

- **FAST FOURIER TRANSFORM (FFT) ALGORITHMS** **(04 Hours)**

  Decimation in Time FFT, Introduction to Radix-2 FFTs, Some Properties of Radix-2 Decimation in Time FFT, Decimation in Frequency Algorithm, Computing the Inverse DFT by Doing a Direct DFT.

- **FILTERS AND ADVANCED SIGNAL PROCESSING** **(08 Hours)**

  Multirate Signal Processing, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) Filter Design, Power Spectral Density, Applications of Digital Signal Processing.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Alan V. Oppenheim and Alan S. Willsky, “Signals and Systems”, 2nd Edition, Pearson Education, 2014.
2. Vinay K. Ingle and John G. Proakis, “Digital Signal Processing using MATLAB”, 2nd Edition, Companion Series 2000.
3. Johnny Johnson,” Introduction to Digital Signal Processing”, PHI, New Delhi, 1997.
4. John G. Proakis & Dimitris G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, 3/E, PHI,1996
5. Alan W. Oppenheim & Ronald W. Schafer, “Discrete-time Signal Processing”, 2nd Edition, PHI, New Delhi, 1992.

B.Tech. III (CSE) Semester – V
LOGIC AND FUNCTIONAL PROGRAMMING
(INSTITUTE ELECTIVE-1)
CS369

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand the concepts and terms used to describe languages that support the imperative, functional, object-oriented, and logic programming paradigms.
CO2	solve complex problems using logic as well as functional programming.
CO3	explain on a simple problem how logic programming differs from functional programming.
CO4	critically evaluate what approach and language is best suited for an upcoming problem.
CO5	implement/design wide range of algorithms and data structures as correct, elegant and efficient functional programs.

2. Syllabus

- **LOGIC** **(03 Hours)**

  Propositional Logic and Predicate Logic, Converse and Contrapositive, Reasoning with Propositions, Natural Deduction – Rules, Provable Equivalence, Semantics, Logical Connectives, Soundness and Completeness of Propositional Logic, Normal Forms, Identities of Propositions and Dual, Use of Identities, Reasoning with Propositions, Semantic Equivalence, Satisfiability and Validity, Conjunctive Normal Forms.

- **PREDICATE LOGIC** **(03 Hours)**

  Terms, Formulas - Well Formed Formula (WFF) of Predicate Logic, Constructing Formulas; Free and Bound Variables, Reasoning with Predicate Logic, Deduction Rules, Quantifier, Semantics, Un-Decidability of Predicate Logic, Expressiveness, Second-Order Logic.

- **VERIFICATION** **(03 Hours)**

  Linear-Time Temporal (LTL) Logic, Syntax and Semantics, Model Checking: Systems, Tools, Properties, Branching-Time 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.

- **THE LAMBDA CALCULAS** **(04 Hours)**

  The Syntax of the Lambda Calculus, Lambda Abstractions, Operational Semantics of the Lambda Calculus, Bound and Free Variables, Recursive Functions, The Denotational Semantics of the Lambda Calculus, Defining the Semantics of Built-In Functions and Constants, Strictness and Laziness, The Correctness of the Conversion Rules.

- **TRANSLATING A HIGH-LEVEL FUNCTIONAL LANGUAGE INTO THE LAMBDA CALCULUS** **(02 Hours)**

  Structure of the Translation Process, Translating Miranda Into the Enriched Lambda Calculus, The TE Translation Scheme.

- **STRUCTURED TYPES AND THE SEMANTICS OP PATTERN-MATCHING** **(03 Hours)**

  Introduction to Structured Types, Introduction to Pattern-Matching, Introducing Pattern-Matching Lambda Abstractions, The Semantics of Pattern-Matching Lambda Abstractions: Variable Patterns, Constant Patterns, Sum-Constructor Patterns, Product-Constructor Patterns.

- **EFFICIENT COMPILATION OF PATTERN-MATCHING** **(02 Hours)**

  The Pattern-Matching Compiler Algorithm: Function Match, Variable Rule, Constructor Rule, Empty Rule, Example.

- **TRANSFORMING THE ENRICHED LAMBDA CALCULUS** **(05 Hours)**

  Transforming Pattern–Matching Lambda Abstractions: Constant Patterns, Product-Constructor Patterns, Sum-Constructor Patterns, Dependency Analysis, Transforming Case-Expressions: Case-Expressions Involving a Product Type, Case-Expressions Involving a Sum Type.

- **LIST COMPREHENSIONS** **(02 Hours)**

  Introduction to List Comprehensions, Reduction Rules for List Comprehensions, Translating List Comprehensions.

- **POLYMORPHIC TYPE-CHECKING** **(02 Hours)**

  Informal Notation for Types: Types, Lists, Structured Types, Functions, Polymorphism: The Identity Function, Rule for Applications, Lambda Abstractions, and Let-Expressions.

- **TYPE-CHECKER** **(02 Hours)**

  Representation of Programs, Representation of Type Expressions, Solving Equations, Keeping Track of Types, The Type-Checker.

- **PROGRAM REPRESENTATION** **(03 Hours)**

  Abstract Syntax Trees, The Graph, Concrete Representation of the Graph, Tags and Type-Checking, Boxed and Unboxed Objects, Tagged Pointers, Storage Management, Garbage Collection, Data Constructors, Input and Output, Evaluating Arguments of Built-In Functions.

- **GRAPH REDUCTION OF LAMBDA EXPRESSIONS** **(03 Hours)**

  Reducing a Lambda Application: Substituting Pointers to the Argument, Overwriting The Roots of the Redex, Constructing a New Instance of the Lambda Body. Reducing a Built-In Function Application, Reduction Algorithm, Indirection Nodes.

- **SUPERCOMBINATORS AND LAMBDA-LIFTING** **(03 Hours)**

  Solving Problems of Free Variables, Transforming Lambda Abstractions Into Supercombinators: Eliminating Redundant Parameters, Parameter Ordering, Recursive Supercombinators: Notation, Generating Supercombinators with Graphical Bodies, Compile-Time Simplifications.

- **FULLY-LAZY LAMBDA-LIFTING** **(02 Hours)**

  Full Laziness, Maximal Free Expressions, Lambda-Lifting Using Maximal Free Expressions.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Greg Michaelson, "An Introduction to Functional Programming through Lambda Calculus", Dover Publications, 2011.
2. Michael Huth, Mark Ryan, "Logic in Computer Science: Modelling and Reasoning about Systems", Cambridge University Press, 2004.
3. Anthony J. Field, Peter Harrison, "Functional Programming", Addison Wesley Publishing Company, 2000.
4. Richard S. Bird, Philip Wadler, "Introduction to Functional Programming", Prentice Hall, 1998.
5. Simon L. Peyton Jones, "The Implementation of Functional Programming Languages", Prentice Hall International, 1987.

ADDITIONAL REFERENCE BOOKS

1. George Metakides, Anil Nerode, "Principles of Logic and Logic Programming", Elsevier Science Ltd., 1996.
2. Kees Doets, "From Logic to Logic Programming", MIT Press, 1994.

B.Tech. III (CSE) Semester – V
DATA SCIENCE (CORE ELECTIVE-1)
CS321

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At end of the Course student will be able to

CO1	understand types of data and various data science approaches.
CO2	apply various data pre-processing and manipulation techniques including various distributed analysis paradigm using hadoop and other tools and perform advance statistical analysis to solve complex and large dataset problems.
CO3	analyse different large data like text data, stream data, graph data.
CO4	interpret and evaluate various large datasets by applying Data Mining techniques like clustering, filtering, factorization.
CO5	design the solution for the real life applications.

2. Syllabus

- **INTRODUCTION (02 HOURS)**

  Examples, Applications and Results Obtained Using Data Science Techniques, Overview of the Data Science Process.

- **MANAGING LARGESCALE DATA (02 HOURS)**

  Types of Data and Data Representations, Acquire Data (E.G., Crawling), Process and Parse Data, Data Manipulation, Data Wrangling and Data Cleaning.

- **PARADIGMS FOR DATA MANIPULATION, LARGE SCALE DATA SET (08 HOURS)**

  Mapreduce (Hadoop), Query Large Data Sets in Near Real Time with Pig and Hive, Moving from Traditional Warehouses to Map Reduce, Distributed Databases, Distributed Hash Tables.

- **TEXT ANALYSIS (10 HOURS)**

  Data Flattening, Filtering and Chunking, Feature Scaling, Dimensionality Reduction, Nonlinear Factorization, Shingling of Documents, Locality Sensitive Hashing for Documents, Distance Measures, LSH Families for Other Distance Measures, Collaborative Filtering.

- **MINING DATA STREAM (08 HOURS)**

  Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Moments, Windows, Clustering for Streams.

- **ADVANCE DATA ANALYSIS** **(12 HOURS)**

  Graph Visualization, Data Summaries, Hypothesis Testing, ML Model-Checking and Comparison, Link Analysis, Mining of Graph, Frequent Item Sets Analysis, High Dimensional Clustering, Hierarchical Clustering, Recommendation Systems.

Total Contact Time: 42 Hours

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3. Books Recommended:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'reilly Media, 2015, ISBN: 9781491901687.
2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, 2014, ISBN: 9781107077232.
3. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50" by , 1st Edition, O'reilly publishing house, 2017, ISBN: 9781491952962.
4. Joel Grus, J. "Data science from scratch", 1st Edition, O'Reilly Media, 2015, ISBN: 9781491901410.
5. Montgomery, Douglas C., and George C. Runger. "Applied statistics and probability for engineers", John Wiley & Sons, 7th Edition, 2018, ISBN: 9781119400363.

B.Tech. III (CSE) Semester – V
ADVANCED MICROPROCESSOR (CORE ELECTIVE-1)
CS323

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	describe different modes of operations of a typical microprocessor.
CO2	design and develop 80x86 assembly language programs using software interrupts and various assembler directives.
CO3	develop Interface microprocessors with various external devices.
CO4	analyse and compare the features of 80x86 microprocessors, Multicore architecture, ARM processors and microcontrollers.
CO5	design and develop assembly language programs using 8051 microcontroller.

2. Syllabus

- **ARCHITECTURAL FEATURES OF 16/32/64 MICROPROCESSORS** **(06 Hours)**

  Internal Architecture, Register Organization (General-Purpose Register, Segment Register, Status and Control Register, Instruction Pointer, Segment Descriptor Cache Register, System Address Registers LDTR, GDTR, Debug Register, Test Registers, Control Registers. Addressing Modes , Real, PVAM, Paging, Address Translation in Real, PVAM, Paging, Enabling and Disabling Paging (Machine Status Word), Salient Features of 32/64 System Architecture, Superscalar Execution, Separate Code & Data Cache, Floating Point Exceptions, Branch Prediction, Intel MMX Architecture.

- **MICROCONTROLLER** **(06 Hours)**

  Overview of Micro Controllers-8051 Family Microcontrollers, Instruction Set, Pin Out, Memory Interfacing.

- **ARM PROCESSOR FUNDAMENTALS** **(07 Hours)**

  Registers, Current Program Status Registers, Pipeline Exceptions, Interrupts and Vector Table, Architecture Revisions, ARM Processor Families, ARM Instruction Set, Thumb Instruction Set-Exceptions Handing, Interrupts, Interrupt Handling Schemes, Firmware, Embedded Operating Systems, Caches-Cache Architecture, Cache Policy, DSP on the ARM7TDMI, ARM9TDMI.

- **ADVANCED INTEL PROCESSORS** **(06 Hours)**

  Architecture and Programming Including Xeon and Others, Dual Processors, DSP Processors, Various Peripherals and Interfacing Including Memory and I/O.

- **INTRODUCTION TO MULTICORE PROCESSORS** **(05 Hours)**

  Hyper Threading Technology, Define Core, Limitations of Single Core Processor, Concept of Multi Core Processing and Its Advantages, Homogeneous and Heterogeneous Multicore

Processors, Single Core and Multicore Processors Comparison, Major Issues in Multicore Processing, Internal Architecture of Intel Core2 Duo, Important Technological Features of IA Processors, Comparison of Core I3, I5 and I7 Processors.

- **INTERFACE C/C++ WITH ASSEMBLY LANGUAGE** **(06 Hours)**

  C and Assembly, Inline Assembly, Linked Assembly, Calling Conventions.

- **I/O BUSES, PARALLEL & SERIAL PORTS, USB** **(03 Hours)**

  Bus Characteristics, Bus Design Considerations, Bus Communications, Bus Standards, Bus Details.

- **CHIPSET, MOTHERBOARD AND CURRENT TRENDS OF PC** **(03 Hours)**

  Chipset Architecture, North/South Bridge Architecture, Hub Architecture, Case Study of Intel Chipsets.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Douglas V Hall, "Microprocessors and Interfacing: Programming & Hardware", 3/E, TMH, 2013.
2. Barry B. Brey, "The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions, 8/e, 2008.
3. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2nd Edition, Pearson Education, 2011.
4. James L. Antonakos, "An introduction to the Intel Family of Microprocessors", 3/E, Pearson Education, Reprint 2001.
5. Shameem Akhter and Jason Roberts, “Multi-Core Programming: Increasing Performance through Software Multi-Threading”, Intel Press, 2006.

ADDITIONAL REFERENCE BOOKS

1. Maurice Herlihy and NirShavit, “The Art of Multiprocessor Programming“, Revised First Edition, Elsevier Publication, 2012.

B.Tech. III (CSE) Semester – V
PARALLEL PROCESSING ARCHITECTURE
(CORE ELECTIVE-1)
CS325

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand implicit and explicit parallel platforms and its physical organization.
CO2	decompose given problem into many sub problems using different decomposition techniques.
CO3	use different performance metrics for analyzing parallel algorithms.
CO4	evaluate performance of various existing parallel algorithms.
CO5	develop parallel algorithms for tightly coupled and loosely coupled parallel systems for various applications.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Implicit Parallelism: Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Parallel Platforms and Its Physical Organization, Routing Mechanisms for Networks, Communication Costs in Parallel Machines, Impact of Process-Processor Mapping and Mapping Techniques.

- **PARALLEL ALGORITHM DESIGN ALGORITHMS** **(06 Hours)**

  Preliminaries, Decomposition Techniques, Load Balancing in Parallel System, Mapping Techniques for Load Balancing, Tasks and Interactions, Interaction Overheads, Parallel Algorithm and its Models.

- **COMMUNICATION OPERATIONS** **(06 Hours)**

  One-To-All Broadcast and All-To-One Reduction, All-To-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-To-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

- **ANALYTICAL MODELING** **(06 Hours)**

  Sources of Overhead in Parallel Programs, Performance Metrics, Effect of Granularity and Data Mapping on Performance, Scalability, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs.

- **MESSAGE PASSING PARADIGM** **(06 Hours)**

  Principles of Message-Passing Programming, The Building Blocks for Send and Receive Operations, MPI for The Message Passing Interface, Topologies, Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations,

Groups and Communicators.

- **SHARED ADDRESS SPACE PLATFORMS THREAD BASICS (04 Hours)**

  Thread Application Programmer Interface, Synchronization Primitives, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs.

- **ALGORITHMIC APPROACHES (05 Hours)**

  Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Issues in Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quick Sort: Definitions and Representation, Minimum Spanning Tree: Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths.

- **ADVANCE TOPICS AND TOOLS (05 Hours)**

  Counting Problems, Interactive Proofs, Probabilistically Checkable Proofs, OpenMP Tools, OpenMP Compilers, High Performance Parallel Programming, CUDA.

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. Kai Hwang, F. Briggs, "Computer Architecture and Parallel Processing", McGraw Hill International Edition, Reprint 2006.
2. M. Flynn, "Computer Architecture: Pipelined and Parallel Processor Design", 1/E, Jones and Bartlett, 1995.
3. Harry F. Jordan, "Fundamentals of Parallel Processing", 1/E, Prentice Hall, 2002.
4. Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", 1/E, Tata McGraw Hill, Reprint 2008.
5. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, “Introduction to Parallel Computing” , 2/E, Pearson Publication, 2003.

B.Tech. III (CSE) Semester – V
INFORMATION THEORY AND CODING (CORE ELECTIVE-1)
CS327

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge about the basics of information measure, Entropy, bit error, various error control encoding and decoding techniques, communication channel capacity and rate.
CO2	apply principles of information theory and linear algebra in source coding, channel coding and efficient error correcting codes.
CO3	analyse the performance of error control codes and communication channel.
CO4	evaluate different types of the channel modelling and codes.
CO5	design and innovate efficient codes, communication channel in terms of higher rate and less distortion.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Information Source, Symbols and Entropy, Mutual Information, Information Measures for Continuous Random Variable, Joint and Conditional Entropy, Relative Entropy, Applications Based on Information Theoretic Approach.

- **SOURCE CODING** **(08 Hours)**

  Source Coding Theorem, Kraft Inequality, Shannon-Fano Codes, Huffman Codes, Run Length Code, Arithmetic Codes, Lempel-Ziv-Welch Algorithm, Universal Source Codes, Prefix Codes, Variable Length Codes, Uniquely Decodable Codes, Instantaneous Codes, Shannon's Theorem, Shannon Fano Encoding Algorithm, Shannon's Noiseless Coding Theorem, Shannon's Noisy Coding Theorem.

- **COMMUNICATION CHANNEL** **(08 Hours)**

  Channel and its Capacity, Continuous and Gaussian Channels, Discrete Memory-Less Channels, Symmetric Channel, Binary Erasure Channel, Estimation of Channel Capacity, Noiseless Channel, Channel Efficiency, Shannon's Theorem on Channel Capacity, MIMO Channels, Channel Capacity with Feedback.

- **VIDEO AND SPEECH CODING** **(08 Hours)**

  Video Coding Basics, Quantization, Symbol Encoding, Intraframe Coding, Predictive Coding, Transform Coding, Subband Coding, Vector Quantization, Interframe Coding, Motion Compensated Coding, Image Compression, JPEG, LZ78 Compression, Dictionary Based

Compression, Statistical Modelling, Variable Length Coding, Bit Allocation.

- **ERROR CONTROL CODING** **(10 Hours)**

  Overview of Field, Group, Galois Field, Types of Codes, Hamming Weight, Minimum Distance Based Codes, Error Detection and Error Correction Theorems, Maximum Likelihood Decoder, MAP Decoder, Linear Block Codes and Their Properties, Equivalent Codes, Generator Matrix and Parity Check Matrix, Systematic Codes, Cyclic Codes, Convolution Codes and Viterbi Decoding Algorithm, Turbo Codes and Low Density-Parity-Check Codes, Asymptotic Equipartition Property.

- **RATE DISTORTION THEORY** **(04 Hours)**

  Rate Distortion Function, Random Source Codes, Joint Source-Channel Coding and the Separation Theorem.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. R. Bose, “Information Theory, Coding and Cryptography”, 3rd Edition, McGraw-Hill, 3rd Ed., 2016.
2. R. Johannesson and K.S. Zigangirov, “Fundamentals of Convolutional Coding”, 2nd Edition, Wiley-IEEE Press, 2015.
3. T. M. Cover and J. A. Thomas,” Elements of Information Theory”, 2nd Edition John Wiley & Sons, New York, 2012.
4. A. B. Robert, “Information Theory”, 2nd Edition, Dover Special Priced Titles, 2007.
5. R. M. Roth, “Introduction to Coding Theory”, Cambridge University Press, 2006.

ADDITIONAL REFENCE BOOKS

1. R.H. Morelos-Zaragoza, “The Art of Error Correcting Coding”, Wiley and sons, 2006.
2. T. K. Moon, “Error Correction Coding: Mathematical Methods and Algorithms”, Wiley, 2005.
3. S. Lin and D. J. Costello, “Error Control Coding”, 2nd Edition, Prentice-Hall, 2004.
4. Mark Nelson, Jean-Loup Gailly, “Data Compression” ,2nd Ed., BPB Publication,1996.
5. R. Hill, ”A First Course in Coding Theory”, Oxford University Press, 1986.

B.Tech. III (CSE) Semester – V
OBJECT ORIENTED TECHNOLOGY (CORE ELECTIVE-1)
CS329

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge about the Project development life cycle, software requirements, model concepts.
CO2	apply models' concepts for different perspective to solve the given problem statement.
CO3	analyze the problem requirement, refinement of requirement, model and resolve errors.
CO4	evaluate object oriented models using various testing concepts and matrices.
CO5	utilize the standard tools for the design and development of solution for given problems.

2. Syllabus

- **INTRODUCTION (04 Hours)**

  Information Systems, Problems in Information Systems Development, Project Life Cycles, Structured System Analysis and Design, Managing Information System Development, User Involvement and Methodological Approaches, Basic Concepts and Origins of Object Orientation Modelling Concepts, Iterative Development and Unified Process.

- **MODELLING REQUIREMENT (02 Hours)**

  Requirement Capture, Requirement Analysis, Refining the Requirement Models, Object Interaction.

- **STRUCTURAL MODELLING (06 Hours)**

  Object Oriented Fundamentals, Basic Structural Modelling, UML Model, Class Diagrams, Object Diagrams, Packages and Interfaces, Case Studies**.**

- **BEHAVIOURAL AND ARCHITECTURAL MODELLING (10 Hours)**

  Use Case Diagrams, Interaction Diagrams, State Chart Diagrams, Collaborations, Design Patterns, Component Diagrams, Deployment Diagrams, Case Studies.

- **OBJECT ORIENTED TESTING METHODOLOGIES (10 Hours)**

  Implications of Inheritance on Testing, State Based Testing, Adequacy and Coverage, Scenario Based Testing, Testing Workflow, Case Studies, Object Oriented Metrics.

- **COMPONENTS (10 Hours)**

Abuses of Inheritance, Danger of Polymorphism, Mix-In Classes, Rings of Operations, Class Cohesion and Support of States and Behaviour, Components and Objects, Design of a Component, Lightweight and Heavyweight Components, Advantages and Disadvantages of Using Components.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Bahrami A., "Object Oriented System Development", McGraw Hill, 1/E, 2017, ISBN: 9780070265127.
2. Page Jones M., "Fundamentals of Object Oriented Design in UML", Pearson Education, 2/E, 2005, ISBN: 9780321267979.
3. Baugh J., Jacobson I. & Booch G., "The unified Modelling Language Reference Manual", Addison Wesley, 2/E, 2004, ISBN-13: 978-0321718952.
4. Booch G., Rumbaugh J. & Jacobsons I., "The Unified Modelling Language User Guide", Addison Wesley 3/E, 2004, ISBN: 9789332553941.
5. Simon Benett, Steve McRobb & Ray Farmer, "Object Oriented System Analysis and Design using UML", McGraw Hill, 2/E, 2004, ISBN: 9780070597914.

ADDITIONAL REFERENCE BOOKS

1. Lar Man C., Applying UML & Patterns: "An Introduction to Object-Oriented Analysis& Design", Addison Wesley, 2002, ISBN: 9780201699463.

B.Tech. III (CSE) Semester – VI
PRINCIPLES OF PROGRAMMING LANGUAGES (CORE-11)
CS302

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand language features of current programming languages.
CO2	program in different language paradigms and evaluate their relative benefits.
CO3	analyze object oriented constructs in different programming languages.
CO4	evaluate the programming solutions of different problems.
CO5	design programs in Functional and Logical Languages.

2. Syllabus

- **INTRODUCTION (06 Hours)**

  Introduction: Role of Programming Languages: Why Programming Languages, Towards Higher-Level Languages, Programming Paradigms, Programming Environments Language Description: Syntactic Structure, Language Translation Issues: Programming Language Syntax, Stages in Translation, Formal Translation Models.

- **BASICS OF PROGRAMMING LANGUAGE (08 Hours)**

  Data, Data Types, and Basic Statements: Names, Variables , Binding, Type Checking, Scope, Scope Rules , Lifetime and Garbage Collection, Primitive Data Types, Strings, Array Types, Associative Arrays ,Record Types, Union Types, Pointers and References , Arithmetic Expressions , Overloaded Operators, Type Conversions , Relational and Boolean Expressions, Assignment Statements, Mixed Mode Assignments, Control Structures, Selection ,Iterations, Branching, Guarded Statements.

- **SUBPROGRAMS (08 Hours)**

  Subprograms and Implementations: Subprograms, Design Issues, Local Referencing, Parameter Passing, Overloaded Methods, Generic Methods, Design Issues for Functions, Semantics of Call and Return, Implementing Simple Subprograms, Stack and Dynamic Local Variables, Nested Subprograms, Dynamic Scoping.

- **OBJECT-ORIENTED PROGRAMING (10 Hours)**

  Object-Orientation, Concurrency, and Event Handling: Grouping of Data and Operations - Constructs for Programming Structures, Abstraction Information Hiding, Program Design with Modules, Defined Types, Object Oriented Programming - Concept of Object, Inheritance, Derived Classes and Information Hiding - Templates, Semaphores, Monitors, Message Passing, Threads, Statement Level Concurrency Exception Handling (Using C++ and Java as Example Language).

- **FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES: (10 Hours)**

Introduction to Lambda Calculus, Fundamentals of Functional Programming Languages, Programming with Programming with ML, Introduction to Logic and Logic Programming - Programming with Prolog. Types of Logic, WFF, Symbolic Logic, Facts, Clauses, Predicates, Unification, Backtracking, Cut, Fail & Built-In Predicates, Recursion in Prolog, Arithmetic Operators & Relational Operators, LIST Processing, String manipulation & Built-In Predicates, Compound Objects, Dynamic Database.

Tutorials will be based on topics discussion in the class (14 Hours)

Practicals will be based on topics discussion in the class (28 Hours)

(Total Contact Time: 42 Hours+14 Hours+28 Hours= 84 Hours)

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3. Tutorials:

1 Programming languages paradigm.

2 Study of programming language and its benefits. Success and Failure of language.

3 Prolog programming.

4 Object oriented programming constructs.

5 Mapping complex problems with available technologies and evaluate its usefulness.

4. Practicals:

1 Convert prolog predicates into semantic net.

2 Implement travelling salesman problem using prolog.

3 Implement 8 puzzle problem using prolog.

4 Implement N-Queens problem using prolog.

5 Implement C++/Java program for class & object, constructor & destructor.

6 Implement C++/Java programs for operator overloading, inheritance, and polymorphism, file operation.

7 Implement of string operation using prolog.

8 Implement of artificial intelligence based application using prolog.

5. Books Recommended:

1. Terrance W.Pratt, Marvin V. Zelkowitz, T.V.Gopal, “Programming Languages: Design and Implementations”, Fourth ed., Prentice Hall, Sep 7, 2000.
2. David A. Watt, “Programming Language Design Concept”, 1st Edition, Willey India, Jan 1, 2009.
3. Ravi Sethi, “Programming languages: Concepts and Constructs”, Second Ed., Pearson, Jan 7, 1996.
4. Benjamin C. Pierce, “Types and programming Languages”, The MIT Press Cambridge, Massachusetts, London, England, Jan 4, 2002.
5. Robert W. Sebesta, Concepts of Programming Languages, 11th Ed., Pearson, Feb 16, 2015.

B.Tech. III (CSE) Semester – VI
DISTRIBUTED SYSTEMS (CORE-12)
CS304

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand the concepts of distributed System and design and implementation issues.
CO2	define key mechanism for designing distributed algorithms for different primitives like mutual exclusion, deadlock detection, agreement etc.
CO3	analyze different types of faults and fault handling techniques in order to implement fault tolerant systems.
CO4	correlate different election algorithm, file system, time synchronization and naming services.
CO5	design and develop distributed programs subject for specific design and performance constraints.

2. Syllabus

- **INTRODUCTION TO DISTRIBUTED SYSTEMS** **(04 Hours)**

  Review of Networking Protocols, Point to Point Communication, Operating Systems, Concurrent Programming, Characteristics and Properties of Distributed Systems, Goals of Distributed Systems, Multiprocessor and Multicomputer Systems, Distributed Operating Systems, Network Operating Systems, Middleware Concept, The Client-Server Model, Design Approaches-Kernel Based-Virtual Machine Based, Application Layering.

- **COMMUNICATIONIN DISTRIBUTED SYSTEMS** **(04 Hours)**

  Layered Protocols, Message Passing-Remote Procedure Calls-Remote Object Invocation, Message Oriented Communication, Stream Oriented Communication, Case Studies.

- **PROCESS MANAGEMENT** **(04 Hours)**

  Concept of Threads, Process, Processor Allocation, Process Migration and Related Issues, Software Agents, Scheduling in Distributed System, Load Balancing and Sharing Approaches, Fault Tolerance, Real Time Distributed System.

- **SYNCHRONIZATION** **(06 Hours)**

  Clock Synchronization, Logical Clocks, Global State, Election Algorithms-The Bully algorithm-A Ring algorithm, Mutual Exclusion-A Centralized Algorithm-A Distributed Algorithm-A token ring Algorithm, Distributed Transactions.

- **CONSISTENCY AND REPLICATION** **(06 Hours)**

  Introduction to Replication, Object Replication, Replication as Scaling Technique, Data Centric Consistency Models-Strict-Linearizability and Sequential-Causal-FIFO-Weak-release-Entry, Client Centric Consistency Models-Eventual Consistency-Monotonic Reads and Writes-Read your Writes-Writes Follow Reads, Implementation Issues, Distribution Protocols-Replica Placement-Update Propogation-Epidemic Protocols, Consistency Protocols.

- **FAULT TOLERANCE** **(04 Hours)**

  Introduction, Failure Models, Failure Masking, Process Resilience, Agreem in Faulty Systems, Reliable Client Server communication, Group communication, Distributed Commit, Recovery.

- **DISTRIBUTED OBJECT BASED SYSTEMS** **(06 Hours)**

  Introduction to Distributed Objects, Compile Time Vs Run Time Objects, Persistent and Transient Objects, Enterprise JAVA Beans, Stateful and Stateless Sessions, Global Distributed Shared Objects, Object Servers, Object Adaptors, Implementation of Object References, Static And Dynamic Remote Method Invocations, Replica Framework.

- **DISTRIBUTED FILE SYSTEMS** **(04 Hours)**

  Introduction, Architecture, Mechanisms for Building Distributed File Systems-Mounting-Caching-Hints-Bulk Data Transfer-Encryption, Design Issues-Naming and Name Resolution-Caches on Disk or Main Memory-Writing Policy-Cache consistency-Availability-Scalability-Semantics, Case Studies, Log Structured File Systems.

- **DISTRIBUTED WEB BASED SYSTEMS** **(04 Hours)**

  Architecture, Processes, Communication, Naming, Synchronization, Web Proxy Caching, Replication of Web Hosting Systems, Replication of Web Applications.

  Practicals will be based on the coverage of the above topics. **(28 Hours)**

  Tutorials will be based on the coverage of the above topics. **(28 Hours)**

  (Total Contact Time 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. <u>Practicals:</u>

1 Implementation of concepts of communication protocols using UDP and TCP IP.

2 Implement the remote procedure call with an application.

3 Implementation of object based system using RMI or CORBA.

4 Implementation of distributed system for file sharing and message passing.

5 Implementation of Socket programming.

6 Implementation of distributed client-server application.

7 Implementation of client-server application with scheduling in distributed environment.

8 Implementation of distributed load balancing and resource sharing.

4. Tutorials:

1 Concepts of communications (UDP and TCP IP).

2 Concepts of fault tolerance.

3 Concept of time Synchronization.

4 Concepts of process management.

5 Concepts of replication and consistency.

6 Object based system (RMI and CORBA).

5. Books Recommended:

1. Andrew S Tanenbaum, “Distributed systems: Principles and Paradigms”, Second Edition, Pearson Education. Inc 2007.
2. Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems”, TMH, McGraw-Hill, Inc. New York, USA 1994.
3. Pradeep K. Sinha, “Distributed Operating System: Concept and design”, PHI, New Delhi 2019.
4. W Richard Stevens, “Unix Network Programming: Vol 1, Networking APIS: Sockets & XTI”, Second Edition E, Pearson Education, 1998.
5. Colouris, Dollimore, Kindberg, "Distributed Systems Concepts & Design", Fourth Edition, Pearson Ed. 2005.

B.Tech. III (CSE) Semester – VI
SYSTEM SOFTWARE (CORE – 13)
CS306

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand systems software components, finite automata, regular expression and context free grammar.
CO2	apply the knowledge of assembler and macro processors to convert assembly language into machine code.
CO3	analyse working phases of Compiler, various parsing techniques, semantic analysis, Error handling, code generation and code optimization techniques to undertake meaningful language translation.
CO4	evaluate Linkers, Loaders, interpreters and debugging methods to manages system memory and provide a portable runtime environment.
CO5	create a language translator application and mimic a simple compiler.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Introduction to System Software, Utility Software, Systems Programming, Recent Trends in Software Development, Programming Languages and Language Processors, Data Structures for Language Processing.

- **ASSEMBLERS** **(06 Hours)**

  Overview of the Assembly Process, Cross Assembler, Micro Assembler, Meta Assembler, Single Pass Assembler, Two Pass Assembler, Design of Operation Code Table, Symbol Table, Literal Table, Advanced Assembly Process .

- **MACRO PROCESSORS** **(06 Hours)**

  Introduction of Macros, Macro Processor Design, Forward Reference, Backward Reference, Positional Parameters, Keyword Parameters, Conditional Assembly, Macro Calls within Macros, Implementation of Macros Within Assembler. Designing Macro Name Table, Macro Definition Table, Kew Word Parameter Table, Actual Parameter Table, Expansion Time Variable Storage.

- **COMPILERS** **(14 Hours)**

  Phases of Compiler, Analysis-Synthesis Model of Compilation, Interface with Input, Parser and Symbol Table, Token, Lexeme, Patterns and Error Reporting in Lexical Analysis, Programming

Language Grammars, Classification of Grammar, Ambiguity in Grammatical Specification, Top Down Parsing, Recursive Descent Parsing, Transformation on The Grammars, Predictive Parsing, Bottom Up Parsing, Operator Precedence Parsing, LR Parsers, Language Processor Development Tools – LEX & YACC, Semantic Gap, Binding and Binding Times, Memory Allocation, Compilation of Expression, Intermediate Representations, Basic Code Optimization.

- **LINKERS AND LOADERS** **(06 Hours)**

  Design of a Linker, Program Relocation, Linking of Overlay Structured Programs, Dynamic Linking, General Loader Schemes, Absolute Loader, Relocating Loader, Dynamic Loader, Bootstrap Loader, Linking Loader, other Loading Schemes, Linkers v/s Loaders.

- **INTERPRETERS & DEBUGGERS** **(06 Hours)**

  Overview of Interpretation and Debugging Process, Types of Errors, Classification of Debuggers, Dynamic/Interactive Debugger, The Java Language Environment, Java Virtual Machine and Recent Developments.

- **Tutorials will be based on the coverage of the above topics separately** **(14 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Practicals:

1 Study, install and setup various system software tools.

2 Implementation of single pass and two pass assembler.

3 Design and implement scanner using lexical analyzer (LEX) tool.

4 Design and implement parser using YACC tools.

5 Design and configure a compiler application using modern tools and softwares.

6 Implementation of different stages of compiler.

7 Implementation of interpreter and debugger.

8 Implementation of optimization based compiler design.

4. Tutorials

1 Problem solving on the basics of assembler.

2 Problem solving on the basics of macro processor.

3 Problem solving on the basics of lexical analysis.

4 Problem solving on the basics of parsing.

5 Problem solving on the basics of linkers and loaders.

6 Problem solving on the basics of interpreters & debuggers.

BOOKS RECOMMENDED

1. D. M. Dhamdhere, "Systems Programming", 1/E, McGraw Hill, 2011.
2. Leland L. Beck, "System Software - An Introduction to System Programming", 3/E, Pearson Education, 2002.
3. John Donovan, “Systems programming”, 1/E, McGraw Hill, 2017.
4. Santanu Chattopadhyay, “System Software” 1/E, Prentice-Hall India,2007.
5. A.V.Aho, R.Sethi & J D.Ullman, "Compilers-Principles, Techniques and Tools", 2/E, Pearson India, 2013.

ADDITIONAL REFERENCE BOOKS

1. Allen. Holub, "Compiler Design in C", 1/E, Pearson India, 2015.
2. Ronald Mak, “Writing Compilers and Interpreters: A Software Engineering Approach”, 3/E, Wiley, 2009.

B.Tech. III (CSE) Semester – VI
ARTIFICIAL INTELLIGENCE (CORE-14)
CS308

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs):

At end of the program, students will be able to

CO1	understand the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.
CO2	apply various knowledge representation technique, searching techniques, constraint satisfaction problem and example problems- game playing techniques.
CO3	analyse the current scope, potential, limitations, and implications of intelligent systems.
CO4	evaluate the AI techniques suitable for recent areas of applications like expert systems, neural networks, fuzzy logic, robotics, natural language processing, and computer vision.
CO5	design a real world problem for implementation and understand the dynamic behaviour of a system.

2. Syllabus

- **INTRODUCTION TO AI** **(03 Hours)**

  Intelligent Agents, AI Techniques, AI-Problem formulation, AI Applications, Production Systems, Control Strategies.

- **KNOWLEDGE REPRESENTATION** **(06 Hours)**

  Knowledge Representation Using Predicate Logic, Introduction to Predicate Calculus, Resolution, Use of Predicate Calculus, Knowledge Representation Using other Logic-Structured Representation of Knowledge.

- **PRODUCTION SYSTEM** **(06 Hours)**

  Defining the Problems as a State Space Search, Production Systems, Production Characteristics, Production System Characteristics, Forward and Backward, State-Space Search, Problem Solving Methods – Problem Graphs, Matching, Indexing.

- **PROBLEM-SOLVING THROUGH SEARCH** **(06 Hours)**

  Generate and Test, BFS, DFS, Blind, Heuristic, Problem-Reduction, A, A*, AO*, Minimax, Constraint Propagation, Neural, Stochastic, and Evolutionary Search Algorithms, Sample Applications, Measure of Performance and Analysis of Search Algorithms, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis, Issues in the Design of Search Programs.

- **KNOWLEDGE INFERENCE** **(06 Hours)**

  Knowledge Representation -Production Based System, Frame Based System. Inference – Backward Chaining, Forward Chaining, Rule Value Approach, Fuzzy Reasoning – Certainty Factors, Bayesian Theory-Bayesian Network-Dempster – Shafer Theory. Symbolic Logic Under Uncertainty : Non-Monotonic Reasoning, Logics for Non-Monotonic Reasoning, Statistical Reasoning : Probability and Bayes Theorem, Certainty Factors, Probabilistic Graphical Models, Bayesian Networks, Markov Networks, Fuzzy Logic.

- **GAME PLAYING AND PLANNING** **(06 HOURS)**

  Overview and Example Domain: Overview, Minimax, Alpha-Beta Cut-Off, Refinements, Iterative Deepening, The Blocks World, Components of a Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques.

- **NATURAL LANGUAGE PROCESSING** **(04 Hours)**

  Introduction, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing, Spell Checking.

- **EXPERT SYSTEMS** **(05 Hours)**

  Expert Systems – Architecture of Expert Systems, Roles of Expert Systems – Knowledge Acquisition – Meta Knowledge, Heuristics, Typical Expert Systems – MYCIN, DART, XOON, Expert Systems Shells.

- **Practicals will be based on the coverage of the above topics using prolog.** **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Practicals:

1 Practical assignment to understanding basic concepts of prolog.

2 Practical assignment to implement various search strategies.

3 Practical assignment to implement various algorithm based on game theory.

4 Implementation of heuristic based search techniques.

5 Implementation of neural network based application.

6 Implementation of fuzzy logic based application.

7 Implementation of fuzzy inference engine for an application.

8 Implementation of neuro-fuzzy based system.

4. Books Recommended:

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw-Hill, 2003.

2. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009.
3. Nils Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann, 1998,
4. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2010.
5. I. Bratko, "Prolog Programming for Artificial Intelligence", 3/E, Addison-Wesley, 2001, 0-201-40375-7.

B.Tech. III (CSE) Semester – VI
CRYPTOGRAPHY (INSTITUE ELECTIVE-2)
CS362

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

neso academy playlist
https://www.nesoacademy.org/cs/11-cryptography-and-network-security

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understands the key concept and mathematical background of cryptography.
CO2	apply the concept of security mechanisms from the application developer's perspective.
CO3	analyse security mechanisms while trying to satisfy the required security services.
CO4	evaluate different information hiding and authentication techniques.
CO5	design and develop the security solution depending on the organisation's requirements.

2. Syllabus

- **CLASSICAL CRYPTOGRAPHY** **(04 Hours)**

  Shift Cipher, Substitution Cipher, Affine Cipher, Vigenere Cipher, Hill Cipher, Permutation Cipher, Stream Ciphers, Cryptanalysis of Classical Ciphers.

- **SHANNON'S THEORY** **(04 Hours)**

  Elementary Probability Theory, Computational, Provable and Perfect Secrecy, Entropy, Huffman Encodings, Properties of Entropy, Spurious Key and Unicity Distance, Product Cryptosystems.

- **NUMBER THEORY** **(04 Hours)**

  Modular Arithmetic, Algebraic Structures-Group, Ring, Fields, Galois Fields GF(P), GF(2^n), Euclidean Algorithm, Polynomials and its Operations, Chinese Remainder Theorem, Euler's Phi Function, Fermat's Theorem.

- **MODERN BLOCK CIPHERS** **(04 Hours)**

  The Substitution-Permutation Networks, Linear Cryptanalysis-Piling-up Lemma, Linear Approximation of S-Boxes, Linear Attack on SPN, Differential Cryptanalysis, The Data Encryption Standard (DES), The Advanced Encryption Standard (AES), Block Cipher Modes of Operation.

- **CRYPTOGRAPHIC HASH FUNCTIONS** **(04 Hours)**

  Hash Functions and Data Integrity, Security of Hash Functions-The Random Oracle Model, Iterated Hash Functions- Merkel Damgard Construction, Secure Hash Algorithm (SHA), Message Authentication Codes (MAC), HMAC, CBC-MAC and Authenticated Encryption,

Unconditionally Secure MACs.

- **PUBLIC KEY CRYPTOGRAPHY AND DISCRETE LOGARITHMS** **(08 Hours)**

  The El-Gamal Cryptosystem and its Security, Algorithms for Discrete Logarithm Problem-Shank, Pollard-rho, Pohlig- Hellman, Index Calculus, Finite Fields, The Diffie-Hellman Problems, Elliptic Curves-Elliptic Curves over Real numbers and Finite Fields, Properties, Point Compression and ECIES, Point Addition, Scalar Multiplication.

- **RSA CRYPTOSYSTEM AND FACTORING INTEGERS** **(06 Hours)**

  RSA Key Generation, Encryption, Decryption, The Integer Factorization Problem, Primality Testing-Legendre and Jacobi Symbols, The Solovay-Strassen Algorithm, The Miller-Rabin Algorithm, Square root modulo a composite, Factoring Algorithm, Attacks on RSA-Computing $\phi(n)$, Low Decryption Exponent Attack, Optimal Asymmetric Encryption Padding.

- **DIGITAL SIGNATURE SCHEMES** **(04 Hours)**

  Security Requirements, Signature and Hash Functions, ElGamal Digital Signature Scheme and its Security, Variants of ElGamal Digital Signature-Schnorr, Digital Signature Algorithm(DSA), Elliptic Curve DSA, Provably Secure Signature Schemes, One Time Signatures, Full Domain Hash, Undeniable Signatures, Blind Signatures, Fail-Stop Signatures.

- **IDENTIFICATION SCHEMES AND ENTITY AUTHENTICATION** **(02 Hours)**

  Challenge Response Protocols, Password Based Authentication, Zero Knowledge Schemes.

- **ADVANCED TOPICS** **(02 Hours)**

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. Stinson, Douglas R., "Cryptography: theory and practice", 3rd Edition, Chapman and Hall/CRC, 2005.
2. Stallings, William, "Cryptography and network security: principles and practice", 7th Edition, Upper Saddle River: Pearson, 2017.
3. Forouzan, Behrouz A., "Cryptography & network security", 3rd Edition, McGraw-Hill, Inc., 2007.
4. Schneier, Bruce, "Applied cryptography: protocols, algorithms, and source code in C", 2nd Edition, john wiley & sons, 2007.
5. Patel, Dhiren R. "Information security: theory and practice", 1st Edition, PHI Learning Pvt. Ltd., 2008.

B.Tech. III (CSE) Semester – VI
DIGITAL FORENSICS (INSTITUE ELECTIVE-2)
CS364

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	get exposure of digital forensic, cryptography and investigation techniques on different computing platforms as well as mobile devices.
CO2	analyse cyber-attacks to assist conventional forensic to investigate digital platforms.
CO3	create disk images, recover deleted files and extract hidden information.
CO4	describe the representation and organization of data and metadata within modern computer systems with the use of various forensic tools.
CO5	to define research problems and develop effective solutions for digital forensic and can compose a draft which can be used for legal procedure.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Introduction to Computer Forensics: Computer Crimes, Evidence, Extraction, Preservation, Analogies to Traditional Forensics and Differences from Traditional Forensics, Hardware and Operating Systems: Structure of Storage Media/Devices; Windows / Macintosh / Linux -- Registry, Boot Process, File Systems, File Metadata.

- **DATA RECOVERY** **(02 Hours)**

  Identifying Hidden Data, Encryption/Decryption, Steganography, Recovering Deleted Files.

- **DIGITAL EVIDENCE ON WINDOWS SYSTEM** **(06 Hours)**

  Deleted Data, File Carving, Hibernation, Sleep, Hybrid Sleep, Registry Structure, Attribution, External Devices, Print Spooling, Recycle Bin, Date and Time Stamp, Thumbnail Cache, Restore Points, Shadow Copy, Link Files.

- **DIGITAL EVIDENCE ON UNIX SYSTEM** **(04 Hours)**

  UNIX Boot Disk, File System, Data Recovery, Log Files, File System Traces, Internet Traces.

- **NETWORK FORENCIS** **(04 Hours)**

  Collecting and Analysing Network-Based Evidence, Reconstructing Web Browsing, Email Activity, and Windows Registry Changes, Intrusion Detection, Tracking Offenders, etc.

- **INTERNET AND EMAIL FORENSICS** **(06 Hours)**

Internet Overview, Role of Internet in Criminal Investigation, Online Anonymity and Self-Protection, Web Technology, Web Browsers, Cookies, Cache, History, Browser Artifacts in Registry, Chat Clients, Email Protocols, Email Evidence, Tracing Email, Email Forgery, Social Networking Sites.

- **MOBILE DEVICE FORENSICS** **(04 Hours)**

  Cellular Network-Basics-Components-Types, Mobile Operating Systems, Cellphone Evidences-Call-detail Records-Collection-Handling-Subscriber Identity Modules-Cellphone Acquisition, Cellphone Forensics Tools, GPS.

- **SOFTWARE REVERSE ENGINEERING** **(04 Hours)**

  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, etc.

- **ADVANCE TOPICS AND LEGAL ISSUES** **(08 Hours)**

  Forensic tools, Forensic report writing, Criminal Law, Expectation of Privacy, Private Searches, Privacy Law, Search Warrant.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Eoghan Casey, "Digital evidence and computer crime: Forensic science, computers, and the internet", 3rd Edition, Academic press, 2011.
2. Dejey and Murugan, "Cyber Forensics", 1st Edition, Oxford University Press, 2018.
3. Sammons, John, "The basics of digital forensics: the primer for getting started in digital forensics", 2nd Edition, Elsevier, 2012.
4. Sherri Davidoff, Jonathan Ham, "Network Forensics: Tracking Hackers Through Cyberspace", Prentice Hall, 2012.
5. Computer Forensics: Hard Disk and Operating Systems, 2nd Edition, EC Council, September 17, 2009.

ADDITIONAL REFERENCE BOOKS

1. Computer Forensics Investigation Procedures and response, EC-Council Press, 2010.
2. Brian Carrier, "File System Forensic Analysis", Addison-Wesley Professional, March 27, 2005.
3. Michael Hale Ligh, Andrew Case, Jamie Levy, Aaron Walters, 'The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory", ISBN: 978-1-118-82509-9, July 2014.

B.Tech. III (CSE) Semester – VI
EMBEDDED SYSTEMS (INSTITUTE ELECTIVE-2)
CS366

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand basic concept of embedded systems.
CO2	apply and analyse the applications in various processors and domains of embedded system.
CO3	analyse and develop embedded hardware and software development cycles and tools.
CO4	evaluate different Embedded Computing and IoT systems.
CO5	design the embedded systems using different concepts of a RTOS, sensors, memory interface, and communication interface.

2. Syllabus

- **INTRODUCTION: HARDWARE** **(04 Hours)**

  Introduction to Embedded System Hardware Needs, Typical and Advanced, Timing Diagrams, Memories (RAM, ROM, EPROM), Tristate Devices, Buses, DMA, UART and PLD's Built-ins on the Microprocessor.

- **INTERRUPTS** **(04 Hours)**

  Interrupts Basics ISR, Context Saving, Shared Data Problem, Atomic and Critical Section, Interrupt Latency.

- **SOFTWARE AND OS** **(04 Hours)**

  Survey of Software Architectures, Round Robin, Function Queue Scheduling Architecture, Use of Real Time Operating System, RTOS, Tasks, Scheduler, Shared Data Re-entrancy, Priority Inversion, Mutex Binary Semaphore and Counting Semaphore.

- **INTER-PROCESS COMMUNICATION** **(05 Hours)**

  Inter Task Communication, Message Queue, Mailboxes and Pipes, Timer Functions, Events Interrupt Routines in an RTOS Environment.

- **EMBEDDED COMPUTING** **(07 Hours)**

  Embedded Design Process, System Description Formalisms, Instruction Sets- CISC and RISC, Embedded Computing Platform- CPU bus, Memory Devices, I/O Devices, Interfacing, Designing with Microprocessors, Debugging Techniques, Hardware Accelerators- CPUs and Accelerators, Accelerator System Design, Embedded System Software Design using an RTOS Hard Real-Time and Soft Real-Time System Principles, Task Division, Need of Interrupt Routines, Shared Data.

- **INTERNET OF THINGS** **(04 Hours)**

  Introduction, IoT Work Flow, IoT Protocols: HTTP, CoAP, MQTT, 6LoWPAN, Building IoT Applications.

- **TOOLS** **(06 Hours)**

  Embedded Software Development Tools, Host and Target Systems, Cross Compilers, Linkers, Locators for Embedded Systems, Getting Embedded Software into the Target System, Debugging Techniques like JTAGS, Testing on Host Machine, Instruction Set Emulators, Logic Analysers In-Circuit Emulators and Monitors.

- **NETWORK** **(04 Hours)**

  Distributed Embedded Architectures, Networks for Embedded Systems, Network-Based Design, and Internet Enabled Systems.

- **SYSTEM DESIGN TECHNIQUES** **(04 Hours)**

  Design Methodologies, Requirements Analysis, System Analysis and Architecture Design, Quality Assurance.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson Education, 2011.
2. Raj Kamal, "Embedded Systems-Architecture, Programming and Design", 2/E, TMH, 2007.
3. Jonathan W. Valvano, "Embedded Microcomputer Systems-Real Time Interfacing", 2nd Edition, Thomson Learning, 2006.
4. David A. Simon, "An Embedded Software Primer", 1/E, Pearson Education,2001.
5. Louis L. Odette, "Intelligent Embedded Systems", Addison-Wesley, 1991.

ADDITIONAL REFERENCE BOOKS

1. Wolf, W. "Computers as components- Principles of embedded computing system design", Academic Press (Indian edition available from Harcourt India Pvt. Ltd., 27M Block market, Greater Kailash II, New Delhi-110 048).
2. Denial D. Gajski , Frank Vahid, "Specification and design Embedded systems", Prentice Hall; Facsimile edition, 1994.

B.Tech. III (CSE) Semester – VI
IMAGE PROCESSING (INSTITUTE ELECTIVE-2)
CS368

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand building approaches of digital image processing systems, image models and mathematical tools for image processing.
CO2	apply spatial filtering, frequency domain filtering, image restoration and color image processing techniques for overall image improvement.
CO3	analyse various image compression methods for effective storage management without degrading the image quality.
CO4	evaluate various morphology, segmentation and object recognition methods to gain high level of understanding of content of an image.
CO5	create an image processing application in the development of computer vision, machine learning, deep learning domains.

2. Syllabus

- **INTRODUCTION (02 Hours)**

  Image Model, Image Sensing and Acquisition, Sampling and Quantization, Mathematical Tool for Digital Image Processing, Types of Digital Images, Image File Formats, Colour Fundamentals and Models.

- **INTENSITY TRANSFORMATION AND SPATIAL FILTERING (06 Hours)**

  Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing and Sharpening Spatial Filters.

- **FILTERING IN FREQUENCY DOMAIN (06 Hours)**

  Sampling and Fourier Transform, Discrete Fourier Transform (DFT), 2-D DFT, Filtering in the Frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Selective Filtering.

- **IMAGE RESTORATION (06 Hours)**

  Image Degradation/ Restoration Process, Noise Models, Spatial Filtering and Frequency Domain Filtering for Noise Reduction, Linear Position-Invariant Degradations, Estimating the Degradation Function, Filtering, Image Reconstruction from Projection.

- **COLOR IMAGE PROCESSING** **(06 Hours)**

  Color Models, Pseudocolor Image Processing, Full Color Image Processing, Color Transformation, Smoothing and Sharpening, Color Based Image Segmentation.

- **IMAGE COMPRESSION** **(06 Hours)**

  Image Compression Fundamentals, Classification of Image Compression Algorithms, Types of Redundancy, Lossless Compression Algorithms, Lossy Compression Algorithms, Image and Video Compression Standards and its Variations.

- **MORPHOLOGY AND SEGMENTATION** **(06 Hours)**

  Erosion and Dilation, Opening and Closing, Morphological Algorithms, Grey Scale Morphology, Point, Line and Edge Detection, Thresholding, Region based Segmentation, Segmentation using Morphological Watersheds, Use of Motion in Segmentation.

- **ADVANCED TOPICS** **(04 Hours)**

  Image Representation and Description, Object Recognition and Recent Developments.

(Total Contact Time = 42 Hours)

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3. <u>Books Recommended:</u>

1. Rafael C. Gonzales andRichard E. Woods,“Digital Image Processing”, 4/E, Pearson Education, 2018.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, 1/E, Pearson India, 2015.
3. S. Jayaraman, T. Veerakumar and S. Esakkirajan, “Digital Image Processing”, 1/E, TMG, 2017
4. S. Sridhar, “Digital Image Processing”, 2/E, Oxford University Press, 2016.
5. S. Annadurai, R. Shanmugalakshmi, “Fundamentals of Digital Image Processing”, 1/E, Pearson Education, 2006.

B.Tech. III (CSE) Semester – VI
ADAPTIVE SIGNAL PROCESSING (INSTITUTE ELECTIVE-2)
CS372

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge about the adaptive signal processing, approaches of least mean square and adaptive filters.
CO2	apply recursive least square algorithm for estimation of least mean square and adaptive filtering of stationary process.
CO3	utilize theory and software implementation to solve adaptive signal problem and analyse the results obtained.
CO4	evaluate the accuracy and performance of the Kalman filtering utilized in adaptive signal processing.
CO5	design an efficient and innovative solution for the real time problems using different adaptive signal processing techniques.

2. Syllabus

- **INTRODUCTION (08 Hours)**

  Adaptive Processing of Signals, Adaptive Filters, Stochastic Processes, Correlation, System Modeling, Minimum Mean Squared Error (MMSE) Estimation, Linear MMSE Estimation, Sequential Linear MMSE Estimation, Introduction to Applications – Noise Cancellation, Inverse Modeling, Discrete Time Wiener Filter, Hilbert Space Formulation, Levinson Filtering, Orthogonalization and Orthogonal project, Orthogonal Decomposition of Signal Subspace.

- **LEAST MEAN SQUARE ALGORITHM (08 Hours)**

  FIR Adaptive Filters, Newton's Method, Steepest Descent Method, Convergence Analysis, Performance Surface, LMS Adaption Algorithms, Convergence, Excess Mean Square Error, Leaky LMS, Normalized LMS, Block LMS.

- **LINEAR LEAST SQUARE ESTIMATION (08 Hours)**

  Least Square Estimation Problem, Geometric Approach, Projection Theorem, Stochastic Linear Least Square Estimation, Recursive Least Square (RLS) Algorithm for Adaptive Filtering of Stationary Process, RLS Adaptive Lattice, RLS Lattice Recursions, Matrix Inversion, Comparison with LMS, RLS for Quasi-Stationary Signals, Exponentially Weighted RLS, Sliding Window RLS, RLS Algorithm for Array Processing, Adaptive Beam Forming, Other Applications

of Adaptive Filters, Echo Cancellation, Channel Equalization.

- **KALMAN FILTERING** **(09 Hours)**

  State Space Model, Dynamic State Estimation, Statistical Filtering for Non-Stationary Signals, Kalman filtering Principles, Initialization and Tracking, Scalar and Vector Kalman filter, Derivation of Kalman Filter using Innovations Approach, Continuous time Kalman Filter, Discrete Kalman Filter, Convergence, Applications in Signal Processing, Time Varying Channel Estimation, Radar Target Tracking.

- **SYSTEM IDENTIFICATION AND APPLICATIONS** **(09 Hours)**

  Process of System Identification, Least Square System Identification Method, RLS based System Identification, Levinson Type Identification, Adaptive Blind Equalization, MIMO, Multi User Detection Application, Channel Estimation, Interference Cancelling, Beam-Forming, Speech Processing.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Simon O. Haykin, "Adaptive Filter Theory", 5th Edition, Pearson Education Limited, 2014.
2. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling," 1st Edition, Wiley India Pvt. Ltd, 2008.
3. Alexander D. Poularikas, Zayed M. Ramadan, "Adaptive filtering primer with MATLAB", 1st Edition, CRC Press, 2006.
4. Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogon, "Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering, and Array Processing", 1st Edition, McGraw-Hill, 2005.
5. Bernard Widrow, Samuel D Stearns, "Adaptive Signal Processing", 1st Edition, Pearson Education, 2002.

ADDITIONAL REFERENCE BOOKS

1. Ali H. Sayed, "Fundamentals of Adaptive Filtering", 1st Edition, Wiley-IEEE Press, 2003.
2. Michael G. Larimore, C. Richard Johnson, "Theory and Design of Adaptive Filters", 1st Edition, Pearson, 2001.

B.Tech. III (CSE) Semester – VI
DATA VISUALIZATION (CORE ELECTIVE-2)
CS322

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge about the design principles of data visualization, categories of data visualization, and data visualization tools.
CO2	apply visualization approaches for animation, representing geospatial, network and other high dimensional data.
CO3	analyse the data visualization categories applicability according to the given data.
CO4	evaluate data visualization both in qualitative and quantitative manner by using various mapping.
CO5	represent real-time data using various visualizations tools and techniques.

2. Syllabus

- **INTRODUCTION (06 HOURS)**

  Data Visualization, Design, Data and Tasks, Data Types, Dataset Types, Basic Charts and Plots, Use of Statistical Indicators, Multivariate Data Visualization, Principles of Perception, Color, Design, and Evaluation, Graphical Integrity, Data-Ink Ratio, Aspect Ratios & Scales.

- **VISUALISATION FORMATS AND STRATEGIES (06 HOURS)**

  Formats-Static Graphs, Interactive Graphs, Infographics, Websites, Animated Videos, GIFs. Strategies-Qualitative and Text-Based Data, Color-Coding, Timelines, Calendars, and Diagrams, Filtering, Parallel Coordinates, Aggregation.

- **DATA VISUALIZATION CATEGORY (10 HOURS)**

  Text Data Visualization, Document Visualization, Images and Video, Interactivity and Animation, Temporal Data Visualization, Part-to-Whole Relationships Visualization, Geospatial Data Visualization, Hierarchical Data Visualization, Network Data Visualization, High-Dimensional Data Visualization, Maps.

- **DATA VISUALISATION SYSTEM (10 HOURS)**

Visual Story Telling, Messaging, Effective Presentations, Design for Information, Visualization and Arts, Visualization Systems, Database Visualization, Redesign Principles and Design Dimensionality, Rapidly Prototype Visualizations, Quantitatively and Qualitatively Evaluation of Visualizations.

- **DATA-DRIVEN DOCUMENTS (D3) (06 HOURS)**

  Introduction, Relative vs. Absolute Judgments, Luminance Perception, D3 Key Features and Concepts, Visualization Process, Design Iterations, Sketching, Data Types, Statistical Graphs, Interaction Design, Brushing and Linking, Animation, Trees and Networks, Radial Layouts, Linear Layouts, Maps, Tree maps, Choropleth Maps, Cartograms, Symbol Maps, Flow Maps, Real-Time Maps.

- **OTHER DATA VISUALISATION TOOLS (04 HOURS)**

  Excel, R, Tableau, Python

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Scott Murray "Interactive Data Visualization for the Web" O'Reilly Media, 2/E, 2017.
2. Alberto Cairo, “The Truthful Art: Data, Charts, and Maps for Communication” 1/E, Berkeley, California: New Riders, 2016, ISBN: 9780321934079.
3. Colin Ware, “Visual Thinking for Design”, Morgan Kaufman Series, 1/E, 2008, ISBN: 9780123708960.
4. Ben Fry "Visualizing Data: Exploring and Explaining Data with the Processing Environment" O'Reilly Media, 1/E, 2008, ISBN: 9780596514556.
5. Few, S, “Information dashboard design: The effective visual communication of data Sebastopol” O’Reilly, 1/E, 2006, ISBN: 9780596100162.

ADDITIONAL REFERENCE BOOKS

1. Edward Tufte "The Visual Display of Quantitative Information" Graphics Press, 2/E, 2001, ISBN: 9781930824133.

B.Tech. III (CSE) Semester – VI
NATURAL LANGUAGE PROCESSING (CORE ELECTIVE-2)
CS324

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand basics principles of natural language processing.
CO2	apply machine learning techniques for NLP based different tasks.
CO3	perform statically analysis and classification, recognition using NLP knowledge acquired.
CO4	evaluate the performance of machine translation solutions through statistical parameters.
CO5	design efficient solution for parser, translator and different applications based on NLP for day to day usage.

2. Syllabus

- **INTRODUCTION (04 Hours)**

  Human Languages, Language Models, Computational Linguistics , Ambiguity and Uncertainty in Language, Processing Paradigms, Phases in Natural Language Processing, Basic Terminology, Overview of Different Applications, Regular Expressions and Automata, Finite State Transducers and Morphology, Automata, Word Recognition, Lexicon, Morphology, Acquisition Models, Linguistics Resources, Introduction to Corpus, Elements in Balanced Corpus.

- **SYNTAX AND SEMANTICS (08 Hours)**

  Natural Language Grammars, Lexeme, Phonemes, Phrases and Idioms, Word Order, Tense, Probabilistic Models of Spelling, N-grams, Word Classes and Part of Speech Tagging using Maximum Entropy Models, Transformation Based Tagging (TBL), Context Free Grammars for English, Features and Unification, Lexicalized and Parsing, Treebanks, Language and Complexity, Representing Meaning, Semantic Analysis, Lexical Semantics, Word Sense Disambiguation.

- **PROBBILISTIC LANUAGE MODELING (08 Hours)**

  Statistical Inference, Hidden Markov Models, Probabilistic (weighted) Finite State Automata, Estimating the Probability of a Word, and Smoothing, Probabilistic Parsing, Generative Models of Language, Probabilistic Context Free Grammars, Probabilistic Parsing, Statistical Alignment and Machine Translation, Clustering, Text Categorization, Viterbi Algorithm for Finding Most Likely HMM Path.

- **PRAGMATICS** **(06 Hours)**

  Discourse, Dialogue and Conversational Agents, Natural Language Generation, Machine Translation, Dictionary Based Approaches, Reference Resolution, Algorithm for Pronoun Resolution, Text Coherence, Discourse Structure, Applications of NLP- Spell-Checking.

- **MACHINE TRANSLATION** **(08 Hours)**

  Probabilistic Models for Translating One to Another Language, Alignment, Translation, Language Generation, Expectation Maximization, Automatically Discovering Verb Subcategorization, Language Modelling Integrated into Social Network Analysis, Automatic Summarization, Question-Answering, Interactive Dialogue Systems.

- **ADVANCED TOPICS** **(08 Hours)**

  Summarization, Information Retrieval, Vector Space Model, Term Weighting, Homonymy, Polysemy, Synonymy, Improving User Queries, Document Classification, Sentence Segmentation, and Other Language Tasks, Automatically-Trained Email Spam Filter, Automatically Determining the Language, Speech Recognition.

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. Daniel Jurafsky, James H. Martin: "Speech and Language Processing", 2/E, Pearson Education, 2009.
2. James Allen, "Natural Language Understanding", 2/E, Addison-Wesley, 1994.
3. Christopher D. Manning, Hinrich Schutze: "Foundations of Statistical Natural Language Processing", 1/E, MIT Press, 1999.
4. Steven Bird, “Natural Language Processing with Python”, 1st Edition, O'Reilly, 2009.
5. Jacob Perkins, “Python Text Processing with NLTK 2.0 Cookbook”, 2nd Edition, Packt Publishing, 2010.
6. Bharati A., Sangal R., Chaitanya V., “Natural language processing: A Paninian perspective”, PHI, 2000.
7. Siddiqui T., Tiwary U. S., “Natural language processing and Information retrieval”, 1st Edition, OUP,2008.

B.Tech. III (CSE) Semester – VI
CLOUD COMPUTING (CORE ELECTIVE-2)
CS326

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of important concepts, key technologies, strengths, and limitations of cloud computing along with its state of the art applications.
CO2	give cloud enabled solutions.
CO3	analyze effectiveness of cloud based solutions.
CO4	identify and evaluate services being offered by different cloud providers.
CO5	design, develop and deploy cloud based applications.

2. Syllabus

- **INTRODUCTION (06 Hours)**

  Nutshell of Cloud Computing, Feature Characteristics and Components of Cloud Computing, Challenges, Risks and Approaches of Migration into Cloud, Evaluating the Cloud's Business Impact and Economics, Future of the Cloud.

- **CLOUD COMPUTING ARCHITECTURE (14 Hours)**

  Virtualization Technology: Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor, VMware, KVM, Xen. Virtualization of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, Virtualization of Server, Desktop, Network, and Virtualization of Datacentre, Cloud Reference Model, Layer and Types of Clouds, Services Models, Datacentre Design and Interconnection Network, Architectural Design of Computer and Storage Clouds, Micro Service Architecture.

- **CLOUD SERVICE MODELS (04 Hours)**

  Introduction, PAAS – Working Principle, Example, SAAS – Working Principle, Example, IAAS – Working Principle, Examples, Service Level Agreements (SLAs), Billing & Accounting, Comparing Scaling Hardware, Economics of Scaling, Managing Data.

- **CLOUD SECURITY (06 Hours)**

  Infrastructure Security, Data Security and Storage, Identity and Access Management, Access Control, Trust and Reputation, Authentication in Cloud Computing.

- **CASE STUDY ON OPEN SOURCE AND COMMERCIAL CLOUDS (12 Hours)**

Eucalyptus, VMware Cloud, GCP, AWS, MS AZURE, IBM CLOUD, Elastic Search.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Nikos Antonopoulos, Lee Gillam: "Cloud Computing: Principles, Systems and Applications", 2nd Edition, Springer, 2012.
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski: "Cloud Computing: Principles and Paradigms",1st Edition, Wiley, 2011.
3. Ronald L. Krutz, Russell Dean Vines: "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", 1st Edition, Wiley-India, 2010.
4. Barrie Sosinsky: "Cloud Computing Bible", 1st Edition, Wiley-India, 2010.
5. Tim Mather, Subra Kumara swamy, Shahed Latif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance”, 1st Edition, O'Reilly Media, 2009.

B.Tech. III (CSE) Semester – VI
WIRELESS NETWORKS (CORE ELECTIVE-2)
CS328

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	understand wireless communication technologies, communication standards and multiple access scheme.
CO2	apply mobile adhoc networks routing methods and forwarding strategies.
CO3	analyse routing protocols for Delay Tolerant Networks, Vehicular Ad-hoc Networks, Wireless Access Protocol and GPS.
CO4	evaluate IoT Design & Deployment, IoT System Management and Platforms Design Methodology.
CO5	create a wireless network using modern tools and simulation software's.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Overview of Wireless Technologies and Communication Standards, Medium Access Control in Wireless LANs, Bluetooth Technology, Personal Area Networks, Delay Tolerant Networks and Cellular Networks.

- **MULTIPLE ACCESS SCHEMES** **(06 Hours)**

  Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Spread Spectrum Technique, Code Division Multiple Access (CDMA).

- **MOBILE AD HOC NETWORKS** **(08 Hours)**

  Topology-Based Versus Position Based Approaches, Proactive Routing Protocols, Reactive Routing Protocols, Hybrid Routing Protocols, Position Based Routing Issues and Forwarding Strategies.

- **WIRELESS SENSOR NETWORKS** **(08 Hours)**

  Routing Protocols, Localization Methods, Sensor Deployment Strategies, Traffic Flow Pattern in WSN, One to Many, Many to One and Many to Many, Routing Protocols for Delay Tolerant Networks, Routing protocols for Vehicular Ad-hoc Networks, Wireless Access Protocol, GPS (Global Positioning System) and Applications, RFID and its Applications.

- **INTERNET OF THINGS & ITS APPLICATIONS** **(06 Hours)**

  Physical Design, Logical Design, IoT Enabling Technologies, IoT Levels & Deployment Templates,

Domain Specific IoTs, IoT and M2M, IoT System Management, IoT Platforms Design Methodology.

- **ADVANCED TOPICS:** 5G and Related Technology and Standards, Recent Trends in Wireless Networks. **(08 Hours)**

(Total Contact Time = 42 Hours)

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3. Books Recommended:

1. M. S. Gast, "802.11 wireless networks: The Definitive Guide", 3/E, O'Reilly, 2017.
2. J. Schiller, "Mobile Communications", 2/E, Pearson India, 2008.
3. Charles Perkins, "Adhoc Networking", Addison Wesley, 1/E, 2000.
4. WCY Lee, " Mobile Cellular Telecommunications: Analog and Digital Systems ", 2/E,TMH, 2017.
5. J. W. Mark and W. Zhuang, "Wireless Communications and Networking", 1/E, Pearson, 2002.

ADDITIONAL REFERENCE BOOKS

1. Robert Faludi, “Building Wireless Sensor Networks”, 1/E, O'REILLY, 2011.
2. Maciej Kranz, “Building the Internet of Things”, 1/E, Wiley, 2016.

B.Tech. III (CSE) Semester – VI
OPTIMIZATION METHODS (CORE ELECTIVE-2)
CS332

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about optimization methods to model real-life problems.
CO2	apply the knowledge of optimization techniques to solve engineering optimization problems.
CO3	analyse the complexity and efficiency of optimization techniques.
CO4	evaluate various optimization methods for a given problem.
CO5	design and develop a solution to complex engineering problem with the help of suitable optimization technique.

2. Syllabus

- **INTRODUCTION AND MATHEMATICAL REVIEW** **(04 Hours)**

  Methods of Proof, Vector Spaces and Matrices, Real Vector Space, Rank of a Matrix, Linear Equations, Inner Product and Norms, Linear Transformations, Eigen Values and Eigen Vectors, Orthogonal Projections, Quadratic Forms, Matrix Norms, Line Segments, Hyperplanes and Linear Varieties, Convex Sets, Neighbourhood, Polytopes and Polyhedral, Sequences and Limits, Differentiability, The Derivative Matrix, Differentiation Rules, Level Sets and Gradients, Taylor Series.

- **UNCONSTRAINED OPTIMIZATION** **(12 Hours)**

  Basics of Set-Constrained and Unconstrained Optimization, Conditions for Local Minimizers, Golden Section Search, Fibonacci Search, Newton's Method, Secant Method, Gradient Methods, The Method of Steepest Descent, Analysis of Gradient Methods, Convergence, Convergence Rate, Levenberg-Marquardt Modification, Newton's Method for Nonlinear Least-Squares, Conjugate Direction Methods, Quasi-Newton Methods, Approximating the Inverse Hessian, The Rank One Correction Formula, The DFP Algorithm, The BFGS Algorithm, Solving Ax = b, Least-Squares Analysis , Recursive Least-Squares Algorithm, Kaczmarz's Algorithm, Unconstrained Optimization and Neural Networks, Single-Neuron Training, Backpropagation Algorithm, Genetic Algorithms, Chromosomes and Representation Schemes, Selection and Evolution, Real-Number Genetic Algorithms.

- **LINEAR PROGRAMMING** **(10 Hours)**

  Introduction, Examples, Two-Dimensional Linear Programs, Convex Polyhedra and Linear Programming, Standard Form Linear Programs, Basic Solutions, A Geometric View of Linear Programs, Simplex Methods, Solving Linear Equations Using Row Operations, The Canonical Augmented Matrix, Updating the Augmented Matrix, The Simplex Algorithm, Matrix Form of

the Simplex Method, The Two-Phase Simplex Method, The Revised Simplex Method, Duality, Dual Linear Programs, Properties of Dual Problems, Non-Simplex Methods, Khachiyan's Method, Affine Scaling Method, Karmarkar's Method.

- **NONLINEAR CONSTRAINED OPTIMIZATION (10 Hours)**

  Problems with Equality Constraints, Tangent and Normal Spaces, Lagrange Condition, Second-Order Conditions, Minimizing Quadratics Subject to Linear Constraints, Problems with Inequality Constraints, Karush-Kuhn-Tucker Condition, Second-Order Conditions, Convex Optimization Problems, Convex Functions, Algorithms for Constrained Optimization, Projections, Projected Gradient Methods, Penalty Methods.

- **SPECIAL TOPICS FOR APPLIED AREAS (6 Hours)**

  Accelerated First Order Methods, Bayesian Methods, Coordinate Methods, Cutting Plane Methods, Interior Point Methods, Optimization Methods for Deep Learning, Parallel and Distributed Methods, Robust Optimization Problems and Methods, Stochastic Mini-batch Methods, Submodular Optimization Problems and Methods, Variance Reduced Stochastic Methods, Zeroth Order Methods.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. E. K. P. Chong and S. Zak, “An introduction to optimization”, 2nd Edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
2. T. Hastie, R. Tibshirani and M. J. Wainwright, “Statistical Learning with Sparsity: The Lasso and Generalizations”, 1st Edition, Chapman and Hall/CRC Press, 2015.
3. S. Sra, S. Nowozin, and S. Wright (eds), “Optimization for Machine Learning”, 1st Edition, The MIT Press, 2011.
4. Y. Nesterov, “Introductory lectures on convex optimization”, 2nd Edition, Kluwer-Academic, 2003.
5. S. Boyd and L. Vandenberghe, “Convex Optimization”, 1st Edition, Cambridge University Press, 2003.

ADDITIONAL REFERENCE BOOKS

1. D. Bertsekas, Nonlinear Programming, 3rd Edition, Athena Scientific, 1999.
2. R. Fletcher, Practical methods of optimization, 2nd Edition, Wiley, 2000, New York.