Department of Computer Science and Engineering
College of Technology and Engineering, Udaipur
POST GRADUATE PROGRAMME

Details of P.G. Programme Courses offered for the award of M.E. in Computer Science & Engineering.

Course No.	Subject	Credits
	I SEMESTER	
CSE511	Distributed Computing (Core Course)	3+1
CSE512	Mobile Computing	3+1
CSE513	Embedded Systems Design (Core Course)	2+1
CSE514	Major Elective –I	2+0
CSE515	Major Elective –II	2+0
PGS 501	LIBRARY AND INFORMATION SERVICES (COMPULSORY NON-CREDIT COURS)	0+1 (practical)
	Total credits for semester	15
	II SEMESTER	
CSE521	Interconnection Networks	3+1
CSE522	Multimedia Computing (Core Course)	3+1
CSE523	Data Mining Technology	2+1
CSE524	Major Elective –III	2+0
CSE525	Major Elective –IV	2+0
	Total credits for semester	15
	III SEMESTER	
CSE531	Advance Operating Systems (Core Course)	3+0
CSE532	Minor Elective- I	3+0
CSE533	Seminar	0+1
CSE534	Comprehensive Examination	NC
CSE535	Thesis	
	Total credits for semester	7
	IV SEMESTER	
	Thesis (Contd. From III Semester)	15
	Total credits for the programme	**52**

List of Major Electives

CSE 514 (A)	Distributed Database Management Systems
CSE 514 (B)	Fault Tolerant Computing
CSE 514 (C)	Information Retrieval
CSE 514 (D)	Parallel Computation & Application
CSE 515 (A)	Advance Computer Architectures and Parallel Processing
CSE 515 (B)	Combinatorics and Graph Theory
CSE 515 (C)	Data Storage Technology
CSE 515 (D)	Digital Image Processing and Communication
CSE 524 (A)	Unix Operating System Design
CSE 524 (B)	Computer Graphics
CSE 524 (C)	Software Testing
CSE 524 (D)	Network Security
CSE 525 (A)	Machine Learning
CSE 525 (B)	Real Time Computing
CSE 525 (C)	Discrete Time Signals & System
CSE 525 (D)	Intelligent Systems

List of Minor Electives

CSE 532 (A)	Numerical Computing
CSE 532 (B)	Digital Integrated Circuit Design
CSE 532 (C)	Soft Computing
CSE 532 (D)	Digital System Design

CSE511 DISTRIBUTED COMPUTING

	L	T	P
Credits	3	0	1
Hours	3	0	2

Distributed computing System Characterization, Challenges & Examples, *Interprocess communication,* External Data Representation, Marshalling, Client Server communications, IPC in unix

Communication between distributed objects, distributed object model, design issues of RMI, Distributed Garbage collection, Sun RPC and Java RMI

Name Services and Domain name system, Directory & discovery services, Time & Global States, synchronizing physical clock, Logical time and logical clocks.

Transaction and Concurrency control: Transactions, Nested transactions, Locks, Optimistic concurrency control, Time stamp ordering, Distributed Transactions, flat and nested distributed transactions, Atomic commit protocols in distributed transactions, concurrency control in distributed transactions, Distributed deadlocks, transaction recovery.

practicals: based on theory.

Texts/References:

- George Coulouris, Jean Dollimore, Tim Kindberg : Distributed Systems, Concepts and Design, 3rd Ed, Addission Wesley.
- A.S. Tanenbaum, M.S. Steen : Distributed System – Principles and Paradigms, Pearson Education

CSE512 MOBILE COMPUTING

	L	T	P
Credits	3	0	1
Hours	3	0	2

Introduction: The Cellular concepts and its implementations, Analog and Digital cellular mobile system, cellular mobile systems, wireless systems**,** Channel allocation, Multiple access, Location management, Handoffs. Mobile network and Transport layers and protocols, General study of 4-G mobile communication systems.

Wireless Networking: MAC protocols, Routing, Transport, Ad-hoc networking. Wireless LAN Architecture, Mobility in Wireless LAN, Mobile Ad-Hoc Networks & Sensor Networks, Wireless LAN security. Energy efficient computing, Impact of mobility on algorithms
Applications: Mobility adaptations, disconnected operations, Data broadcasting, Mobile agents.

practicals: Based on theory.

Text Book/References :

1 Asoke k Talukdar and Roopa R Yavagal, *Mobile Computing,*Tata Mc-Graw Hill.
2 William Stallings, *Wireless Communications & Networks*, Pearson Education.
3 John Schiller, *Mobile Communications*, Pearson Education.
4 T.S. Rappaport, *Wireless Communications*, Principles & Practices.

CSE513 EMBEDDED SYSTEMS DESIGN

	L	T	P
Credits	2	0	1
Hours	2	0	2

Design Challenges, Processor, Technology, IC Technology, Design Technology. *Custom Single purpose processor*: Custom single purpose processor design, operation, programmer view, development environment, Application specific instruction set processor, selecting a microprocessor.

Standard single purpose processor peripherals, Timers counters, watchdog timers, UART, Pulse with modulator, LCD controller, Keypad controller, APC, Real time clocks. *Memory*: Memory write ability and storage performance. Common memory types, composing memories, memory hierarchy and cache, advanced RAM: DRAM, FPMDRAM, EDO DRAM, SDRAM, RDRAM, Memory management unit.

Interfacing: Arbitration, Multi-level bus architectures, *Serial Protocols*: 12C bus, CAN bus, Fire Wire Bus, USAB, *Parallel Protocols*: PCI and ARM Bus, wireless protocols: 1rdA, Bluetooth, IEEE 802.11
Control Systems: Open loop and closed loop systems, General control systems and PID controllers, Fuzzy control, Practical issues related to computer based control, Benefits of computer based control implementations.

practicals: Based on theory.

Text /References:

- Frank Vohid and Tomy Givargi , Embedded System Design: A Unified Hardware/software Introduction, wiley 2001.

CSE514A DISTRIBUTED DATABASE MANAGEMENT SYSTEMS

	L	T	P
Credits	2	0	0
Hours	2	0	0

Introductory concepts and design of Distributed Database Systems, Data Fragmentation, Replication, and allocation techniques for DDBMS, Methods for designing and implementing DDBMS, designing a distributed relational database, Architectures for DDBMS cluster, federated, parallel databases and client server architecture.

Advanced concepts in DDBMS: Overview of distributed management, atomicity,consistency,isolation,durability,two phase locks, time stamp ordering, optimistic concurrency control, concurrency and recovery in DDBMS, Distributed Deadlock Management, transaction recovery and replication servers, Distributed Query Processing and Optimization.

Current trends and developments related to Distributed database applications technologies.

Introduction to related database technologies: Parallel Databases, Mobile database and Web Databases.

Texts/References:

- M. Tomer Ozsu, P. Valduriez: Principles of Distributed Database Systems 2nd Ed, Pearson Education.
- S. Ceri, G. Pelagapati : Distributed Database, Principles and Systems, McGraw Hill Publication.

CSE514B FAULT TOLERANT COMPUTING

	L	T	P
Credits	2	0	0
Hours	2	0	0

Fundamental Concepts: Definitions of fault tolerance, fault classification, fault tolerant attributes and system structure. *Fault-Tolerant Design Techniques*: Information redundancy, hardware redundancy, and time redundancy. Dependability

Evaluation Techniques: Reliability and availability models: (Combinatorial techniques, Fault-Tree models, Markov models), Performability Models. Architecture of Fault-Tolerant Computers: General-purpose systems, high-availability systems, long-life systems, critical systems.

Software faults and their manifestation, design techniques, reliability models. Fault Tolerant Parallel/Distributed Architectures: Shared bus and shared memory architectures, fault tolerant networks.

Texts/References:

- B.W.Johnson, : Design and Analysis of Fault-Tolerant Digital Systems,Addison-Wesley
- K.S.Trivedi :Probability and Statistics with Reliability, Queueing and Computer Science Application, Prentice Hall

CSE514C INFORMATION RETRIEVAL

	L	T	P
Credits	2	0	0
Hours	2	0	0

Basics **:** Introduction to IR – need and comparison with data retrieval. Modeling: Formal specifications of IR systems. Set theoretic model - Boolean, Vector and Probabilistic based IR systems. Comparison between searching and browsing.

Performance Measures : Recall, Precision, R-precision, Single Value Summaries. User oriented measures: coverage, novelty, expected search length. Query Languages: Single and multi word queries, phrase based queries, structural queries, contextual queries, Structured text: Form based, Hierarchical and Link based.

Text Processing : Information processing, entropy measure, Zipf's Law, Heap's Law, growth of vocabulary, Logical view of documents, Lexical analysis: handling stop-words, punctuations, use of thesaurus, Stemming techniques - Porter's algorithm, Text compression: Statistical and Dictionary schemes, Huffman coding. Inverted lists compression.

Indexing and Searching : Suffix Tries, Supra indices, B+ trees and Hashing construction techniques. Substring matching: Brute Force, KMP, Regular Expression, Shift-Or technique, Suffix Automaton.

Web search: Issues handling web documents, Web Crawling, Web documents ranking - PageRank ranking algorithm.

Texts/References:

- Ricardo Baeza Yates and Berthier Ribeiro Neto, " *Modern Information Retrieval"*, Addison Wesley Longman Publication Inc, 1st edition , 2003
- I. Witten, A. Moffat, and T. Bell. "Managing Gigabytes" Mc-Graw hill publication, 1st edition, 2003

CSE514D PARALLEL COMPUTATION & APPLICATION

	L	T	P
Credits	2	0	0
Hours	2	0	0

Parallel processing terminology, parallel control and data approaches. PRAM algorithms, reduction of number of processors. Processor arrays, multiprocessors, and multicomputers; processor organization-mesh, binary tree, hyper-tree, and hyper-cube.

Parallel programming languages, programming parallel processes, parallel programming features of Fortran 90, C*, nCUBE C, and C-LINDA. Mapping and scheduling, dynamic load balancing and static scheduling.

Basic parallel algorithms, matrix multiplication and fast Fourier transforms.

Typical examples of parallel sorting algorithms, and dictionary operations, Sorting - Lower bounds on parallel sorting, Odd-Even transposition sort, Bitonic Merge, Quicksort based algorithms..

Texts/References:

- Michel J quinn : Parallel Computing, Tata Mc graw hill Edition.
- Kai Hwang : Advanced Computer Architecture, McGraw Hill.

CSE515A ADVANCE COMPUTER ARCHITECTURES AND PARALLEL PROCESSING

	L	T	P
Credits	2	0	0
Hours	2	0	0

Architectural classification schemes for parallel computers, instruction and data multiplicity, serial verses parallel computers, parallelism verses pipelining, Memory hierarchy

General pipelines and reservation tables, interleaved memory organization, instruction pre-fetch and branch – handling, data buffering and business structures, internal forwarding and register tagging, hazard detection and resolution, job sequencing and collision prevention, dynamic pipelines and re configurability.

SIMD computer organization, masking and data routing mechanism inter PE communication, introduction to associative array processing. Multiprocessor architecture: loosely coupled & tightly coupled multiprocessor, processor characteristics for multiprocessing, interconnection networks, cache coherence protocols, scalable multiprocessors, clusters and network of workstations

Texts/References:

- Hwang and Briggs : Computer Architecture and Parallel Processing, Mcgraw- Hill
- Kai Hwang : Advanced Computer Architecture, McGraw- Hill
- V. Rajaraman: Parallel Computers Architecture and Programming.
- D. E. Culler, J. P. Singh : Parallel Computer Architecture
- D.A.PATTERSON, J.L.HENNESSY, "Computer Architecture: A Quantitative Approach",Harcourt Asia, Morgan Kaufmann, 1999

CSE515B COMBINATORICS AND GRAPH THEORY

	L	T	P
Credits	2	0	0
Hours	2	0	0

Permutations and Combinations - Distribution of distinct / non-distinct objects - Generating functions for combinations - Portion of integers - Ferrers graph.

Recurrence Relations - Linear recurrence relations with constant coefficients - Solution by the technique of generating functions - Permutations with restrictions on relative positions.

Basic Definitions - Trees and fundamental circuits - Cut-sets and Cut-vertices - Connectivity and Separability - Network flows - 1 and 2 isomorphism.

Planar and Dual Graphs - Kuratowski's graphs - Representations of a planar graph - Vector space associated with a graph - Subspaces - Orthogonal vectors and spaces.

Matrix Representation of Graphs - Circuit matrix - Cutset matrix - Path matrix - Adjacency matrix - Coloring problems - Algorithms for fundamental circuits, cut-vertices and separability.

Texts/References:

- E.S.Page and L.B.Wilson, "An introduction to computational combinatorics", Cambridge University Press, 1979
- D.E.Knuth, O.Patashuk, R.L.GrahamM, "Concrete Mathematics", 1994
- Douglus. B. West, "Introduction to Graph Theory", Second edition. Prentice Hall,2001

CSE515C DATA STORAGE TECHNOLOGY

	L	T	P
Credits	2	0	0
Hours	2	0	0

Storage devices & I/O Subsystems: Traditional Backup devices, Disk arrays, Disk physical structure- components, properties, performance, and specifications. Tape drives. JBODs, RAIDs, Hot spares. Storage I/O & Storage system connectivity protocols.

Introduction to Networked Storage : Discussion of Direct Attached Storage (DAS), Storage Area Networks (SAN), Network Attached Storage (NAS) and Content Addressable Storage(CAS). Basic architecture, connectivity and management principles.

Introduction to Information availability: Business Continuity and Disaster Recovery Basics, Local business continuity techniques, Remote business continuity techniques, Disaster Recovery principles & techniques.

Storage Area Networks (SAN) : SAN components & Building blocks, SAN software, data access over SAN. Fiber channel basics, protocols & connectivity. SAN topologies, Elements of SAN design, scalability, availability, performance, security, capacity, and manageability issues. Studies and critiques of existing SAN design scenarios (partial mesh, full mesh, core/edge, & tiered designs).

Texts/References:

- Marc Farley Osborne, “Building Storage Networks”, Tata McGraw Hill ,2005
- Robert Spalding, “Storage Networks: The Complete Reference“, Tata Mcgraw Hill.
- Gupta Meena, “Storage Area Network Fundamentals”, Pearson Ed., 2005

- EMC Technology Foundations student guide

CSE515D DIGITAL IMAGE PROCESSING AND COMMUNICATION

	L	T	P
Credits	2	0	0
Hours	2	0	0

Introduction: Origins of digital image processing, application area , components of an image processing system. elements of visual perception,, light and the electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, relationships between pixels.
Image Enhancement in the Spatial Domain: Background,gray level transformations ,histogram processing ,enhancement using arithmetic/logic operations, spatial filtering, smoothing spatial filters,sharpening spatial filters, combining spatial enhancement methods.
Image Enhancement in the Frequency: Introduction to the fourier transform and the frequency domain, smoothing frequency-domain filters , sharpening frequency domain filters, homomorphic filtering,implementation.
Image Restoration: Model of the image degradation/restoration process, noise models, restoration in the presence of noise only–spatial filtering, periodic noise reduction by frequency domain filtering , linear, position-invariant degradations, estimating the degradation function, inverse filtering, minimum mean square error (wiener) filtering, constrained least squares filtering. Geometric mean filter,geometric transformations.
Color Image Processing: Color fundamentals, and models, pseudocolor image processing, color image processing, transformations, smoothing and sharpening, color segmentation.
Wavelets and Multiresolution Processing: Multiresolution expansions, wavelet transforms in one dimension, fast wavelet transform, wavelet transforms in two dimensions, wavelet packets.
Image Compression: Image compression models, elements of information theory, error-free compression, lossy compression, image compression standards.
Image and Video Communication: Packet audio/video in the network environment: Packet voice, integrated packet networks, packet video. Video Transport across generic networks: Layered video coding, Error-resilient video coding techniques, scalable rate control, and Streaming video over the Internet, protocols for streaming video, and Video over IP. Multicasting, caching, and perfecting issues in IP network.

Text/Reference:

- Rafael C. Gonzalez, Richard E. "Woods Digital Image Processing" Pearson Education
- Gonzalez R., Wood R. E., Digital Image Processing, Prentice Hall of India
- K.R. Rao, Zoran S. Bojkovic, and Dragorad A. Milovanovic: Multimedia Communication Systems, Prentice-Hall of India Private Limited, New Delhi.

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; eresourcesaccess methods.

CSE521 INTERCONNECTION NETWORKS L T P

	L	T	P
Credits	3	0	1
Hours	3	0	2

Introduction : shared medium networks, Direct Networks, Indirect Networks, multiple Backplane buses, Hierarchical networks, cluster based networks.

Message Switching Layer : Basic switching techniques: circuit switching, packet switching, virtual cut-through switching, wormhole switching, mad postman switching, Virtual channels

Deadlock, livelock, and starvation : A theory of deadlock avoidance : network & router model, deadlock avoidance in SAF & VCT switching, deadlock avoidance in wormhole switching, Channel classes, central queues, deflection routing, injection limitations, deadlock avoidance in switch based networks, deadlock prevention in circuit switching and PCS, Deadlock recovery: deadlock probability, detection of potential deadlocks, progressive and regressive recovery techniques, Livelock avoidance.

Routing Algorithms : deterministic routing algorithms, partially adaptive routing algorithm: planar adaptive and turn model, Fully adaptive algorithms : algorithms based on structured buffer pools, algorithms derived from SAF algorithms, virtual networks, deterministic and adaptive sub networks, maximally adaptive routing algorithms : algorithms with minimum buffer requirement, true fully adaptive routing algorithms, Nonminimal routing algorithms, Backtracking protocols, Routing in switch based networks with irregular topologies, Resource allocation policies: selection function, policies for arbitration & resource allocation.

practicals: Based on theory.

Texts/References:

- J. Duato, S. Yalamanchili. L. Ni : Interconnection Networks

CSE522 MULTIMEDIA COMPUTING

	L	T	P
Credits	3	0	1
Hours	3	0	2

Multimedia Authoring and Data Representation: Component of multimedia, Multimedia software tools, Multimedia Authoring and tools. *Graphic and Image Data Representations:* Graphic and Image data types, Popular file format. Colour models in images and video. *Video and Audio:* Types of Video signals, Analog video, Digital video, Digitization of sound, musical instrument digital interface (MIDI), Quantization and transmission of audio.

Multimedia Data Compression: Lossless and lossy compression algorithms, Image compression standards, Video compression techniques, MPEG video coding-I (MPEG-1 and MPEG-2), MPEG video coding-II (MPEG-4 and MPEG-7 and beyond), Audio compression techniques. MPEG audio compression.

Multimedia Communication: Computer and multimedia networks, multiplexing techniques, Quality of Multimedia data transmission, Multimedia over IP, Transport of MPEG-4 video, Video-on-demand, Multimedia over wired and wireless network. *Multimedia Applications:* Media preparation, media composition, media integration, media communication, media entertainment

practicals: Based on theory.

Texts/References:

1. Ralf Steinmetz and Klara Nahrstedt, “Multimedia: Computing, Communication and applications”, Pearson Education 2001.
2. Prabhat K. Andleigh and Kiran Thakrar, “Multimedia Systems Design”, PHI.
3. Ze-Nian Li and Mark S. Drew, “ Fundamentals of Multimedia”, Pearson Education ,2004
4. Buford, “Multimedia systems” , Pearson Education, 2000.

CSE523 DATA MINING TECHNOLOGY

	L	T	P
Credits	3	0	1
Hours	3	0	2

Data Warehousing, OLAP and Data Mining, classification of data mining techniques, Discovery and analysis of patterns, trends and deviations
Data Ware Housing Schema - Star Schema, snowflake schema, and Fact constellation schema. Data Warehouse architecture, Data Marts, OLAP operations in the multidimensional data model, Types of OLAP servers.

Data Preprocessing - Data Cleaning, Data Integration and Transformation, Data Reduction. Data Mining Architecture, Knowledge discovery in databases.

Data Mining Models- Classification and Prediction - Parametric and Non-Parametric Approaches.

Classification based on Association Rules and Decision Tree Models. Advanced Classification- Neural Networks, Genetic Algorithms, and Fuzzy Systems.

Cluster Analysis - Hierarchical Models, Model Based Clustering Methods, Outlier Analysis.

practicals: Based on theory.

Texts/References:

- Inmon W.H. Building the Data Warehouse. USA: John Wiley & Sons Inc. Third Edition, 2002.
- Jiawei Han and Micheline Kamber. Data Mining Concepts and Techniques. San Francisco: Morgan Kaufmann Publishers, *An Imprint of Elsevier*. 2003.

CSE524A UNIX OPERATING SYSTEM DESIGN

	L	T	P
Credits	2	0	0
Hours	2	0	0

Operating system services, Architecture of the UNIX operating system, system concept, kernel data structure, system administration,

Buffer header, structure of the buffer pool, scenarios for retrieval of a buffer, reading & writing disk blocks, advantages & disadvantages of the buffer cache, Internal representation of files : Inodes, structure of a regular file, directories, conversion of a path name to an inode, super block, inode assignment to a new file, allocation of a disk blocks, other file types.

process creation, signals, process termination, awaiting process termination invoking other programs, the user ID of a process, changing the size of a process,

Process scheduling & time: Process scheduling, system Calls for time clock, Memory management: swapping, Demand paging, A hybrid system with swapping and demand paging.

Texts/References:

- Maurice J. bach : The Design of the Unix Operating System, Pearson Education.

CSE524B COMPUTER GRAPHICS

	L	T	P
Credits	2	0	0
Hours	2	0	0

Introduction to computer graphics, application areas, display devices, raster scan, random scan, color monitor, display file, frame buffer, 3-D display technique, input devices, hard copy devices.

Points, lines, plane and coordinate, character vector, circle generation algorithm, antialiasing techniques, representation of polygons, Interfacing and filling polygon, 2-D transformation, translation, rotation, scanning, shearing, reflection, composite transformation, raster transformations.

Windows, multiple windowing, view port, viewing transformation, clipping algorithm for points, line using Sutherland and Cohen, polygon, text clipping. Segment and segment operations. Interactive graphics, user dialogue, input modes, interactive picture construction techniques, curves and curved surface, interpolation and approximation curve, continuity of curve.

Concept of 3-D, representation of 3-D object, 3-D transformation, translation, rotation, reflection, scaling. Parallel perspective, Isometric Projections. 3-D clipping Sutherland and Cohen algorithm. Hidden lines and surface removal techniques. Back face, Z-buffer, painter algorithm.

Texts/References:

- D. Hearn and M.P. Baker, Computer Graphics: C Version, 2nd Ed, Pearson Education
- James D. Foley; Andries Van Dam; Steven K. Feiner; John F. Hughes, Interactive Computer Graphics, Addison Wesley

CSE524C SOFTWARE TESTING

	L	T	P
Credits	2	0	0
Hours	2	0	0

Testing Concepts, Issues and Planning: Purpose, Activities, Processes and Context Questions about Testing, Functional vs Structural Testing: Coverage –based vs Usage –based Testing: When to Stop Testing? – Test Planning and Preparation: Goals, Strategies, and techniques, Testing models and test cases. Test suite preparation and management, Preparation of Test procedure, Test Execution, Result Checking, and Measurement, Analysis and Follow-up, Activates, People, and Management, Test Automation

Coverage based and Boundary Testing Techniques : Checklist-Based Testing and its Limitations, Testing for partition Coverage, Partition: Concepts and definitions, Testing decisions and predicates for partition coverage, Usage-Based Statistical Testing, a case study, Input Domain Partitioning and Testing, Input domain testing for partition and boundary problems, simple Domain Analysis and the Extreme point Combination Strategy, Other Boundary Test Strategies and Applications

Control Flow, Data Dependency, and Integration Testing: Basic Control Flow Testing, Model construction path selection & sensitization, Loop Testing, CFT Usage, and Other Issues, Different types of loops and corresponding CFGs, Loop testing: Difficulties and a heuristic strategy, CFT Usage and other Issues, Data Dependency and Data flow Testing: Basic concepts: Operations on data and data dependencies, DFT and DDG elements and characteristics DFT: Coverage and Applications, Achieving slice and other coverage.

Testing Techniques: Adaptation, Specialization and Integration: Testing Sub-Phases and Applicable Testing Techniques, Specialized Test Tasks and Techniques.

Quality assurance beyond testing: Defect Prevention and Process Improvement: Basic concepts and Generic Approaches, Root cause Analysis for Defect Prevention Other Techniques for Defect Prevention, Analysis and modeling for defect prevention, Technologies, standards, and methodologies for defect prevention, Software tools to block defect injection, Focusing on Software Processes – Process selection , definition and conformance, Process maturity.
Software Inspection and Formal verification: Basic concepts and Generic Process, Fagan inspection, Other Inspections and Related Activities, Code reading, other formal reviews and static analyses, Defect Detection Techniques, Tool / Process Support, and Effectiveness Basic Concepts: Formal Verification and Formal Specification, Formal Verification: Axiomatic Approach

Text /References:

- Jeff Tian, "Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement", - John Wiley and Sons Inc., and IEEE Computer Society Press, February 2005
- Edwar.Dkit. "Software testing in the Real World", Pearson Education 2003.
- William E Perry. "Effective Methods for Software Testing", Second Edition, John Wiley and Sons, 2003
- Stephan H. Kan, "Metrics and Models in Software Quality Engineering", Second Edition, Pearson Education, 2003
- "Rapid Testing" by Robert Culbertson, Chris Brown and Gary Cobb; Prentice-Hall, 2002.

CSE524D NETWORK SECURITY

	L	T	P
Credits	2	0	0
Hours	2	0	0

Principle of security, Types of attacks, Cryptography Techniques: Plain Text and Cipher text, Substitution techniques, Transposition techniques, Encryption & decryption, symmetric & asymmetric cryptography, steganography, key range and key size, possible types of attacks.

Computer- based Symmetric key Cryptography Algorithms: symmetric key cryptography, DES, IDEA, blowfish, advance encryption standards, Computer- based Asymmetric key Cryptographic Algorithms: RSA algorithms, Digital Signature, MD5.

Public Key Infrastructure (PKI): Digital Certificates, private key management, *Authentication* : password, authentication tokens, certificate based authentication, biometric authentication, Kerberos, single sign on(SSO)

Internet Security Protocols: Secure socket layer, Secure hyper text transfer protocol, Time stamping protocol, Secure electronic transaction ,electronic money, E-Mail Security, Wireless application protocol (WAP) security, Network Security: IP security, firewalls, Virtual Private networks, denial of service attack(case study) IP spoofing attacks, cross site scripting vulnerability, contract signing, secrect splitting, virtual elections.

Texts/References:

- Atul Kahate : Cryptography and Network Security, Tata McGraw- Hill Publishing Company Ltd.

- William Stallings : Cryptography and Network Security, 2nd Ed, Pearson Asia

CSE525A MACHINE LEARNING

	L	T	P
Credits	2	0	0
Hours	2	0	0

The concept learning task. General-to-specific ordering of hypotheses. Version spaces. Inductive bias. Decision Tree Learning. Rule Learning: Propositional and First-Order, Over-fitting, Cross-Validation.

Experimental Evaluation of Learning Algorithms Instance-Based Learning: k-Nearest neighbor algorithm, Radial basis functions. Case-based learning. Computational Learning Theory: probably approximately correct (PAC) learning. Sample complexity. Computational complexity of training. Vapnik-Chervonenkis dimension.

Artificial Neural Networks : Linear threshold units, Perceptrons, Multilayer networks and backpropagation, recurrent networks. Probabilistic Machine Learning Maximum Likelihood Estimation, MAP, Bayes Classifiers Naive Bayes. Bayes optimal classifers.

Minimum description length principle. Bayesian Networks, Inference in Bayesian Networks.
Bayes Net Structure Learning Unlabelled data: EM, preventing overfitting, cotraining Gaussian Mixture Models, K-means and Hierarchical Clustering, Clustering and Unsupervised Learning, Hidden Markov Models, Reinforcement Learning. Support Vector Machines Ensemble learning: boosting, bagging.

Texts/References:

- Tom. M. Mitcheli : Machine Learning, McGraw- Hill Publishing Company Ltd.

CSE525B REAL TIME COMPUTING

	L	T	P
Credits	2	0	0
Hours	2	0	0

Introduction to real-time computing - Structure of a real-time system - Characterization of real-time systems and tasks - Performance measures. Task Assignment and Scheduling - Uniprocessor scheduling algorithms – Task assignment- Mode changes - Fault tolerant scheduling.

Real-time Communication - Network topologies and architecture issues - Protocols - Contention-based, token-based, polled bus - Fault tolerant routing.

Real-time Databases - Transaction priorities and aborts - Concurrency control issues - Scheduling algorithms - Two-phase approach to improve predictability.

Programming Languages and Tools - Hierarchical decomposition - Run-time error handling - Overloading - Timing specification - Recent trends and developments.

Texts/References:

- C.M. Krishna and K.G. Shin, *Real-Time Systems*, McGraw Hill
- Jane W.S.Liu, “Real Time Systems”, Pearson Edition-2004
- J. Stankovic, "Misconceptions About Real-Time Computing," *IEEE Computer*, Vol. 21, No. 10, October 1988, pp. 10-19.

- K.G. Shin and P. Ramanathan, "Real-time computing: A new discipline of computer science and engineering," Proc. IEEE, vol.82, no.1, pp.6-24, Jan. 1994.
- K. Ramamritham and J. A. Stankovic, "Scheduling algorithms and operating systems support for real-time systems," Proc. IEEE, vol.82, no.1, pp.55-67, Jan. 1994.

CSE525C DISCRETE TIME SIGNALS & SYSTEM

	L	T	P
Credits	2	0	0
Hours	2	0	0

Discrete Time Signal: Sequences; Discrete Time System, Classification; Linear Time Invariant Systems, Its Properties; Frequency Domain Representation of Discrete Time Signals and
Systems; Symmetry properties of the Fourier Transform, Fourier Transform Theorems.

Z- Transform L: Definition and Properties, the Region of Convergence; Bilateral Z Transform, Inverse Z – transform; Z transform properties.
Discrete Fourier Transform: Representation of Periodic Sequence: The Discrete Fourier Series- Properties; Sampling in Time and Frequency Domain; Fourier Representation of Finite Duration Sequences: The Discrete Fourier Transform.- Properties ; Linear Convolution using the DFT; Two Dimensional DFT; Discrete Time Fourier Transform.

Realisation of Digital Linear Systems: Introduction, Basic Realization, Block Diagram & the Signal Flow Graph; Basic Structures for IIR and FIR Systems.
Digital Filter Design Techniques: Design of IIR Digital Filters from analogue filters; Properties of FIR Digital Filters; Design of FIR Filters using Windows; Comparison of IIR and FIR Filters, Linear Phase Filters.
Computation of the Discrete Fourier Transform: Goertzel Algorithm; Decimation in Time algorithms; Decimation in Frequency algorithms; FFT algorithms for an N composite number; General Computational considerations in FFT algorithms; Chirps Z Transform algorithm.

Discrete Hilbert Transform: Real and Imaginary part Sufficiency for Causal Sequences; Minimum Phase Condition; Hilbert Transform Relations for the DFT and the Complex Sequences.

Text /References:

1. Proakis J.G., Manolakis G. D., Digital Signal Processing*, 3RD ED., Pearson Education Asia.*
2. Oppenheim A.V., Schafer Roland W., Discrete- Time Signal Processing, Prentice Hall India.
3. S Salivahanan, A Vallavaral, and C Gnanapriya, Digital Signal Processing,Tata MCGraw-Hill.
5. Mitra S.K., "Digital Signal Processing: A Computer Based Approach", TMH

CSE525D INTELLIGENT SYSTEMS

	L	T	P
Credits	2	0	0
Hours	2	0	0

Artificial Intelligence: Introduction, Intelligent Agents, Solving problems by searching., Informed Search methods,. Game Playing.

Neural Networks: Introduction. Basic Neural Computational Models Learning: Supervised versus unsupervised., Knowledge Based Neural networks, Mathematical modeling.

Expert Systems : .Knowledge acquisition and representation., Inference Engines.
Reasoning under uncertainty, .Hybrid Expert Systems , Fuzzy Logic and neural networks.

Texts/References:

- Stuart Russell, & Peter Norvig, "Artificial Intelligence- A Modern Approach", Pearson Education Asia, 2002.
- Li Min Fu, "Neural Networks in Computer Intelligence", TMH, 2003.
- B. Kosko, "Neural Networks and Fuzzy Systems- A Dynamical systems approach to machine intelligence", PHI,1997.

CSE531 ADVANCE OPERATING SYSTEMS

	L	T	P
Credits	3	0	0
Hours	3	0	0

Distributed OS: Architecture of Distributed Systems, issues in DOS, client-server computing, message-passing, remote procedure call (RPC), limitations of DS, absence of shared memory and global clock, Lamport's Logical clocks, vector clocks, causal ordering of messages

Distributed Mutual Exclusion and deadlock: Mutual exclusion algorithms, token-based and non-token-based algorithms, Deadlock models and algorithms, deadlock detection and prevention

Distributed File Systems and Shared Memory: architecture of Distributed file systems, design issues, replication algorithms, cache coherence.

Distributed Scheduling: Motivation and issues, load distribution, balancing and sharing algorithms, Load distribution algorithms, load scheduler, task migration

Failure Recovery and Fault Tolerance: introduction and basic concepts, classification of failures, backward and forward recovery, check pointing and recovery, issues in fault tolerance, Commit and voting protocols.

Real-Time OS: Characteristics of real time OS, Hard Versus Soft Real-Time Systems, Real-Time communications, Real-Time Scheduling, case study: Windows CE, PalmOS

Texts/References:

- M. Singhal & N.G. Shivaratri, "Advanced concepts in operating systems", TMH, 2001.
- A. S. Tanenbaum, "Modern Operating System", Second edition, PHI, 1990.
- W. Stallings, "Operating Systems", PHI, 1995.

CSE532A NUMERICAL COMPUTING

	L	T	P
Credits	3	0	0
Hours	3	0	0

Non-Linear Systems - Various types of errors - Bisection method - Regula falsi method -Newton-Raphson method - Horner's Method - Graffe's method - Bairstow's method -Newton's method.

Solution of Simultaneous Linear Equations: Gaussian elimination, pivoting, Gauss-Jordan method, Gauss-Seidal method, Cholesky's method, evaluation of determinant. Matrix inversion, matrix inversion in-place. *Eigenvalues and Eigenvectors*: Matrix iteration methods, power and inverse power method.
Interpolation: Lagrangian and Hermite interpolation, cubic spline interpolation. Curve fitting, polynomial method, methods of least squares. *Numerical Integration and Differentiation*: Numerical integration by trapezoid rule, Simpson's rule, Weddle's rule, Gauss quadrature.

Numerical differentiation: Differentiation based on equal interval interpolation, second order derivative, Derivatives using Newton's backward difference formula, Derivatives using central difference, Based on Stirling's, Differentiations based on Lagrange's interpolation.

Solution of Ordinary Differential Equations: Euler's method, modified Euler's method, Runge-Kutta methods, predictor-corrector methods – Milne'es method. Introduction to finite difference methods. *Eigen values and Eigen vectors:* Determination of Eigen values and Eigen vectors of matrices, Inverse of a matrix – Recent trends and developments.

Text /References:

- Cheneg and Kincaid, "Introduction to Numerical Computing", Tata McGraw-Hill, 1998
- S.S. Sastry: Introductory Methods of Numerical Analysis, PHI.
- M.K.Jain, S.R.K.Iyengar, and R.K.Jain: Numerical Methods for Scientific and Engineering Computation, New Age International (P) Limited.

CSE532B DIGITAL INTEGRATED CIRCUIT DESIGN

	L	T	P
Credits	3	0	0
Hours	3	0	0

Introduction, VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality, VLSI Design Styles, Design Quality, Packaging Technology, Introduction of Computer-Aided Design Technology. *Combinational MOS Logic Circuits*: Introduction, Classification of CMOS digital circuit types, Circuit design procedures. Metal-Oxide Semiconductor (MOS) Logic: Enhancement-Type MOSFET,The p-channel MOSFET, Depletion MOSFET. NMOS Inverter, NMOS NAND gate, NMOS NOR gate, Complementary metal oxide semiconductor (CMOS) Logic: CMOS Inverter, CMOS NAND Gates, CMOS NOR Gate, Pass-Transistor logic circuits, Complex logic circuits, CMOS characteristics.

CMOS Bistable Elements, The SR Latch Circuit based on NAND and NOR gates, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop. Dynamics logic circuit techniques, High-performance CMOS circuits: Domino CMOS Logic, NORA CMOS Logic, and TSPC Dynamic CMOS.

Memory-Chip Organization, Random-Access Memory (RAM) Cells, Read-Write Operation of Static Memory and Dynamic Memory Cell. Sense Amplifiers and Address Decoders. Read Only Memory (ROM): A MOS ROM, EPROM Cell. BiCMOS Bipolar Junction Transistors (BIT): Structure and Operation. Basic BiCMOS Circuits, Switching Delay in BiCMOS Logic Circuits, BiCMOS NOR gate and NAND Gate.

Design For Manufacturability and Testability: Manufacturability: Introduction, Process Variations, Basic Concepts and Definitions, Design of Experiments and Performance Modeling. *Testability:* Fault Types and Models, Controllability and absorbability, Ad Hoc Testable Design Techniques, Scan-Based Techniques, and Built-In Self Test (BIST) Techniques. Intoduction to VHDL, entity, architecture, configuration declaration, data objects, simple examples of VHDL codes

Texts/References:

- CMOS Digital Integrated Circuits Analysis and Design, Sung -Mo Kang, Yusuf Leblebici, Tata McGrawHill Edition.
- R. P. Jain : Modern digital electronics, McGraw Hill publication

CSE532C SOFT COMPUTING

	L	T	P
Credits	3	0	0
Hours	3	0	0

Fundamentals of Artificial Neural Networks & Applications, Characteristics of ANNs .The Biological Prototype, Perceptron, Multilayer NN. Learning Methods Backpropagation, Counterpropagation, ART, BAM, Associative memories.
Introduction to Fuzzy Logic, Fuzzy sets, Fuzzy model, Fuzzy rule generation. Fuzzy inference system, Defuzzification. Introduction to Neuro Fuzzy Systems, Architecture of a Neuro Fuzzy system and its applications
Genetic Algorithm: An overview, Problem solving using GA, Applications of GA & GP, Hybrid systems

Text /References:

1. Neuro fuzzy and soft computing by Jang, Pearson Education
2. Learning and Soft Computing by Kecman, Pearson Education
3. Fuzzy Sets and Fuzzy Logic - Klir and Yuan, PHI
4. Neurocomputing: Theory & Practice by Philip D.Wasserman, VanNostrand Reinhold
5. Neural Network in computer Intelligence by Fu, TMH
6. Neural Networks and Fuzzy Systems by Bart Kosko, PHI
7. An Introduction to Genetic Algorithm -Melaine Mitchell, PHI Course
8.

CSE532D DIGITAL SYSTEM DESIGN

	L	T	P
Credits	3	0	0
Hours	3	0	0

Introduction: Introduction to Computer aided design tools for digital systems. Hardware description languages; introduction to VHDL, data objects, classes and data types, Operators, Overloading, Logical operators. Types of delays Entity and Architecture declaration. Introduction to behavioral, data flow and structural models.

VHDL Statements : Assignment statements, sequential statements and process, conditional statements, case statement Array and loops, resolution functions, Packages and Libraries, concurrent statements. Subprograms: Application of Functions and Procedures, Structural Modeling, component declaration, structural layout and generies.

Combinational Circuit Design: VHDL Models and Simulation of combinational circuits such as Multiplexers, Demultiplexers, encoders, decoders, code converters, comparators, implementation of Boolean functions etc. Sequential Circuits Design: VHDL Models and Simulation of Sequential circuits. Shift Registers, Counters etc.

Design of Microcomputer: Basic components of a computer, specifications, architecture of a simple microcomputer system, implementation of a simple microcomputer system using VHDL.

Design with CPLDs and FPGAs: Programmable logic devices: ROM, PLAs, PALs, GAL, PEEL, CPLDs and FPGA. Design implementation using CPLDs and FPGAs.

Text /References:

1. IEEE Standard VHDL Language Reference Manual (1993).
2. Digital Design and Modelling with VHDLand Synthesis: KC Chang; IEEE Computer Society Press.
3. "A VHDL Primmer": Bhasker; Prentice Hall 1995.
4. "Digital System Design using VHDL": Charles.H.Roth; PWS (1998)
5. "VHDL-Analysis & Modelling of Digital Systems" : Navabi Z; McGraw Hill.
6. VHDL – IV Edition: Perry TMH (2002)
7. "Introduction to Digital Systems": Ercegovac. Lang & Moreno; John Wiley (1999).
8. Fundamentals of Digital Logic with VHDL Design: Brown and Vranesic; TMH (2000).
9. Modern Digital Electronics – III Edition: R.P.Jain; TMH (2003)