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

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

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:
- A.S. Tanenbaum, M.S. Steen: Distributed System – Principles and Paradigms, Pearson Education

CSE512 MOBILE COMPUTING

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.


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.
CSE513 EMBEDDED SYSTEMS DESIGN

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.


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:

CSE514A DISTRIBUTED DATABASE MANAGEMENT SYSTEMS

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:
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


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


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.


Texts/References:
- Ricardo Baeza Yates and Berthier Ribeiro Neto, ”Modern Information Retrieval”, Addison Wesley
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:

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 reconfigurability.

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 multiprocesing, interconnection networks, cache coherence protocols, scalable multiprocessors, clusters and network of workstations

Texts/References:
- Hwang and Briggs : Computer Architecture and Parallel Processing, Mcgraw- Hill
- D. E. Culler, J. P. Singh : Parallel Computer Architecture
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.


Texts/References:

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:
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.


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

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; e-resources access methods.

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


practicals: Based on theory.

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

CSE522 MULTIMEDIA COMPUTING

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.


practicals: Based on theory.

Texts/References:

CSE523 DATA MINING TECHNOLOGY

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Data Warehousing, OLAP and Data Mining, classification of data mining techniques, Discovery and analysis of patterns, trends and deviations
Data Warehousing 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.


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

practicals: Based on theory.

Texts/References:

CSE524A UNIX OPERATING SYSTEM DESIGN

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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

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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.


Texts/References:
- James D. Foley; Andries Van Dam; Steven K. Feiner; John F. Hughes, Interactive Computer Graphics, Addison Wesley

CSE524C SOFTWARE TESTING

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Credits 2 0 0
Hours 2 0 0


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.


Text/References:

CSE524D NETWORK SECURITY

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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.


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


Texts/References:


Texts/References:

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:

CSE525C DISCRETE TIME SIGNALS & SYSTEM

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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:


CSE525D INTELLIGENT SYSTEMS

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Texts/References:
- Li Min Fu, “Neural Networks in Computer Intelligence”, TMH, 2003.

CSE531 ADVANCE OPERATING SYSTEMS

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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.


Texts/References:

CSE532A NUMERICAL COMPUTING

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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.


Text /References:
- S.S. Sastry: Introductory Methods of Numerical Analysis, PHI.

CSE532B DIGITAL INTEGRATED CIRCUIT DESIGN

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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. Introduction to VHDL, entity, architecture, configuration declaration, data objects, simple examples of VHDL codes
Texts/References:
- R. P. Jain: Modern digital electronics, McGraw Hill publication

CSE532C SOFT COMPUTING

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Fundamentals of Artificial Neural Networks & Applications, Characteristics of ANNs .The Biological Prototype, Perceptron, Multilayer NN. Learning Methods Backpropagation, Counterpropagation, ART, BAM, Associative memories.

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
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. Cemented Concrete

CSE532D DIGITAL SYSTEM DESIGN

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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.


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: