THIRD SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSPC21</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Data Structures</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
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<tr>
<td>Prerequisites(Course code)</td>
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<tr>
<td>Course Type</td>
<td>PC</td>
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</table>

Objectives
- To understand the various techniques of sorting and searching
- To design and implement arrays, stacks, queues, and linked lists
- To understand the complex data structures such as trees and graphs

Unit – I
Development of Algorithms - Notations and analysis - Storage structures for arrays - Sparse matrices - Stacks and Queues: Representations and applications.

Unit – II
Linked Lists - Linked stacks and queues - Operations on polynomials - Doubly linked lists - Circularly linked lists - Dynamic storage management - Garbage collection and compaction.

Unit – III

Unit – IV
Graphs - Representation of graphs - BFS, DFS - Topological sort - Shortest path problems. String representation and manipulations - Pattern matching.

Unit – V
Sorting Techniques - Selection, Bubble, Insertion, Merge, Heap, Quick, and Radix sort - Address calculation - Linear search - Binary search - Hash table methods.

Outcomes
- Ability to develop programs to implement linear data structures such as stacks, queues, linked lists, etc.
- Ability to apply the concept of trees and graph data structures in real world scenarios
- Ability to comprehend the implementation of sorting and searching algorithms

Text Books

Reference Book
Course Code: CSPC22  
Course Title: Digital Systems Design  
Number of Credits: 3-0-0-3  
Prerequisites (Course code): -  
Course Type: PC

Objectives
- To understand the essential knowledge on the fundamental of digital circuits
- To understand the overview on the design principles of digital computing systems

Unit - I

Unit - II

Unit - III
Sequential logic - Basic latch - Flip-flops (SR, D, JK, T and Master-Slave) - Triggering of flip-flops - Counters - Design procedure - Ripple counters - BCD and Binary - Synchronous counters, Registers - Shift registers - Registers with parallel load, Reduction of state and flow tables - Race-free state assignment - Hazards.

Unit - IV

Unit - V

Outcomes
- Ability to design and implement complicated digital systems using Verilog
- Ability to design a VLSI circuit for an application
- Ability to comprehend the digital design logic

Text Books

Reference Books
Course Code : CSPC23
Course Title : Principles of Programming Languages
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : PC

Objectives
- To understand and describe syntax and semantics of programming languages
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event handling in programming languages
- To develop programs in non-procedural programming paradigms

UNIT - I

UNIT - II

UNIT - III

UNIT - IV

UNIT - V

*Programming assignments are mandatory.

Outcomes
- Describe syntax and semantics of programming languages
- Explain data, data types, and basic statements of programming languages
- Design and implement subprogram constructs
- Apply object-oriented, concurrency, and event handling programming constructs
- Develop programs in Scheme, ML, and Prolog
- Understand and adopt new programming languages
Text Books
Course Code : CSPC24
Course Title : Computer Organization
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : PC

Objectives
- To understand the basic hardware and software issues of computer organization
- To understand the representation of data at machine level
- To understand how computations are performed at machine level

Unit – I

Unit – II
MIPS Addressing for 32-Bit Immediates and Addresses, Parallelism and Instructions: Synchronization, Translating and Starting a Program, Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Arithmetic: Subword Parallelism, Streaming SIMD Extensions and Advanced Vector Extensions in x86.

Unit – III
Logic Design Conventions, Building a Datapath, A Simple Implementation Scheme, overview of Pipelining, Pipelined Datapath, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions, The ARM Cortex – A8 and Intel Core i7 Pipelines, Instruction –Level Parallelism and Matrix Multiply Hardware Design language

Unit – IV
Memory Technologies, Basics of Caches, Measuring and Improving Cache Performance, dependable memory hierarchy, Virtual Machines, Virtual Memory, Using FSM to Control a Simple Cache, Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks, Advanced Material: Implementing Cache Controllers

Unit – V
Disk Storage and Dependability, Parallelism and Memory Hierarchy: RAID levels, performance of storage systems, Introduction to multi threading clusters, message passing multiprocessors.

Outcomes
- Ability to analyze the abstraction of various components of a computer
- Ability to analyze the hardware and software issues and the interfacing
- Ability to work out the tradeoffs involved in designing a modern computer system

Text Book

Reference Book
<table>
<thead>
<tr>
<th>Course Code</th>
<th>MAIR37</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Introduction to Probability Theory</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites(Course code)</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>GIR</td>
</tr>
</tbody>
</table>

**Objectives**

- To introduce the fundamental concepts and theorems of probability theory
- To apply elements of stochastic processes for problems in real life
- To understand elementary queuing concepts and apply elsewhere in computer science.

**Unit – I**
Definitions of Probability – Notion of sample space – Events – Basics of Combinatorial Analysis – Posing Probability problems mathematically – Examples

**Unit – II**

**Unit – III**

**Unit – IV**
Chebyshev Inequality – Law of Large Numbers – Central Limit Theorem – Random Process – Markov Dependence, Markov Chains, definition, examples, ergodicity

**Unit – V**
Finite Markov Chain – Various States – Limiting Probability – Introduction to Markov Process – M/M/l Queues with finite and infinite waiting space

**Outcomes**

- Ability to conceptualize the necessity of randomness concept in practical situation
- Ability to approximate the real problems using stochastic process and deduce results
- Ability to deduce useful results and interpret them based on the analysis of queuing theory

**Text Books**

Course Code : CSPC25
Course Title : Combinatorics and Graph Theory
Number of Credits : 3
Prerequisites (Course code) : CSPC11
Course Type : PC

Objective
- To introduce basic combinatorics and graph theory

Unit – I
Scope of the course, Application areas in CS, A feel of some advanced problems in Combinatorial Optimization/Graph Theory, Sum/Product rules, Power set - algorithm, Bijectons/Mapping/Examples Permutations and combinations, examples, Combinatorial ideas, Pascal Triangle Counting principles via examples, Insertion sort, Stirling numbers

Unit – II
Average case analysis and combinatorial ideas Double counting - Fubini’s method, PHP principle, various illustrations Stirling numbers of II kind, Combinatorial identities, Binomial theorem Multinomial theorem, $P(n,t_1, - , ,tp)$ notation, Euler PHI-function, Properties, Steps in Sieve of Eratosthenes

Unit – III

Unit – IV
Basics of GFs, Review problems, Examples, GF manipulations Coupled difference equations, Graph theory fundamentals, Representations, Examples in CS - MST review, Party problem Distance in graphs, Floyd-Warshall algorithm, Operations in graphs, Meanings of products

Unit – V
Regular graphs, related results, Coloring, Cliques and independent sets, Trees, definitions, related problems, properties, Network Flows, Definitions, Related discussions and Max-Flow Min-Cut Theorem, Introduction to optimization problems in CS, LP formulation, Branch-and-Bound

Outcomes
- Ability to apply combinatorial ideas in mathematical arguments in analysis of algorithms, queuing theory, etc.
- Ability to comprehend graph theory fundamentals and tackle problems in dynamic programming, network flows, etc.
- Ability to design and develop real time application using graph theory

Textbooks
Reference Books
### Course: Data Structures Laboratory

**Course Code:** CSLR21  
**Course Title:** Data Structures Laboratory  
**Number of Credits:** 0-0-3-2  
**Prerequisites:** CSPC21  
**Course Type:** ELR

#### Objectives
- To analyze the time and space complexities and efficiency of various algorithms.  
- To understand the practical application of linear and nonlinear data structures.  
- To introduce and practice advanced algorithms, programming techniques necessary for developing sophisticated computer application programs.

#### Outcomes
- Ability to apply and implement the learned algorithm for problem solving  
- Ability to identify the data structure to develop program for real time applications  
- Ability to design and develop optimal algorithms

#### Experiments
- Problems in C/C++/ Java using data structures involving arrays, stacks, queues, strings, linked lists, trees, graphs.  
- Operations on stacks, queues and linked lists  
- Conversion of infix expressions to postfix and evaluation of postfix expressions  
- Implementation of priority queue  
- Implementation of Binary Tree and Binary Search Tree  
- Implementation of Sorting Techniques

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### Course: Digital Systems Design Laboratory

**Course Code:** CSLR22  
**Course Title:** Digital Systems Design Laboratory  
**Number of Credits:** 0-0-3-2  
**Prerequisites:** CSPC22  
**Course Type:** ELR

#### Objectives
- To develop programs in Hardware Description Language  
- To design and implement synchronous sequential, asynchronous sequential circuits  
- To be familiar with basic combinational and sequential components used in the typical data path designs

#### Outcomes
- Ability to design synchronous sequential circuits using basic flip-flops, counters, PLA, PAL  
- Ability to design and develop basic digital systems  
- Ability to debug digital circuits

#### Experiments
- Design of a 32-bit carry look-ahead adder with logarithmic depth using Verilog  
- Design of a Wallace tree multiplier using Verilog  
- Design of a 4-bit DSP processor using Verilog  
- Burning the 4-bit DSP processor on a FPGA
FOURTH SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>:</td>
<td>Operating Systems</td>
</tr>
<tr>
<td>Number of Credits</td>
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<tr>
<td>Course Type</td>
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<td>PC</td>
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</table>

Objectives

- To provide knowledge about the services rendered by operating systems
- To provide a detailed discussion of the various memory management techniques
- To discuss the various file-system design and implementation issues
- To discuss how the protection domains help to achieve security in a system

Unit – I

Unit – II

Unit – III
Memory Management Strategies – Contiguous and Non-Contiguous allocation – Virtual memory Management – Demand Paging- Page Placement and Replacement Policies

Unit – IV

Unit – V
Distributed Systems – Distributed operating systems – Distributed file systems – Distributed Synchronization.

Outcomes

- Ability to comprehend the techniques used to implement the process manager
- Ability to comprehend virtual memory abstractions in operating systems
- Ability to design and develop file system interfaces, etc.

Text Book

References Books
Course Code : MAIR44
Course Title : Principles of Operations Research
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : GIR

Objectives
- To classify and formulate real-life problem for modelling, solving and applying for decision making.
- To study the formulation and various methods of solutions for linear programming, transportation, assignment, CPM and PERT problems
- To solve problems using dynamic programming method

Unit - I
Introduction to operational research-Linear programming problems (LPP)-Graphical method-Simplex method-Big M Method-Dual simplex method-Primal Dual problems

Unit – II
Dual theory and Sensitivity analysis-Transportation and assignment problems-Applications(Emphasis should be more on problems than theory)

Unit – III
CPM and PERT –Network diagram-Events and activities-Project Planning-Reducing critical events and activities-Critical path calculations-example-Sequencing problems

Unit – IV
Replacement problems-Capital equipment- Discounting costs- Group replacement - Inventory models-various costs- Deterministic inventory models-Economic lot size-Stochastic inventory models-Single period inventory models with shortage cost.

Unit – V
Dynamic programming-Formulation-Invest problem-General allocation problem-Stage coach problem-Production Scheduling.

Outcomes
- Ability to analyse problems in engineering, management, or business environment, focusing on important details
- Ability to formulate real problems in terms of input-output-parameters relationships and identify the solution procedure
- Ability to comprehend the methodologies and correlate with engineering problems

Text Books
4. H. M. Wagner, Principles of operational research with applications to managerial decisions, PH, Inc, 1975
Course Code : CSPC27
Course Title : Data Communications and Networks
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : PC

Objectives
- To provide insight about fundamental concepts and reference models (OSI and TCP/IP) and its functionalists
- To gain comprehensive knowledge about the principles, protocols, and significance of Layers in OSI and TCP/IP
- To know the implementation of various protocols and cryptography techniques

UNIT- I

UNIT-II
Physical Layer: Digital and analog Signals, Periodic Analog Signals, Transmission Impairments, Digital data transmission techniques, Analog data transmission techniques, Multiplexing and Spread Spectrum.*

UNIT-III

UNIT-IV

UNIT-V

*Programming assignments are mandatory.

Outcomes
- Ability to gain insight about basic network theory and layered communication architectures
- Ability to provide solutions to various problems in network theory
- Ability to conceptualize and design a network stack

Text Books

Reference Books
## Course Code: CSPC28  
## Course Title: Automata and Formal Languages  
## Number of Credits: 3-1-0-4  
## Prerequisites(Course code): CSPC11  
## Course Type: PC

### Objectives
- To introduce concepts in automata theory and theory of computation  
- To identify different formal language classes and their relationships  
- To design grammars and recognizers for different formal languages

### Unit – I
**Introduction:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from another, Myhill-Nerode Theorem

### Unit – II
**Regular Expression (RE):** Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen’s Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

### Unit – III
**Context Free Grammar (CFG) and Context Free Languages (CFL):** Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs

### Unit – IV
**Push Down Automata (PDA):** Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG,

### Unit – V
**Turing machines (TM):** Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Chur ch’s Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory

### Outcomes
- Ability to relate practical problems to languages, automata, and computability  
- Ability to demonstrate an increased level of mathematical sophistication  
- Ability to apply mathematical and formal techniques for solving problems
Text Book

Reference books
Course Code : CSPC29
Course Title : Introduction to Algorithms
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC21
Course Type : PC

Objectives
- To understand the importance of algorithm and its complexity
- To analyze the complexity of an algorithm in terms of time and space complexities
- To design and implement various programming paradigms and its complexity

Unit – I

Unit – II

Unit – III
Dynamic Programming - Multistage graphs - All pair’s shortest paths - Optimal binary search trees - Travelling salesman problem - Fast Fourier transform.

Unit – IV
Randomized Algorithms and Amortized Analysis - Las Vegas and Monte Carlo types - Randomized quick sort and its analysis - Min-Cut algorithm.

Unit – V
NP-Hard and NP-complete problems - Basic concepts - Reducibility - Cook's theorem (without proof) - Turing machines - NP-Hard graph problems.

Outcomes
- Ability to analyze the time and space complexity, given an algorithm
- Ability to apply the techniques of algorithm in solving real world problems
- Ability to develop systematically an algorithm for solving a problem

Textbook
<table>
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<tr>
<th>Course Code</th>
<th>HSIR14</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Professional Ethics</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
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<tr>
<td>Prerequisites(Course code)</td>
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<td>Course Type</td>
<td>GIR</td>
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This Course Syllabus will provided by the Humanities Department
<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSLR23</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Algorithms Laboratory</td>
</tr>
<tr>
<td>Number of Credits</td>
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<td>Prerequisites(Course code)</td>
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<tr>
<td>Course Type</td>
<td>ELR</td>
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**Objectives**
- To learn how to analyze the complexity of algorithms
- To compare and evaluate algorithms in terms of time and space complexity
- To program brute force, divide and conquer, decrease and conquer, transform and conquer, greedy, and dynamic techniques

**Experiments**
- Estimating worst-case/average-case complexity of algorithms via programs
- Determining machine constants
- Programs involving some advanced data structures
- Implementing example problems
- Illustrating the different paradigms of algorithm design
- Solving miscellaneous problems e.g. problems in string manipulation, graph theory, optimization

**Outcomes**
- Ability to solve and analyze general algorithms based on space and time complexity
- Ability to implement and empirically compare fundamental algorithms and data structures to real-world problems
- Ability to design, develop, and optimize algorithms in different paradigms
Course Code : CSLR24
Course Title : Operating Systems Laboratory
Number of Credits : 0-0-3-2
Prerequisites(Course code) : CSPC26
Course Type : ELR

Objectives
- To understand the concept of Operating System
- To experience the practical side of the functioning of various blocks in OS

Experiments
1. Hands on Unix Commands
2. Shell programming for file handling
3. Shell Script programming using the commands grep, awk, and sed
4. Implementation of CPU scheduling algorithms
5. Pthread Programming
6. Implementation of Synchronization problems using Semaphores, Message Queues and Shared Memory
7. Implementation of Memory Management - Allocation, Placement and replacement Algorithms

Outcomes
- Ability to make use of tools for solving synchronization problems
- Ability to compare and contrast various CPU scheduling algorithms
- Ability to understand the differences between segmented and paged memories

References
FIFTH SEMESTER

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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Computer Architecture</td>
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<tr>
<td>Number of Credits</td>
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<tr>
<td>Course Type</td>
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</table>

Objectives
- To understand the concept of advanced pipelining techniques
- To understand the current state of art in memory system design
- To know the working principle of I/O devices

Unit - I

Unit - II
Basic and Intermediate pipelining Concepts, The Major Hurdle of Pipelining – Pipeline Hazards, Pipelining Implementation, Implementation issues that makes Pipelining hard, Extending the MIPS Pipeline to Handle Multicycle Operations, The MIPS R4000 Pipeline.

Unit - III

Unit - IV

Unit - V
Review of Memory Hierarchy Design, Cache Performance, Basic Cache Optimizations, Virtual Memory, Protection and Examples of Virtual Memory, Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Protection: Virtual Memory and Virtual Machines, Crosscutting Issues: The Design of Memory Hierarchies. Case Studies / Lab Exercises

Outcomes
- Ability to apply performance metrics to find the performance of systems
- Ability to identify the problems in components of computer
- Ability to comprehend and differentiate various computer architectures and hardware

Text Book

Reference Book
Course Code : CS PC 32
Course Title : Internetworking Protocols
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC27
Course Type : PC

Objectives
- To provide insight about networks, topologies, and the key concepts
- To gain comprehensive knowledge about the layered communication architectures (OSI and TCP/IP) and its functionalities
- To understand the principles, key protocols, design issues, and significance of each layers in ISO and TCP/IP
- To know the implementation of various layers

Unit – I

Unit - II
IPv4 headers, IP forwarding, Host Processing of IP datagrams, DHCP and Autoconfiguration, Firewalls and NAT, ICMPv4, IP Fragmentation, DNS, Broadcasting and Local Multicasting – IGMP, Routing Protocols

Unit – III
IPv6 Transition issues, Protocol basics, Addressing, Options and Extension headers, ICMPv6, Neighbor Discovery, Routing, Autoconfiguration, Multicast Listener Discovery (MLD), IPv6 and DNS

Unit – IV
Transmission Control Protocol (TCP), TCP Connection Management, TCP Data Flow and Window Management, Stream Control Transmission Protocol (SCTP), Services, SCTP Association management, SCTP flow and error control

Unit - V
Need for Mobile IP, Overview of Mobile IP, Details of Mobile IP, Tunneling, Mobility for IPv6, Applications of Mobile IP – Security primer, Campus Mobility, Internet wide mobility, A service provider perspective

Outcomes
- Ability to gain insight about basic network theory and layered communication architectures
- Ability to code and implement MAC protocols, IPv4, IPv6, and TCP
- Ability to design and develop Mobile IP
- Ability to design and develop a communication protocol

Text Books

Reference Books
Course Code: CSPC33  
Course Title: Database Management Systems  
Number of Credits: 3-0-0-3  
Prerequisites(Course code): -  
Course Type: PC

Objectives
- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques

Unit – I

Unit – II
Relational Model: Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL

Unit – III
Database Design: Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF

Unit – IV
Transactions: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

Unit – V
Implementation Techniques: Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.

Outcomes
- Ability to Install, configure, and interact with a relational database management system
- Ability to master the basics of SQL and construct queries using SQL
- Ability to design and develop a large database with optimal query processing

Text Books

References Books
Course Code : CSPC34
Course Title : Software Engineering
Number of Credits : 3-0-1-4
Prerequisites(Course code) : -
Course Type : PC

Objectives
- To understand the Software Engineering Practice & Process Models
- To understand Design Engineering, Web applications, and Software Project Management
- To gain knowledge of the overall project activities.

Unit-I
Introduction: Role of Software Engineer, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Quality Attributes.

Unit-II

Unit-III
Assessment: Framing SQA Plan. ISO 9000 Models, SEI-CMM Model and their relevance to project Management-other emerging models like People CMM.

Unit –IV
Assessment: Team Analysis in Metrics Calculation.

Unit-V
Assessment: Preparation of Risk mitigation plan.

Outcomes
- Assessment in each module gives the overall Software engineering practice.
- Ability to enhance the software project management skills
- Ability to comprehend the systematic methodologies involved in SE
- Ability to design and develop a software product in accordance with SE principles
Textbooks

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<tr>
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<tr>
<td>Course Title</td>
<td>Network Programming Laboratory</td>
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<tr>
<td>Number of Credits</td>
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<td>Prerequisites(Course code)</td>
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<td>Course Type</td>
<td>ELR</td>
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**Objectives**
- To create client and server applications using the "Sockets" API and the implementation of Data link layer protocol and TCP layer
- To conduct computer communication network simulations
- To have a hands on experience of computer network simulation and modeling techniques using NS-3 simulation software

**Experiments**
1. Exercises on Socket Programming using C and Java
2. Exercises using NS-3 Network Simulator
   a. Basics of Network Simulation
      - Introduction, Platform required to run network simulator, Backend Environment of Network Simulator, Agents and applications, Tracing
   b. Simulating a Local Area Network
      - Local Area Network, LAN Topologies, MAC Protocol, Taking turns, Ethernet, Ethernet Frame Structure, Ethernet Versions, Simulating a LAN using Network Simulator 3
      - Implementation of various MAC protocols
      - Setting up of various network topologies
      - Measurement of routing protocols
   c. Measuring Network Performance
      - Setting up of network that carries various application protocols and analyzing the performances
3. Hands on experiments on Network equipments
   a. Switches, Routers
   b. Hardware firewall

**Outcomes**
- Ability to invoke analytical studies of Computer Networks through network simulation
- Ability to design a network using NS-3 toolkit and its importance in designing a real network
- Ability to measure and analyze the network parameters for a high throughput network

**Text Books**
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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Database Management Systems Laboratory</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>0-0-3-2</td>
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<td>CSPC33</td>
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<td>Course Type</td>
<td>ELR</td>
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**Objectives**

- To explore the features of a Database Management Systems
- To interface a database with front end tools
- To understand the internals of a database system

**Experiments**

- Working with DDL, DML and DCL
- Inbuilt functions in RDBMS.
- Nested Queries & Join Queries.
- Set operators & Views in SQL.
- Control structures.
- Working with Procedures and Functions.
- Triggers
- Dynamic & Embedded SQL
- Working with XML
- Forms & Reports
- Database Design and implementation (Mini Project)

**Outcomes**

- Ability to use databases for building client server applications
- Ability to comprehend the internal working of a database system
- Ability to design and develop a database using SQL and the mechanism in connecting with a Web based GUI

**Text Books**

SIXTH SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSPC35</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Principles of Cryptography</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
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<tr>
<td>Prerequisites(Course code)</td>
<td>CSPC25</td>
</tr>
<tr>
<td>Course Type</td>
<td>PC</td>
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</tbody>
</table>

**Objectives**
- To gain knowledge about the mathematics of the cryptographic algorithms
- To get an insight into the working of different existing cryptographic algorithms
- To learn how to use cryptographic algorithms in security

**Unit – I**
Number Theory: Fermat's theorem, Cauchy’s theorem, Chinese remainder theorem, Primality testing algorithm, Euclid's algorithm for integers, quadratic residues, Legendre symbol, Jacobi symbol.*

**Unit – II**
Cryptography and cryptanalysis, Classical Cryptography, different type of attack: CMA, CPA, CCA etc., Shannon perfect secrecy, OTP, Pseudo random bit generators, stream ciphers and RC4.*

**Unit – III**
Block ciphers: Modes of operation, DES and its variants, finite fields ($2^n$), AES, linear and differential cryptanalysis.*

**Unit – IV**
One-way function, trapdoor one-way function, Public key cryptography, RSA cryptosystem, Diffie-Hellman key exchange algorithm, ElGamal Cryptosystem.*

**Unit – V**
Cryptographic hash functions, secure hash algorithm, Message authentication, digital signature, RSA digital signature.*

*Programming assignments are mandatory.

**Outcomes**
- Ability to understand the basic concepts of symmetric cryptosystem, public key cryptosystem and digital signature scheme
- Ability to reason about the security of cryptographic constructions
- Ability to break the cryptosystems that are not secure

**Text Book**

**Reference Books**
3. Thomas Koshy, “Elementary Number Theory with Applications”, Elsevier India, 2005
4. Online course: course on cryptography by Dan Boneh
Course Code : CSPC36
Course Title : Microprocessors and Microcontrollers
Number of Credits : 3-0-0-3
Prerequisites (Course code) : CSPC22
Course Type : PC

Objectives
- To understand the concepts of Architecture of 8086 microprocessor
- To understand the design aspects of I/O and Memory Interfacing circuits
- To understand the architecture and programming of ARM processor

Unit – I

Unit – II

Unit – III

Unit – IV
Introduction to Embedded Systems: Complex systems and microprocessors– Embedded system design process – Instruction sets preliminaries - ARM Processor – CPU: programming input and output supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance

Unit – V

Outcomes
- Ability to design and implement programs on 8086 microprocessor
- Ability to design I/O circuits and Memory Interfacing circuits
- Ability to design and develop components of ARM processor
Text Books

References Books
Course Code : CSPC37
Course Title : Mobile Applications Development
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC32
Course Type : PC

Objectives
- To learn the basics of mobile application development
- To get accustomed to Android platform
- To develop skills in developing basic Android applications

Unit – I
Introduction to Android: Native Android Application; SDK Features; Introduction to Open Handset Alliance; Development Framework; Application Fundamentals; Device Compatibility; System permissions.

Unit –II
User Interface and Application Components: Basic UI Design; Fragments; Widget Toolbox; Creating New View; Introduction to Intents; Intent Filters and broadcast Receivers; Activities; Services; Content Providers; Application Widgets; Processes and Threads.

Unit – III
Files and Database Handling: Saving Application Data; Shared Preferences; Preference Framework and Activity; Static File as Resource; File System; Introduction to SQLite Database; Querying SQLite; Storage options; Data backup

Unit – IV
User Experience Enhancement: Action Bar; Menus and Action Bar Items; Settings; Dialogs; Customizing Toast; Notifications; Search; Drag and Drop

Unit – V
Multimedia, Wireless Connectivity and Telephony: Audio and Video Handling; Manipulating Raw Audio; Sound Effects; Camera Programming; Video Recording; Managing Wireless Connectivity: WiFi, Bluetooth, Near Field Communication; Hardware Support for Telephony; Telephony Management; SMS and MMS

Outcomes
- Ability to comprehend Android platform and its usefulness in application development
- Ability to acquire skill set to execute applications in Android based devices
- Ability to design and develop deployable Android applications

Text Books
Course Code : CSLR33
Course Title : Mobile Applications Development Laboratory
Number of Credits : 0-0-3-2
Prerequisites(Course code) : CSPC37
Course Type : ELR

Objectives
- To learn the basics of mobile application development
- To get accustomed to Android platform
- To develop skills in developing basic Android applications

Experiments
1. Install the Android SDK and developer tools and build a test project to confirm that those tools are properly installed and configured
2. Write a program using a Table Layout for our restaurant data entry form, add a set of radio buttons to represent the type of restaurant
3. Write a program using activity class to show different events.
4. Write a program to send user from one application to another. (For example redirection to map)
5. Write a program to play audio files.
6. Write a program to play video files.
7. Write a program to capture image using built in camera.
8. Write a program to send SMS.
9. Write a program to convert text to speech.
10. Write a program to call a number.

Outcomes
- Ability to gain hands on experience in Android SDK
- Ability to design and develop applications in Android based devices
- Ability to design and develop deployable Android applications
Course Code : CSELR34
Course Title : Microprocessor and Microcontroller Laboratory
Number of Credits : 0-0-3-2
Prerequisites(Course code) : CSPC36
Course Type : ELR

Objectives
- To understand and learn the assembly language programming of various microprocessor architectures.
- To obtain the practical training of interfacing the peripheral devices with the processor and microcontroller.
- To control the components of a microprocessor based system through the use of interrupts.
- To have a practical knowledge on assembling PC hardware, installation and troubleshooting the Microprocessor and Microcontrollers.

Experiments
- Solving problems using 8086 Microprocessor.
- Interfacing 8255 Programmable parallel I/O device with 8086 microprocessor.
- Interfacing A.D convertor, D/A convertor with 8086 microprocessor.
- Solving 8086 procedure and macro oriented programs in Turbo Assembler TASM
- Interfacing various devices with the microcontroller 8051 : A/D converter, D/A converter, seven segment display, LCD, stepper motor, external keyboard, interrupt controller and 8251 for serial data transfer.
- PC hardware assembly.
- Installation and trouble shooting

Outcomes
- Ability to write programs in assembly language using trainer kits
- Ability to interface development kits effectively for the real time applications of various peripheral devices with the processor
- Ability to assemble and troubleshoot hardware devices
<table>
<thead>
<tr>
<th>Course Code</th>
<th>HSIR13</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Industrial economics and foreign trade</td>
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<tr>
<td>Number of Credits</td>
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<td>Prerequisites(Course code)</td>
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<td>Course Type</td>
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This Course Syllabus will provided by the Humanities Department
<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSPC41</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Principles of Compiler Design</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites(Course code)</td>
<td>CSPC28</td>
</tr>
<tr>
<td>Course Type</td>
<td>PC</td>
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</tbody>
</table>

**Objectives**
- To introduce the major concept areas of language translation and compiler design
- To enrich the knowledge in various phases of compiler and its use
- To provide practical programming skills necessary for constructing a compiler

**Unit – I**

**Introduction to Compiling:** Compilers – Analysis of the source program – Phases of a compiler – Cousins of the Compiler – Grouping of Phases – Compiler construction tools – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens.*

**Unit – II**


**Unit – III**


**Unit – IV**


**Unit – V**


*Programming Assignments are mandatory

**Outcomes**
- Ability to apply the knowledge of lex tool & yacc tool to develop a scanner & parser
- Ability to design and develop software system for backend of the compiler
- Ability to comprehend and adapt to new tools and technologies in compiler design

**Text Books**

Reference books
2. C. N. Fischer and R. J. LeBlanc, “Crafting a compiler with C”, Benjamin Cummings, 2003
### List of Programme Elective Subjects

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Mobile Computing and Communication</td>
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<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisite (Course code)</td>
<td>CSPC27</td>
</tr>
<tr>
<td>Course Type</td>
<td>PE</td>
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</tbody>
</table>

#### Objectives
- To understand the fundamentals of mobile communication.
- To understand the architecture of various Wireless Communication Networks.
- To understand the significance of different layers in mobile system.

#### Unit – I

#### Unit – II

#### Unit – III

#### Unit – IV

#### Unit – V
WAP Model- Mobile Location based services -WAP Gateway –WAP protocols – WAP user agent profile- caching model-wireless bearers for WAP - WML - WML Scripts - WTA – iMode - SyncML.*

*Programming assignments are mandatory.

#### Outcomes
- Ability to develop a strong grounding in the fundamentals of mobile Networks
- Ability to apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
- Ability to comprehend, design, and develop a lightweight network stack

#### Text Books
Reference Books

Course Code : CSPE12
Course Title : Design and Analysis of Parallel Algorithms
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC29
Course Type : PE

Objectives
- To understand parallel computing algorithms and models
- To analyze parallel algorithms for PRAM machines and various interconnection networks

Unit – I
Introduction to Parallel Computers - SIMD - EREW, CREW - SM-SIMD algorithms - Shared memory SIMD - Tree and mesh interconnection computers - Classifying MIMD Algorithms - Hypercube SIMD Model.*

Unit – II

Unit – III
Matrix operations - Mesh transpose – Shuffle transpose - EREW transpose - Mesh multiplication - Cube multiplication - Matrix by vector multiplication - Tree multiplication.*

Unit – IV

Unit – V

*Programming assignments are mandatory.

Outcomes
- Ability to analyze parallel algorithms for PRAM machines
- Ability to comprehend and apply parallel algorithms to real world applications
- Ability to design and develop optimal parallel algorithms

Text Book

Reference Books
Course Code: CSPE13
Course Title: Real Time Systems
Number of Credits: 3-0-0-3
Prerequisites(Course code): CSPC26
Course Type: PE

Objectives
- To study issues related to the design and analysis of systems with real-time constraints.
- To learn the features of Real time OS.
- To study the various Uniprocessor and Multiprocessor scheduling mechanisms.
- To learn about various real time communication protocols.
- To study the difference between traditional and real time databases

Unit – I
Introduction to real-time computing - Structure of a real-time system - Characterization of real-time systems and tasks - Performance measures*

Unit – II
Task Assignment and Scheduling - Uniprocessor scheduling algorithms - Task assignment - Mode changes - Fault tolerant scheduling.*

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

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

Unit – V
Programming Languages and Tools - Hierarchical decomposition - Run-time error handling - Overloading - Timing specification - Recent trends and developments*

*Programming Assignments are mandatory

Outcomes
- Ability to analyze schedulability problems
- Ability to learn Real-time programming environments
- Ability to develop real time systems.

Text Book

Reference Book
Objectives

- To understand the principles of Data Warehousing and Data Mining
- To know the Architecture of a Data Mining system
- To perform classification, association, and prediction of data

Unit – I

Unit – II

Unit – III
Classification and Prediction: Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section. *

Unit – IV

Unit – V
Applications of Data mining-Social Impacts of Data mining-Tools- Mining the World Wide Web– Spatial Data Mining – Multimedia Data Mining – Text Mining. *

*Programming assignments are mandatory.

Outcomes

- Ability to comprehend the various architectures and its application with data mining
- Ability to design and develop data mining algorithms to analyze raw real world data
- Ability to monitor and analyze to predict online digital activities

Text Book

1. Jiawei Han, Micheline Kamber, and Jian Pei, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011
**Reference Books**

Course Code : CSPE15
Course Title : Wireless Network Systems
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC32
Course Type : PE

Objectives
- To understand the fundamentals of wireless communication
- To understand the architecture of different Wireless Networks
- To understand the significance of MAC and Network layers in Wireless Network System

Unit – I
Wireless Communications & Cellular System Fundamentals: Introduction to wireless communications systems, examples, comparisons and trends, Cellular systems, Frequency Management and Channel Assignment- types of handoff and their characteristics, dropped call rates & their evaluation. MAC techniques for Wireless Communication: FDMA, TDMA, MA(FHMA/CDMA/Hybrid techniques), SDMA techniques.*

Unit – II

Unit – III
Wireless LAN: Introduction to wireless LANs - IEEE 802.11 WLAN – Architecture and Services, Physical Layer, MAC sub layer- MAC Management Sub layer, Other IEEE 802.11 standards, HİPERLAN, WiMAX standard. *

Unit – IV
Ad hoc and Sensor Networks: Characteristics of MANETs, Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks- Classification, MAC and Routing protocols.*

Unit – V
Wireless MAN and PAN: Wireless MANs – Physical and MAC layer details, Wireless PANs – Architecture of Bluetooth Systems, Physical and MAC layer details, Standards. *

*Programming assignments are mandatory.

Outcomes
- Ability to make critical assessment of wireless networks
- Ability to comprehend the fundamentals of Wireless Networks
- Ability to apply the knowledge gained in the development of MAC, Network Layer protocols of Wireless Network

Text Books
Reference Books
Course Code : CSPE16
Course Title : Principles of Processor Design
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC31
Course Type : PE

Objectives
- To understand the basics of Verilog HDL
- To study about the design aspects of various circuits using Verilog

Unit – I

Unit – II

Unit – III

Unit – IV

Unit – V

*Programming assignments are mandatory.

Outcomes
- Ability to comprehend the intricacies in processor design
- Ability to implement a CPU to exploit its full capability
- Ability to design and develop processor circuits using Verilog

Text Books
**Course Code**: CSPE17  
**Course Title**: Advanced Database Management Systems  
**Number of Credits**: 3-0-3  
**Prerequisites (Course code)**: CSPC33, CSPE14  
**Course Type**: PE

### Objectives
- To understand the different database models and language queries to access databases
- To understand the normalization forms in building an effective database tables
- To protect the data and the database from unauthorized access and manipulation

### Unit – I
**Relational Model Issues**: ER Model - Normalization – Query Processing – Query Optimization  
- Transaction Processing - Concurrency Control – Recovery - Database Tuning

### Unit – II

### Unit – III

### Unit – IV
**Emerging Systems**: Enhanced Data Models - Client/Server Model - Data Warehousing and Data Mining – Web Databases – Mobile Databases- XML and Web Databases.*

### Unit – V
**Current Issues**: Rules - Knowledge Bases - Active and Deductive Databases - Multimedia Databases Multimedia Data Structures – Multimedia Query languages - Spatial Databases.*

*Programming assignments are mandatory.

### Outcomes
- Ability to comprehend the complex query processing techniques
- Ability to design and implement multimedia databases and writing query structure
- Ability to develop skill set in file organization, Query Optimization, Transaction management, and database administration techniques

### Text Book

### Reference Books
Course Code : CSPE18
Course Title : Advanced Cryptography
Number of Credits : 3-0-0-3
Prerequisites (Course code) : CSPC35
Course Type : PE

Objectives
- To study the concepts of applied cryptography
- To understand the application of cryptographic techniques in real world applications
- To comprehend the notion of provable security and its implication with improved security guarantees

Unit – I
Review of number theory, group, ring and finite fields, quadratic residues, Legendre symbol, Jacobi symbol.*

Unit – II

Unit – III
Public key cryptography, RSA cryptosystem, probabilistic encryption, homomorphic encryption, Elliptic curve cryptosystems, Blum-Goldwasser cryptosystems, identity based encryption, Cryptographic hash functions.*

Unit – IV
Digital signatures and the notion of existential unforgability under chosen message attacks, ElGamal digital signature scheme, Schnorr signature scheme, blind signature, electronic voting.*

Unit – V
Zero Knowledge Proofs and Protocols, lattice based cryptography.*

*Programming assignments are mandatory.

Outcomes
- Ability to break cryptosystems that are not provably secure
- Ability to derive simple provable security proofs for cryptographic schemes
- Ability to design and implement cryptographic protocols

Text Books
2. Thomas Koshy, “Elementary Number Theory with applications”, Elsevier India, 2005
Course Code : CSPE19  
Course Title : Network Processor Design  
Number of Credits : 3-0-0-3  
Prerequisites(Course code) : CSPC32, CSPE16  
Course Type : PE

**Objectives**
- To understand the basics of networking and network processor architecture
- To understand basic concepts of processor scheduling and other parameters used for measuring performance of network processor

**Unit – I**

**Unit – II**

**Unit – III**

**Unit – IV**

**Unit – V**
Running the Virtual Local Area Network Example - Writing Your First High-Speed Network Application. Implementing High performance, High-value Traffic management using Agere Network Processor Solutions- Nepal: A Framework for Efficiently structuring Applications for NP.*

*Programming assignments are mandatory.

**Outcomes**
- Ability to comprehend the network processor and its communication mechanisms
- Ability to implement various programming aspects of network processors
- Ability to design and develop optimal Network Processor

**Text Books**
Course Code : CSPE20
Course Title : Programming for Embedded Systems
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC36
Course Type : PE

Objectives
- To understand basics of embedded system programming
- To know how the intricacies of Embedded programming

Unit – I

Unit – II

Unit – III
Designing Elements of Embedded System Program: Basic Input Output Device Interface Programming, Developing Programmable Interrupt Controller, Timers and Counters, LCD hardware and Programming, Analog to Digital Clock, Introduction to data EEPROM.*

Unit – IV
Real Time Programming for Embedded System: Scheduling in Real Time Environment, Real Time Clock Designing, Real Time Operating System Support for Programming, Task Management in Real Time Environment, Semaphores handling, Message Queuing: States, Content, Storage, Introduction to Kernel Objects.*

Unit – V

*Programming assignments are mandatory.

Outcomes
- Ability to comprehend the importance of Embedded programming for real time systems
- Ability to analyze and design embedded systems for smart applications
- Ability to design and develop application Specific embedded System

Text Books
Course Code : CSPE21
Course Title : Machine Learning
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC25
Course Type : PE

Objectives
- To understand the basic building blocks and general principles that allow one to design machine learning algorithms
- To become familiar with specific, widely used machine learning algorithms
- To learn methodology and tools to apply machine learning algorithms to real data and evaluate their performance

Unit – I

Unit – II
Model (or hypothesis) representation, decision boundary, cost function, gradient descent, regularization, Diagnostic: debugging a learning algorithm, evaluating a hypothesis (Model selection), training/validating/testing procedures, diagnosing bias versus variance and vice versa, regularization and bias/variance, learning curves, Accuracy and Error measures: classifier accuracy measures, predictor error measure, evaluating the accuracy of a classifier or predictor, Confusion metric, precision, recall, tradeoff between both, accuracy.*

Unit – III
Decision Tree : representation, hypothesis, issues in Decision Tree Learning, Pruning, Rule extraction from Tree, Learning rules from Data, Probabilistic classifier: Bayes rule, Maximum Likelihood Estimation, case study, Support Vector Machine, Nearest Neighbor.*

Unit – IV
Clustering: Unsupervised learning technique, Similarity and Distance Measures, k-means and k-medoids algorithm, optimization objective, random initialization, choosing value of k, EM algorithm Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, Graphical Models, Combining Multiple Learners.*

Unit – V
Reinforcement Learning: Elements of Reinforcement Learning, Model-Based Learning, Temporal Difference Learning, Generalization, Design and Analysis of Machine Learning Experiments.*

*Programming assignments are mandatory.

Outcomes
- Ability to implement and apply machine learning algorithms to real-world applications.
- Ability to identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.
- Ability to understand how to perform evaluation of learning algorithms and model selection.
Text Book
1. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning From Theory to Algorithms, Cambridge University Press, 2014

Reference Books
1. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2005
Course Code : CSPE22
Course Title : Randomized Algorithms
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC29
Course Type : PE

Objectives
- To introduce the concept of randomized algorithms
- To apply the concepts of probabilistic analysis of algorithms

Unit – I
Elements of probability theory, Verification of strings, poly identities, matrix multiplication Las Vegas and MonteCarlo algorithms, Expectations, Jensen's Inequality, Coupon collector's problem, geometric distribution.*

Unit – II
Randomized Quick Sort and its expected run-time, Variance and moments, Chebyshev's inequality, Coupon collector's problem, randomized median finding, analysis, moment generating functions.*

Unit – III
Derivation and application of Chernoff's bounds, Sum of Poisson Trials, Coin flips, Set balancing, Packet routing in sparse networks, permutation routing on the hypercube, butterfly.*

Unit – IV
Birthday paradox, balls and bins model, application to bucket sort, Poisson distribution, Application to hashing, random graph models, Hamiltonian cycles in random graphs.*

Unit – V
Markov chains, representations, randomized algorithm for 2-satisfiability and 3-satisfiability, classification of states, gambler's ruin, random walks on undirected graphs, s-t connectivity algorithm.*

*Programming assignments are mandatory.

Outcomes
- Ability to apply basics of probability theory in the analysis of algorithms
- Ability to comprehend randomized algorithms and its advantages to traditional algorithm
- Ability to design and implement randomized techniques in solving real world problems

Textbook
Course Code : CSPE23
Course Title : Natural Language Processing
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC28
Course Type : PE

Objectives
- To understand the application of computational methods in linguists
- To apply statistical and probabilistic methods for parameter estimation and inference
- To know how the computational methods give insight into observed human language phenomena

Unit – I
Sound: Biology of Speech Processing; Place and Manner of Articulation; Word Boundary Detection; Argmax based computations; HMM and Speech Recognition.*

Unit – II
Words and Word Forms: Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.*

Unit – III
Structures: Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents; Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and Attachment Ambiguity resolution.*

Unit – IV
Meaning: Lexical Knowledge Networks, Wordnet Theory; Indian Language Wordnets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors; Coreferences.*

Unit – V
Web 2.0 Applications: Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).*

*Programming Assignments are mandatory

Outcomes
- Ability to compare and contrast approaches to natural language processing
- Ability to comprehend and analyze the various elements of speech processing
- Ability to design and develop machine learning techniques in the area of NLP

Text books
Course Code : CSPE24
Course Title : Artificial Intelligence and Expert Systems
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPE21
Course Type : PE

Objectives
- To learn the concepts of Artificial Intelligence
- To learn the methods of solving problems using Artificial Intelligence
- To introduce the concepts of Expert Systems and machine learning

Unit – I
Introduction to AI, Control strategies, Search strategies, Production system characteristics - Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms.*

Unit – II
Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.*

Unit – III
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.

Unit – IV

Unit – V

*Programming assignments are mandatory.

Outcomes
- Ability to comprehend AI & ES to analyze and map real world activities to digital world
- Ability to identify problems that are amenably solved by AI methods
- Ability to design and carry out an empirical evaluation of different AI algorithms

Text Books

Reference Books
<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Software Quality Assurance</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
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<tr>
<td>Prerequisites(Course code)</td>
<td>CSPC34</td>
</tr>
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<td>PE</td>
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</table>

**Objectives**
- To understand software quality management process and quality management models
- To learn software quality metrics, assurance and various software standards

**Unit – I**
Defining Software Quality - Software Quality factors - Components of software quality assurance - pre project software quality components- Contract Review - Development and Quality Plans

**Unit-II**

**Unit-III**
Software Quality Infrastructure Components - Procedures and Work Instructions - Supporting Quality Devices - Staff Training, Instructing and Certification - Preventive and Corrective Actions - Configuration Management - Documentation and Quality Records Controls

**Unit-IV**
Management Components Software Quality - Project Progress Control - Components, Internal & External Participants, Progress control regimes, Computerized tools, Software Quality Metrics – Objective, Classification, Process & Product Metrics, Implementation & Limitation of Software Metrics - Software Quality Costs – Objective, Classification Model of cost, Extended Model and Applications

**Unit-V**

**Outcomes**
- Ability to comprehend industrial standards in maintaining SQA
- Ability to apply basic software quality assurance practices to ensure software quality and standards
- Ability to design and model software projects that conform to international quality standards and practices

**Text Books**
Course Code : CSPE26
Course Title : Parallel Architectures and Programming
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC26, CSPC31
Course Type : PE

Objectives
- To understand the fundamental principles and engineering trade-offs involved in designing modern parallel computers
- To develop programming skills to effectively implement parallel architecture

Unit – I
Introduction: The need for parallelism, Forms of parallelism (SISD, SIMD, MISD, MIMD), Moore's Law and Multi-cores, Fundamentals of Parallel Computers, Communication architecture, Message passing architecture, Data parallel architecture, Dataflow architecture, Systolic architecture, Performance Issues.*

Unit – II
Large Cache Design: Shared vs. Private Caches, Centralized vs. Distributed Shared Caches, Snooping-based cache coherence protocol, directory-based cache coherence protocol, Uniform Cache Access, Non-Uniform Cache Access, D-NUCA, S-NUCA, Inclusion, Exclusion, Difference between transaction and transactional memory, STM, HTM.*

Unit – III
Graphics Processing Unit: GPUs as Parallel Computers, Architecture of a modern GPU, Evolution of Graphics Pipelines, GPGPUs, Scalable GPUs, Architectural characteristics of Future Systems, Implication of Technology and Architecture for users, Vector addition, Applications of GPU.*

Unit – IV
Introduction to Parallel Programming: Strategies, Mechanism, Performance theory, Parallel Programming Patterns: Nesting pattern, Parallel Control Pattern, Parallel Data Management, Map: Scaled Vector, Mandelbrot, Collative: Reduce, Fusing Map and Reduce, Scan, Fusing Map and Scan, Data Recognition: Gather, Scatter, Pack, Stencil and Recurrence, Fork-Join, Pipeline.*

Unit – V

*Programming assignments are mandatory.

Outcomes
- Ability to comprehend parallel architecture and its importance in solving engineering problems
- Ability to design parallel programs to enhance machine performance in parallel hardware environment
- Ability to design and implement parallel programs in modern environments such as CUDA, OpenMP, etc.
Text Books

Course Code : CSPE27
Course Title : Service Oriented Architecture
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : PE

Objectives
- To provide an overview of XML Technology and modeling databases in XML
- To provide an overview of Service Oriented Architecture and Web services and their importance
- To introduce Security solutions in XML and Web Services and to introduce Security standards for Web Services

UNIT-I

UNIT - II
SOA Basics: Service Oriented Architecture (SOA) – Comparing SOA with Client-Server and Distributed architectures - Characteristics of SOA – Benefits of SOA -- Principles of Service orientation – Service layers - Business Process management

UNIT - III

UNIT - IV

UNIT- V
*Programming assignments are mandatory.

Outcomes
- Ability to design and develop real work applications using the concepts of SOA and Web services
- Ability to comprehend approaches for providing security for XML documents as well as messages exchanged among Web Services
- Ability to develop an application using .NET and J2EE enterprise technology

Text Books
Reference Books
Course Code: CSPE28
Course Title: Data Sciences
Number of Credits: 3-0-0-3
Prerequisites (Course code): CSPC33, CSPE14
Course Type: PE

Objectives
- To understand the concepts of machine learning
- To appreciate supervised and unsupervised learning and their applications
- To learn aspects of computational learning theory

Unit – I
Introduction to Data Science - Overview of the Data Science process - Introduction to Data science technologies - Introduction to Machine Learning – Regressions – Classification - Clustering - Recommendation.*

Unit – II
Working with Data in Azure ML - Data Acquisition - Data Ingestion and Ingress - Data Sampling and Quantization - Data Cleaning and Transformation.*

Unit – III
Building and Evaluation of Models - Data Exploration and Visualization of Models - Business Metrics and Cost-Based Metrics - Model Evaluation - Comparison and Selection.*

Unit – IV

Unit – V

*Programming assignments are mandatory.

Outcomes
- To implement a neural network for an application of your choice using an available tool
- To implement probabilistic discriminative and generative algorithms for an application of your choice and analyze the results
- To use a tool to implement typical clustering algorithms for different types of applications

Text Books
Minors Offered

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSMI11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Data Structures and Algorithms</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites(Course code)</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>MI</td>
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</tbody>
</table>

Objectives
- To understand the various techniques of sorting and searching
- To design and implement arrays, stacks, queues, and linked lists
- To understand the complex data structures such as trees and graphs
- To design and implement various programming paradigms and its complexity

Unit – I

Unit – II

Unit – III

Unit – IV

Unit – V
Searching and Sorting Techniques - Selection, Bubble, Insertion, Merge, Quick, and Radix sort - Address calculation - Linear search - Binary search.

Outcomes
- Ability to develop programs to implement linear data structures such as stacks, queues, linked lists, etc.
- Ability to apply the concept of trees and graph data structures in real world scenarios
- Ability to comprehend the implementation of sorting and searching algorithms

Text Books

Reference Book
Course Code: CSMI12
Course Title: Computer Organization
Number of Credits: 3-0-0-3
Prerequisites(Course code): -
Course Type: MI

Objectives
- To understand the basic hardware and software issues of computer organization
- To understand the representation of data at machine level
- To understand how computations are performed at machine level

Unit – I

Unit – II
MIPS Addressing for 32-Bit Immediate and Addresses, Parallelism and Instructions: Synchronization, Translating and Starting a Program, Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Arithmetic: Subword Parallelism, Streaming SIMD Extensions

Unit – III
Logic Design Conventions, Building a Datapath, A Simple Implementation Scheme, overview of Pipelining, Pipelined Datapath, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions

Unit – IV
Memory Technologies, Basics of Caches, Measuring and Improving Cache Performance, dependable memory hierarchy, Virtual Machines, Virtual Memory, Using FSM to Control a Simple Cache, Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks

Unit – V
Disk Storage and Dependability, Parallelism and Memory Hierarchy: RAID levels, Performance of storage systems, Introduction to multi threading clusters, message passing multiprocessors.

Outcomes
- Ability to analyze the abstraction of various components of a computer
- Ability to analyze the hardware and software issues and the interfacing
- Ability to work out the tradeoffs involved in designing a modern computer system

Text Book

Reference Book
Course Code : CSMI13
Course Title : Operating Systems
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSMI13
Course Type : MI

Objectives
- To provide knowledge about the services rendered by operating systems
- To provide a detailed discussion of the various memory management techniques
- To discuss the various file-system design and implementation issues
- To discuss how the protection domains help to achieve security in a system

Unit – I

Unit – II
Inter process synchronization, Mutual exclusion algorithms, Hardware support, Semaphores, Concurrent programming using semaphores.

Unit – III
Inter process communication, Deadlocks: Characterization, Prevention, Avoidance, detection and recovery, combined approach to deadlock handling.

Unit – IV
Contiguous allocation, Static and dynamic partitioned memory allocation, Segmentation, Non-contiguous allocation, Paging, Hardware support, Virtual Memory, Demand Paging.

Unit – V
Need for files, File abstraction, File naming, File system organization, File system optimization, Reliability, Security and protection, I/O management and disk scheduling, Recent trends and developments.

Outcomes
- Ability to comprehend the techniques used to implement the process manager
- Ability to comprehend virtual memory abstractions in operating systems
- Ability to design and develop file system interfaces, etc.

Text Book

References Books
Course Code : CSM114
Course Title : Database Management Systems
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : MI

Objectives
- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques

Unit – I

Unit – II
Relational Model: Relational Data Model - Concept of relations, schema-instance distinction, keys, integrity rules, relational algebra operators, SQL: data definition, data manipulation, aggregate function, Null Values, nested sub queries, Joined relations. Work with MySQL Workbench.

Unit – III
Database Design: Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF 4NF, and 5NF, decompositions and desirable properties of them.

Unit – IV
Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), database recovery management.

Unit – V

Outcomes
- Ability to Install, configure, and interact with a relational database management system
- Ability to master the basics of SQL and construct queries using SQL
- Ability to design and develop a large database with optimal query processing

Text Books

References Books
Course Title: Software Engineering
Number of Credits: 3-0-0-3
Prerequisites(Course code): MI

Objectives
- To understand the Software Engineering Practice & Process Models
- To understand Design Engineering, Web applications, and Software Project Management
- To gain knowledge of the overall project activities.

Unit-I

Unit-II

Unit-III

Unit –IV
Software Testing, Taxonomy of S/W testing, Black box testing, Testing boundary conditions, Structural testing, Regression testing, S/W testing strategies: Unit testing, Integration testing, Validation testing, System testing and debugging.

Unit-V
Software Project Management, S/W cost estimation, Function point models, COCOMO model, Project Scheduling, S/W maintenance.

Outcomes
- Ability to enhance the software project management skills
- Ability to comprehend the systematic methodologies involved in SE
- Ability to design and develop a software product in accordance with SE principles

TEXT BOOKS:

REFERENCES:
<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSMI16</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Digital Systems Design</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
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<tr>
<td>Prerequisites</td>
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</tr>
<tr>
<td>Course Type</td>
<td>MI</td>
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</tbody>
</table>

**Objectives**

- To understand the essential knowledge on the fundamental of digital circuits
- To understand the overview on the design principles of digital computing systems

**Unit - I**


**Unit - II**


**Unit - III**

Sequential logic - Basic latch - Flip-flops (SR, D, JK, T and Master-Slave) - Triggering of flip-flops - Counters - Design procedure - Ripple counters - BCD and Binary - Synchronous counters, Registers - Shift registers.

**Unit - IV**

Introduction to VLSI design - Basic gate design - Digital VLSI design - Design of general boolean circuits using CMOS gates. Verilog Concepts – Basic concepts – Modules & ports, Gate level modeling, Data flow modelling, Behavioral modeling, Tasks and functions.

**Unit - V**

Timing and delays – Switch level modelling, User defined primitives, Modeling Techniques

**Outcomes**

- Ability to design and implement complicated digital systems using Verilog
- Ability to design a VLSI circuit for an application
- Ability to comprehend the digital design logic

**Text Books**


**Reference Books**

Course Code : CSMI17
Course Title : Data Communications and Networks
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : MI

Objectives
- To provide insight about fundamental concepts and reference models (OSI and TCP/IP) and its functionalists
- To gain comprehensive knowledge about the principles, protocols, and significance of Layers in OSI and TCP/IP
- To know the implementation of various protocols and cryptography techniques

UNIT- I

UNIT-II

UNIT-III

UNIT-IV
Transport Layer - Transport Services – UDP - TCP - Congestion Control – Quality of Services (QOS).

UNIT-V
Application Layer - Domain Name Space (DNS) – Electronic Mail – HTTP-WWW.

Outcomes
- Ability to gain insight about basic network theory and layered communication architectures
- Ability to provide solutions to various problems in network theory
- Ability to conceptualize and design a network stack

Text Books

Reference Books
List of Open Elective Subjects

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSOE11</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Computer Graphics</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites(Course code)</td>
<td>-</td>
</tr>
<tr>
<td>Course Type</td>
<td>OE</td>
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</tbody>
</table>

**Objectives:**
- To understand the basics of various inputs and output computer graphics hardware devices.
- Exploration of fundamental concepts in 2D and 3D computer graphics.
- To know 2D raster graphics techniques, 3D modelling, geometric transformations, 3D viewing and rendering.

**Unit - I**
**Basic of Computer Graphics:** Applications of computer graphics, Display devices, Random and Raster scan systems, Graphics input devices, Graphics software and standards.*

**Unit - II**
**Graphics Primitives:** Points, lines, circles and ellipses as primitives, scan conversion algorithms for primitives, Fill area primitives including scan-line polygon filling, inside-outside test, boundary and flood-fill, character generation, line attributes, area-fill attributes, character attributes. *

**OpenGL primitives:** Functions, pipeline, sample programs for drawing 2-D, 3-D objects; event handling and view manipulation.*

**Unit - III**
**2D transformation and viewing:** Transformations, matrix representation, homogeneous coordinates, composite transformations, reflection and shearing, viewing pipeline and coordinates system, window-to-viewport transformation, clipping including point clipping, line clipping, polygon clipping.*

**Unit - IV**
**3D concepts and object representation:** 3D display methods, polygon surfaces, tables, equations, meshes, curved lines and surfaces, quadric surfaces, spline representation, cubic spline interpolation methods, Bazier curves and surfaces, B-spline curves and surfaces.*

**3D transformation and viewing:** 3D scaling, rotation and translation, composite transformation, viewing pipeline and coordinates, parallel and perspective transformation, view volume and general (parallel and perspective) projection transformations.*

**Unit - V**
**Advance topics:** visible surface detection concepts, back-face detection, depth buffer method, illumination, light sources, illumination methods (ambient, diffuse reflection, specular reflection), Color models: properties of light, XYZ, RGB, YIQ and CMY color models.*

*Programming assignments are mandatory.

**Outcomes**
- Ability to understand the various computer graphics hardware and display technologies.
- Ability to implement various 2D and 3D objects transformation techniques.
- Ability to apply 2D and 3D viewing technologies into the real world applications.
Text Books:


Reference Books

Course Code : CSOE12
Course Title : Human Computer Interaction
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : OE

Objectives
- To gain knowledge on the interplay between humans, tasks, technology, and contexts
- To gain knowledge on important human factors that affect HCI
- To be able to apply HCl principles, guidelines, methods, and techniques

Unit – I
Introduction to Human-computer Interaction - Methodology for Designing User-computer Interfaces -Task analysis -Conceptual, semantic, syntactic, and lexical models.*

Unit – II

Unit – III
Design and Evaluation Process -Prototyping -Testing and evaluating interface designs -Guidelines and criteria for designing UI, UI Software and Specifications -Languages and tools for specifying and building interfaces -Dialogue independence –UIMSLanguages and software abstractions -Programming support tools -. Basic Interaction Tasks, Techniques, and Devices.*

Unit – IV
Human Performance -Scientific foundations for designing user interfaces -Visual presentation of information -Graphical design -Designing experiments - Introduction to Research in Human-Computer Interaction -Why do HCI research? -Research prototypes -Interdisciplinary nature of HCl research -Examples of HCI research.*

Unit – V
New Interaction Techniques -New modes of human-computer communication -Voice Gesture -Eye movement -Tangible user interfaces -Brain-computer interfaces - Case Study,*

*Programming assignments are mandatory.

Outcomes
- Ability to comprehend the basics of human and computational abilities and limitations
- Ability to evaluate the quality of a user interface
- Ability to apply appropriate HCI techniques to design systems that are usable by people

Text Books
Course Code: CSOE13  
Course Title: Web Technology  
Number of Credits: 3-0-0-3  
Prerequisites (Course code): -  
Course Type: OE

Objectives
- To understand the basics of Web Designing using HTML, DHTML, and CSS
- To learn the basics about Client side scripts and Server side scripts

Unit - I

Unit – II
Java Script - Control statements, Functions, Arrays, Objects, Events, Dynamic HTML with Java Script, Ajax. *

Unit – III

Unit – IV
PHP - Basics, String Processing and Regular Expressions, Form Processing and Business Logic, Using Cookies *, Dynamic Content, Operator Precedence Chart

Unit – V
Database Connectivity with MySQL - Servlets, JSP, PHP. * Case Studies - Student information system, Health Management System.

*Programming assignments are mandatory.

Outcomes
- Ability to design and develop client side scripting techniques
- Ability to build real world applications using client side and server side scripting languages
- Ability to design and develop an e-Governance application using web technology

Text books

Reference Books
Course Code : CSOE14
Course Title : Multimedia Systems
Number of Credits : 3-0-0-3
Prerequisities(Course code) : CSOE11
Course Type : OE

Objectives
- To understand the different media and design issues in multimedia systems
- To understand Multimedia security and data hiding for image/video

Unit – I

Unit – II

Unit – III

Unit – IV

Unit – V
Multimedia Data Hiding: Overview– Data hiding framework-Key elements -Basic embedding mechanisms- Techniques for Embedding multiple bits-Quantitative model for Uneven embedding Capacity- CER-VER -Data Hiding in Binary image-Multilevel embedding-Multilevel image and video data hiding,*

*Programming assignments are mandatory.

Outcomes
- Ability to design multimedia components efficiently
- Ability to develop integrated, collaborative multimedia systems
- Ability to develop data hiding algorithms for the specialized applications

Text Books

Reference Books
Course Code : CSOE15
Course Title : Cloud Computing
Number of Credits : 3-0-0-3
Prerequisites (Course code) : CSMI17
Course Type : OE

Objectives
- To provide comprehensive knowledge of fundamental concepts and of cloud computing
- To demonstrate an understanding of Service models, deployment models, Virtualization
- To describe the programming and software environments of Cloud
- To shed light on the security issues in Cloud

Unit – I

Unit – II
Virtual Machines and Virtualization – Implementation levels of Virtualization – Virtualization structures/tools and Mechanisms – Virtualization of CPU, Memory and I/O Devices – Storage Virtualization.*

Unit – III

Unit – IV

Unit – V

*Programming assignments are mandatory.

Outcomes
- Ability to articulate the Virtualization concepts
- Ability to identify the architecture, service models and deployment models of Cloud
- Ability to master the programming aspects of Cloud

Text Book

Reference Books
Course Code : CSOE16
Course Title : Network Security
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSMI17
Course Type : OE

Objectives
- To understand the network security, services, attacks, mechanisms, types of attacks
- To comprehend and apply authentication services, authentication algorithms
- To comprehend and apply network layer security protocols, Transport layer security protocols, Web security protocols.

Unit -I
Overview of Network Security, Security services, attacks, Security Issues in TCP/IP suite-Sniffing, spoofing, buffer overflow, ARP poisoning, ICMP Exploits, IP address spoofing, IP fragment attack, routing exploits, UDP exploits, TCP exploits.*

Unit-II

Unit-III

Unit-IV
Intruders, Viruses, Worms, Trojan horses, Distributed Denial-Of-Service (DDoS), Firewalls, IDS, Honey nets, Honey pots.*

Unit-V
Introduction to wireless network security, Risks and Threats of Wireless networks, Wireless LAN Security (WEP, WPA).*

*Programming assignments are mandatory.

Outcomes
- Ability to determine appropriate mechanisms for protecting the network.
- Ability to design and develop security solutions for a given application or system
- Ability to develop a secure network stack

Text Books

Reference Books
Course Code: CSOE17
Course Title: Big Data Analytics
Number of Credits: 3-0-0-3
Prerequisites(Course code): CSMI16
Course Type: OE

Objectives
- To understand the financial value of big data analytics
- To explore tools and practices for working with big data
- To understand how big data analytics can leverage into a key component

UNIT – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V

*Programming assignments are mandatory.

Outcomes
- Ability to apply the concepts of big data analytics for a domain
- Ability to design and develop Hadoop and Map Reduce Framework
- Ability to contextually integrate and correlate large amounts of information
Text Books

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSOE18</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Image Processing</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
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<tr>
<td>Prerequisites(Course code)</td>
<td>CSOE11</td>
</tr>
<tr>
<td>Course Type</td>
<td>OE</td>
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</tbody>
</table>

**Objectives**
- To understand the fundamentals of Digital imaging and Image Processing techniques
- To be familiar with image compression and segmentation

**Unit – I**

**Unit – II**

**Unit – III**

**Unit – IV**
Recognition of Image Patterns : Introduction, Decision Theoretic Pattern Classification, Baesian Decision Theory, Nonparametric Classification, Linear Discriminant Analysis, Unsupervised Classification Strategies-clustering, K-means clustering algorithm, Syntactic Pattern Classification, Syntactic Inference, Symbolic Projection method. Texture and Shape Analysis .*

**Unit – V**

*Programming assignments are mandatory.

**Outcomes**
- Ability to design and apply image enhancement and restoration techniques
- Ability to apply image compression and segmentation Techniques
- Ability to design and develop image processing techniques for assisting digital forensics

**Text Book**
Course Code : CSOE19
Course Title : Internet of Things
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSMI17
Course Type : OE

Objectives
- To learn the basic issues, policy and challenges in the Internet
- To get an idea of some of the application areas where Internet of Things can be applied.
- To understand the cloud and internet environment.
- To understand the various modes of communications with Internet.

Unit – I

Unit – II

Unit – III

Unit – IV

Unit – V

*Programming assignments are mandatory.

Outcomes
- Identify the components of IoT
- Analyze various protocols of IoT
- Design portable IoT using appropriate boards
- Develop schemes for the applications of IOT in real time scenarios
- Design business Intelligence and Information Security for WoT
Text Books

References
Course Code : CSOE20
Course Title : Bitcoin and Crypto Currencies
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : OE

Objectives
- To understand the basic concept of Cryptographic Hash Functions, Hash Pointers and Elliptic Curve Digital Signature Algorithm.
- To get an insight into the working of the Bitcoin network, wallet, Bitcoin mining and distributed consensus for reliability.

Unit – I
Introduction to Cryptography, Cryptographic Hash Functions, SHA-256, Hash Pointers and Data Structures, Merkle tree.*

Unit – II
Digital Signatures, Elliptic curve group, Elliptic Curve Digital Signature Algorithm (ECDSA), Public Keys as Identities, A Simple Crypto currency. *

Unit – III
Centralization vs. Decentralization, Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work. Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network.*

Unit – IV
Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.*

Unit – V

*Programming assignments are mandatory.

Outcomes
- Able to understand the how Bitcoin and other crypto currencies work.
- Able to do mining job in Bitcoin transaction.

Text Books
<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSOE21</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Probability, Queuing Theory, and Statistics for CS</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>-</td>
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<tr>
<td>Course Type</td>
<td>OE</td>
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</tbody>
</table>

**Objectives**
- To refresh fundamentals in probability theory
- To focus on Queuing theory with relevant CS examples
- To introduce elements of statistical analysis

**Unit – I**
Basic notions of probability, Bernoulli trials, Random variables and associated parameters, distributions – binomial, geometric, Poisson, uniform, exponential, Gaussian, conditional probability, probability distributions, central limit theorem, transform methods.

**Unit – II**
Elements of a queuing system, Standard notations and definitions, Little’s Law, birth- and – death process models, Poisson process and its properties.

**Unit – III**
M/M/1, M/M/m, M/G/1 queuing systems and their characteristics, Embedded Markov chains, other standard results from the literature, basic ideas of priority queuing systems.

**Unit – IV**
Modeling of computer systems, finite population models, Jackson networks and Baskett-Chandy-Muntz-Palacios generalizations, other examples from data networks.

**Unit – V**
Basics of statistical inference, estimators, confidence intervals, exploratory data analysis, hypothesis testing, test of means, variances, ANOVA, ideas in regression and correlation analyses.

**Outcomes**
- Ability to appreciate performance modeling of data networks
- Ability to solve Queuing theory problems relevant to CS

**Text Books**
Course Code : CSOE22
Course Title : Software Project Management
Number of Credits : 3-0-0-3
Prerequisites(Course code) : -
Course Type : OE

Objectives

- To understand the basic concepts and issues of software project management
- To understand successful software projects that support organization's strategic goals

Unit – I


Unit – II

Software Measurements: Monitoring & measurement of SW development – cost, size and time metrics – methods and tools for metrics – issues of metrics in multiple projects.*

Unit – III


Unit – IV


Unit – V

SPM Tools: Software project management using Primavera & Redmine and case study on SPM tools.*

*Programming assignments are mandatory.

Outcomes

- Ability to maintain software projects and monitor software project process
- Ability to design and develop project modules and assign resources
- Ability to comprehend, assess, and calculate the cost of risk involved in a project management

Text Books

HONORS ELECTIVE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CSHO11</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Distributed Algorithms</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>CSPC29</td>
</tr>
<tr>
<td>Course Type</td>
<td>HONORS</td>
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</tbody>
</table>

Objectives
- To understand the fundamental algorithms and protocols that are commonly used in distributed computing
- To learn the basics about synchronous and asynchronous models

Unit - I
Introduction, Synchronous Network Model, Leader election in a synchronous ring, Algorithms in general synchronous networks, Distributed consensus with link failures, Distributed consensus with process failures.*

Unit - II
Asynchronous system model, Asynchronous shared memory model, mutual exclusion, resource allocation, consensus and atomic objects.*

Unit - III
Asynchronous network model, basic asynchronous network algorithms and synchronizers.*

Unit - IV
Shared memory versus networks, logical time, global snapshots and stable properties, network resource allocation, partially synchronous system models.*

Unit - V

*Programming assignments are mandatory.

Outcomes
- Ability to comprehend distributed protocols and algorithms
- Ability to comprehend, develop, and analyze distributed algorithms for mission critical applications
- Ability to design and develop distributed algorithms for real world problems

Text Books
Course Code : CSH012  
Course Title : High Speed Networks  
Number of Credits : 3-0-0-3  
Prerequisites(Course code) : CSPC27  
Course Type : HONORS  

Objectives
- To understand up-to-date survey of developments in High Speed Networks  
- To know how techniques involved to support real-time traffic and congestion control  
- To understand different levels of quality of service (QoS) to different applications  

Unit – I  

Unit – II  

Unit – III  

Unit – IV  
Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services*

Unit – V  

*Programming Assignments are mandatory

Outcomes
- Ability to comprehend protocols for high speed networks  
- Ability to analyze and compare the parameters of high speed networks and architectures  
- Ability to design, develop, and analyze High speed network scenarios

Text Books
Course Code: CSHO13
Course Title: Software Defined Networking
Number of Credits: 3-0-0-3
Prerequisites(Course code): CSPC27
Course Type: HONORS

Objectives
- To know the reduced Complexity of Network Operation
- To understand the concepts of minimize Layer and maximize Network Resources
- To understand the Faster Time to Revenue for New Applications

Unit – I

Unit – II
VMware, Nicira, Mininet, NOX/POX, Trema, Ryu, Big Switch Networks/Floodlight, Layer 3 Centric – L3VPN, Path Computation Element Server, Plexxi Affinity, Cisco OnePK, Management Interface, Network Divide, Modern Programmatic Interfaces, Modern Orchestration.*

Unit – III
Multitenant Data Center, Virtualized Multitenant Data Center, SDN Solutions for Data Center Network, VLANs, EVPN, VxLan, NVGRE, Virtualization and Data Plane I/O, Services Engineered Path, Service Locations and Chaining, NEV at ETSI, Non-ETSI NEV Work.*

Unit – IV

Unit – V
Bandwidth Scheduling, Manipulation, Calendaring - Bandwidth Calendaring, Big Data and Application Hyper – Virtualization for Instant CSPF, Expanding Technology, Use Cases for Data Center Overlays, Big Data, Network Function Virtualization - Data Center Orchestration, Puppet, Network Function Virtualization, Optimized Big Data, - Firewall as Service, Network Access Control Replacement, Virtual Firewall, Feed Back and Optimization, Intrusion Detection/Threat Mitigation.*

*Programming Assignments are mandatory

Outcomes
- Ability to comprehend Software Defined Networks
- Ability to compare and analyze the advantages of SDN over traditional network
- Ability to design and implement software defined network

Textbooks
Course Code : CSHO14
Course Title : Transaction Processing Systems
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC26
Course Type : HONORS

Objectives
- To know how in processing data generated by and about transactions that maintain high degree of accuracy and integrity
- To understand and recognize fraudulent transactions and produce timely user responses and reports

Unit – I
Consistency, Atomicity, Durability, Isolation, Flat Transactions, Providing Structure within a Transaction, Structuring an Application as Multiple Transactions.*

Unit – II

Unit – III
Crash, Abort and Media Failure, Immediate-Update Systems and Write-Ahead Logs, Recovery in Deferred-Update Systems, Recovery from Media Failure.*

Unit – IV

Unit – V

*Programming assignments are mandatory.

Outcomes
- Ability to develop solutions that addresses all of the information processes
- Ability to design and develop techniques where information systems shall meet emerging needs
- Ability to analyze situations, identify needs, propose and develop solutions

Textbooks
Course Code : CSHO15
Course Title : Pervasive Computing
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC27
Course Type : HONORS

Objectives
- To understand the characteristics and principles of Pervasive computing and solutions
- To design and implement pervasive application that are embedded into cars, airplanes, ships, bikes, posters, signboards, walls and even clothes

Unit – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V

*Programming assignments are mandatory.

Outcomes
- Ability to analyze and compare the performance of different data dissemination techniques
- Ability to develop solutions with comparisons for problems related to pervasive computing system through investigation
- Ability to design, analyze, and develop smart computing techniques

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Text Books
Course Code : CSHO16
Course Title : Programming for Multi-Core Systems
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC36
Course Type : HONORS

Objectives
- To understand the fundamentals of multi-core architecture
- To be able to know the basic concepts of multi core programming using threads
- To be able to understand various programming constructs in multi-core architecture

Unit – I

Unit – II
**Introduction to Threads** : Defining threads-System View of threads-Threading above the OS- Inside the OS-Threads inside the Hardware-What happened When a thread is created- Application Programming models and threading-VMs and Platforms-Run time Virtualization, System Virtualization. *

Unit –III

Unit – IV
**Thread Handling and Debugging** : Too many threads-Data Races, Deadlock and Live locks- Heavily Contended Locks-Non-blocking algorithms-Thread safe functions and libraries-Memory Issues –Cache Related Issues-Avoiding Pipeline Stalls in IA-32-Data Organization for High Performance, Multithreaded Debugging Techniques: General Debugging Techniques. *

Unit – V
**Implementation of the Programming Constructs** : Foundations of Shared Memory, Spin Locks and Contention-Monitors and Blocking Synchronization- Concurrent Queues and the ABA Problem- Concurrent Stacks and Elimination-Counting, Sorting, and Distributed Coordination Concurrent Hashing and Natural Parallelism- Skip lists and Balanced Search-Futures, Scheduling, and Work Distribution- Barriers-Transactional Memory - Software Transactional Memory-hardware Transactional Memory –Threading on Intel Multicore Processors.*

*Programming assignments are mandatory.

Outcomes
- Ability to comprehend the programming constructs of multi-core systems
- Ability to exploit the benefit of parallel programming
- Ability to design and develop APIs for Multithreaded Applications
Text Books

Reference Books
Course Code : CSHO17
Course Title : Soft Computing
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC25
Course Type : HONORS

Objectives
- To understand the concepts of feed forward & feedback neural networks
- To understand the concept of fuzziness involved in various systems
- To expose the ideas about genetic algorithm
- To provide adequate knowledge about of FLC and NN toolbox

Unit – I

Unit – II

Unit – III
Different faces of imprecision - inexactness, Ambiguity, Undecidability, Fuzziness and certainty, Fuzzy sets and crisp sets. Intersections of Fuzzy sets, Union of Fuzzy sets, the complement of Fuzzy sets - Fuzzy reasoning. Linguistic variables, Fuzzy propositions, Fuzzy compositional rules of inference - Methods of decompositions and defuzzification.*

Unit – IV
Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.*

Unit – V

*Programming assignments are mandatory.

Outcomes
- Ability to comprehend machine learning and soft computing techniques in solving real world applications
- Ability to design and develop ML techniques with assistance of MATLAB
- Ability to visualize and analyze behavioural pattern to develop evolutionary algorithm
Text Books

Course Code : CSHO18
Course Title : Digital System Testing and Verification
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC22
Course Type : HONORS

Objectives
- To design the Models at various levels and detects the faults in modeling
- To learn the testability techniques and to learn the Verilog for building the systems
- To test and verify the validity of the Model

Unit I

Unit II

Unit III

Unit IV
Design for Testability : Testability, Ad Hoc Design for Testability Techniques, Controllability and Observability by means of Scan Registers, Generic Scan-Based Designs, Storage cells for Scan designs, Classical scan designs, Scan Design Costs, Board level and system level DFT Approaches, Advanced scan concepts, Boundary Scan Standards.*

Unit V
Basics of Test and Role of HDLs : Design and Test, Test Concerns, HDLs in Digital System Test. Verilog HL for Design and Test : HDL for developing test methods, Using verilog in design, Using verilog in test, Basic structures of verilog, Combinational Circuits, Sequential circuits. Fault and detection modeling using verilog.*

*Programming assignments are mandatory.

Outcomes
- Ability to design the modeling of systems
- Ability to write the test bench to test the validity of the model
- Ability to write Verilog code to built the systems
Text Books

Reference Book
Course Code : CSHO19
Course Title : CAD for VLSI
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC22
Course Type : HONORS

Objectives
- To provide experience designing integrated circuits using Computer Aided Design (CAD) Tools
- To introduce the concepts and techniques of modern integrated circuit design and testing (CMOS VLSI)
- To understand the programming paradigms of Hardware Description language (HDL)

Unit I
Introduction to CAD tools, Evolution of Design Automation, Basic Transistor Fundamentals, CMOS realizations of basic gates.*

Unit II
Modelling techniques, Types of CAD tools and Introduction to logic simulation*

Unit III
Verilog: Syntax, Hierarchical modelling and Delay modelling, Verilog constructs, Memory modelling.*

Unit IV
Logic Synthesis: Introduction synthesis of different Verilog constructs.*

Unit V
Introduction to Reconfigurable computing, FPGAs, the AltraQuartus II flow.*

*Programming assignments are mandatory.

Outcomes
- Ability to acquire hands-on skills of using CAD tools in VLSI design
- Ability to develop coding skill set using HDL
- Ability to design and develop VLSI project having a set of objective criteria and design constraints

Text Books
Course Code : CSHO20
Course Title : Middleware Technologies
Number of Credits : 3-0-0-3
Prerequisites(Course code) : CSPC32
Course Type : HONORS

Objectives
- To understand the essence of client-server and middleware architectures
- To learn the basics of CORBA and C#.NET technologies

Unit – I
Introduction to client server computing-client server models, Benefits of client server computing, pitfalls of client server programming, Middleware – Client / server building blocks, RPC, RMI.*

Unit – II
Middleware – Objects, Elements, Architecture, Middleware distributed applications, middleware types, transaction oriented middleware.*

Unit – III
CORBA with Java - Client/Server CORBA-style, CORBA with Java, Static CORBA, ORBlets with Applets, Dynamic, CORBA Beans, CORBA initialization protocol, CORBA activation services, CORBA java- to- IDL mapping.*

Unit – IV
EJBs and CORBA - Object transaction monitors CORBA OTM’s, EJB and CORBA OTM’s, EJB container frame work, Session and Entity Beans, EJB client/server development Process The EJB container protocol, support for transaction EJB packaging EJB design Guidelines.*

Unit – V
C# and .NET Platform- .NET Assemblies, Object Oriented Programming with C#, Callback Interfaces, Delegates, and Events, Type Reflection, Late Binding, and Attribute-Based Programming, Object Serialization and the .NET Remoting Layer.*

*Programming assignments are mandatory.

Outcomes
- Ability to comprehend of Middleware tools
- Ability to build real time applications based on .Net and C#
- Ability to design, develop, and analyze middleware architecture in developing enterprise technologies

Text Books