



**B.Tech. in COMPUTER SCIENCE AND ENGINEERING COURSE  
STRUCTURE & SYLLABUS (SR24 Regulations)**

**Applicable from AY 2024-25 Batch**

**IV-I YEAR I SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1	S24CS701PC	Cryptography and Network Security	3	0	0	3
2	S24CS702PC	Compiler Design	3	0	0	3
3		Professional Elective-IV	3	0	0	3
4		Professional Elective-V	3	0	0	3
5		Open Elective-II	3	0	0	3
6	S24CS703PC	Cryptography and Network Security Lab	0	0	2	1
7	S24CS704PC	Compiler Design Lab	0	0	2	1
8	S24CS705PC	Project Stage- I	0	0	6	3
	S24**MC706	Universal Human Values	3	0	0	0
		<b>Total Credits</b>	<b>18</b>	<b>0</b>	<b>10</b>	<b>20</b>

**Universal Human Values in IV Yr I Sem be Registered by Lateral Entry Students Only.**

**IV YEAR II SEMESTER**

S. No.	Course Code	Course Title	L	T	P	Credits
1	S24CS801PC	Organizational Behavior	3	0	0	3
2		Professional Elective-VI	3	0	0	3
3		Open Elective-III	3	0	0	3
4	S24CS802PC	Project Stage-II including Seminar	0	0	22	11
		<b>Total Credits</b>	<b>9</b>	<b>0</b>	<b>22</b>	<b>20</b>

**Professional Elective-IV**

S24CS741PE	Graph Theory
S24CS742PE	Cyber Security
S24CS743PE	Soft Computing
S24CS744PE	Cloud Computing
S24CS745PE	Ad hoc & Sensor Networks
S24CS746PE	Neural Networks & Deep Learning

**Professional Elective-V**

S24CS751PE	Advanced Algorithms
S24CS752PE	Agile Methodology
S24CS753PE	Robotic Process Automation
S24CS754PE	Block chain Technology
S24CS755PE	Software Process &Project Management
S24CS756PE	Information Storage Management

**Professional Elective-VI**

S24CS861PE	Computational Complexity
S24CS862PE	Distributed Systems
S24CS863PE	Deep Learning
S24CS864PE	Human Computer Interaction
S24CS865PE	Cyber Forensics
S24CS866PE	Principles Of Gamification In Engineering

**Open Elective-2:**

1. S24CS721OE:Operating Systems
2. S24CS722OE:Software Engineering

**Open Elective-3:**

1. S24CS831OE:Algorithms Design and Analysis
2. S24CS832OE:Introduction to Computer Networks

**S24CS702PC: COMPILER DESIGN**

B.Tech. IV Year I Sem.

L T P C

3 0 0 3

**Prerequisites**

1. A course on "Formal Languages and Automata Theory".
2. A course on "Computer Organization and architecture".
3. A course on "Data Structures".

**Course Objectives:**

- Introduce the major concepts of language translation and compiler design and impart the
- knowledge of practical skills necessary for constructing a compiler.
- Topics include phases of compiler, parsing, syntax directed translation, type checking use of symbol tables, code optimization techniques, intermediate code generation, code generation and data flow analysis.

**Course Outcomes:**

- Demonstrate the ability to design a compiler given a set of language features.
- Demonstrate the knowledge of patterns, tokens & regular expressions for lexical analysis.
- Acquire skills in using lex tool & yacc tool for developing a scanner and parser.
- Design and implement LL and LR parsers
- Design algorithms to do code optimization in order to improve the performance of a program in terms of space and time complexity.
- Design algorithms to generate machine code.

**UNIT - I**

**Introduction:** The structure of a compiler, the science of building a compiler, programming language basics

**Lexical Analysis:** The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, The Lexical-Analyzer Generator Lex, Finite Automata, From Regular Expressions to Automata, Design of a Lexical-Analyzer Generator, Optimization of DFA-Based Pattern Matchers.

**UNIT - II**

**Syntax Analysis:** Introduction, Context-Free Grammars, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Introduction to LR Parsing: Simple LR, More Powerful LR Parsers, Using Ambiguous Grammars and Parser Generators.

**UNIT - III**

**Syntax-Directed Translation:** Syntax-Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax-Directed Translation, Syntax-Directed Translation Schemes, Implementing L-Attributed SDD's.

**Intermediate-Code Generation:** Variants of Syntax Trees, Three-Address Code, Types and Declarations, Type Checking, Control Flow, Switch-Statements, Intermediate Code for Procedures.

**UNIT - IV**

**Run-Time Environments:** Stack Allocation of Space, Access to Nonlocal Data on the Stack, Heap Management, Introduction to Garbage Collection, Introduction to Trace-Based Collection.

**Code Generation:** Issues in the Design of a Code Generator, The Target Language, Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, A Simple Code Generator, Peephole Optimization, Register Allocation and Assignment, Dynamic Programming Code-Generation

## **UNIT - V**

**Machine-Independent Optimization:** The Principal Sources of Optimization, Introduction to Data-Flow Analysis, Foundations of Data-Flow Analysis, Constant Propagation, Partial-Redundancy Elimination, Loops in Flow Graphs.

### **TEXT BOOK:**

1. Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman.

### **REFERENCE BOOKS:**

1. Lex & Yacc – John R. Levine, Tony Mason, Doug Brown, O'reilly
2. Compiler Construction, Louden, Thomson.

**S24CS741PE: GRAPH THEORY (Professional Elective – IV)**

B.Tech. IV Year I Sem.

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**Course Objectives:**

- Understanding graphs, trees, connected paths, applications of trees and graphs.

**Course Outcomes:**

- Know some important classes of graph theoretic problems;
- Prove central theorems about trees, matching, connectivity, coloring and planar graphs;
- Describe and apply some basic algorithms for graphs;
- Use graph theory as a modeling tool.

**UNIT - I**

**Introduction**-Discovery of graphs, Definitions, Subgraphs, Isomorphic graphs, Matrix representations of graphs, Degree of a vertex, Directed walks, paths and cycles, Connectivity in digraphs, Eulerian and Hamilton digraphs, Eulerian digraphs, Hamilton digraphs, Special graphs, Complements, Larger graphs from smaller graphs, Union, Sum, Cartesian Product, Composition, Graphic sequences, Graph theoretic model of the LAN problem, Havel-Hakimi criterion, Realization of a graphic sequence.

**UNIT - II**

**Connected graphs and shortest paths** - Walks, trails, paths, cycles, Connected graphs, Distance, Cut-vertices and cut-edges, Blocks, Connectivity, Weighted graphs and shortest paths, Weighted graphs, Dijkstra's shortest path algorithm, Floyd-Warshall shortest path algorithm.

**UNIT - III**

**Trees**- Definitions and characterizations, Number of trees, Cayley's formula, Kirchoff-matrix-tree theorem, Minimum spanning trees, Kruskal's algorithm, Prim's algorithm, Special classes of graphs, Bipartite Graphs, Line Graphs, Chordal Graphs, Eulerian Graphs, Fleury's algorithm, Chinese Postman problem, Hamilton Graphs, Introduction, Necessary conditions and sufficient conditions.

**UNIT - IV**

**Independent sets coverings and matchings**- Introduction, Independent sets and coverings: basic equations, Matchings in bipartite graphs, Hall's Theorem, König's Theorem, Perfect matchings in graphs, Greedy and approximation algorithms.

**UNIT - V**

**Vertex Colorings**- Basic definitions, Cliques and chromatic number, Mycielski's theorem, Greedy coloring algorithm, Coloring of chordal graphs, Brooks theorem, Edge Colorings, Introduction and Basics, Gupta-Vizing theorem, Class-1 and Class-2 graphs, Edge-coloring of bipartite graphs, Class-2 graphs, Hajos union and Class-2 graphs, A scheduling problem and equitable edge-coloring.

**TEXT BOOKS:**

1. J. A. Bondy and U. S. R. Murty. Graph Theory, volume 244 of Graduate Texts in Mathematics. Springer, 1st edition, 2008.
2. J. A. Bondy and U. S. R. Murty. Graph Theory with Applications.

**REFERENCE BOOKS:**

1. Lecture Videos: <http://nptel.ac.in/courses/111106050/13>
2. Introduction to Graph Theory, Douglas B. West, Pearson.

## S24CS742PE: CYBER SECURITY (Professional Elective – IV)

B.Tech. IV Year I Sem.

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### Course objectives:

- To understand various types of cyber-attacks and cyber-crimes.
- To learn threats and risks within the context of cyber security.
- To have an overview of the cyber laws & concepts of cyber forensics.
- To study the defensive techniques against these attacks.

### Course Outcomes:

1. Analyze and evaluate the cyber security needs of an organization.
2. Understand Cyber Security Regulations and Roles of International Law.
3. Design and develop security architecture for an organization.
4. Understand fundamental concepts of data privacy attacks.

### UNIT- I

**Introduction to Cyber Security:** Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

### UNIT - II

**Cyberspace and the Law & Cyber Forensics:** Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy.

Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics.

### UNIT - III

**Cybercrime: Mobile and Wireless Devices:** Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.

### UNIT- IV

**Cyber Security: Organizational Implications:** Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.

**UNIT - V**

**Privacy Issues:** Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

**Cybercrime: Examples and Mini-Cases**

**Examples:** Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

**Mini-Cases:** The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

**TEXT BOOKS:**

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley

**REFERENCE BOOKS:**

1. B. B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press
2. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
3. Introduction to Cyber Security, Chwan-Hwa(john) Wu, J.David Irwin, CRC Press T&F Group.

## **S24CS743PE: SOFT COMPUTING (Professional Elective – IV)**

**B.Tech. IV Year I Sem.**

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### **Course Objectives:**

- Familiarize with soft computing concepts
- Introduce and use the idea of fuzzy logic and use of heuristics based on human experience
- Familiarize the Neuro-Fuzzy modeling using Classification and Clustering techniques
- Learn the concepts of Genetic algorithm and its applications
- Acquire the knowledge of Rough Sets.

### **Course Outcomes:**

- Identify the difference between Conventional Artificial Intelligence to Computational Intelligence.
- Understand fuzzy logic and reasoning to handle and solve engineering problems
- Apply the Classification techniques on various applications.
- Perform various operations of genetic algorithms and Rough Sets.

### **UNIT - I**

**Introduction to Soft Computing:** Evolutionary Computing, "Soft" computing versus "Hard" computing, Soft Computing Methods, Recent Trends in Soft Computing, Characteristics of Soft computing, Applications of Soft Computing Techniques.

### **UNIT- II**

**Fuzzy Systems:** Fuzzy Sets, Fuzzy Relations, Fuzzy Logic, Fuzzy Rule-Based Systems

### **UNIT- III**

Fuzzy Decision Making, Particle Swarm Optimization

### **UNIT- IV**

Genetic Algorithms: Basic Concepts, Basic Operators for Genetic Algorithms, Crossover and Mutation Properties, Genetic Algorithm Cycle, Fitness Function, Applications of Genetic Algorithm.

### **UNIT- V**

Rough Sets, Rule Induction, and Discernibility Matrix, Integration of Soft Computing Techniques.

### **TEXT BOOK:**

1. Soft Computing - Advances and Applications - Jan 2015 by B.K. Tripathy and J. Anuradha - Cengage Learning

### **REFERENCE BOOKS:**

1. S. N. Sivanandam & S. N. Deepa, "Principles of Soft Computing", 2nd edition, Wiley India, 2008.
2. David E. Goldberg, "Genetic Algorithms-In Search, optimization and Machine learning", Pearson Education.
3. J. S. R. Jang, C.T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education, 2004.
4. G.J. Klir & B. Yuan, "Fuzzy Sets & Fuzzy Logic", PHI, 1995.
5. Melanie Mitchell, "An Introduction to Genetic Algorithm", PHI, 1998.
6. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International editions, 1995

**S24CS744PE: CLOUD COMPUTING (Professional Elective – IV)**

B.Tech. IV Year I Sem.

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3 0 0 3

**Pre-requisites:**

1. A course on “Computer Networks”.
2. A course on “Operating System”.

**Course Objectives:**

- This course provides an insight into cloud computing
- Topics covered include- Cloud Computing Architecture, Deployment Models, Service Models, Technological Drivers for Cloud Computing, Networking for Cloud Computing and Security in Cloud Computing

**Course Outcomes:**

- Understand different computing paradigms and potential of the paradigms and specifically cloud computing
- Understand cloud service types, cloud deployment models and technologies supporting and driving the cloud
- Acquire the knowledge of programming models for cloud and development of software application that runs the cloud and various services available from major cloud providers
- Understand the security concerns and issues in cloud computing
- Acquire the knowledge of advances in cloud computing.

**UNIT - I**

Computing Paradigms, Cloud Computing Fundamentals, Cloud Computing Architecture and Management

**UNIT - II**

**Cloud Deployment Models, Cloud Service Models, Technological Drivers for Cloud Computing:**

SOA and Cloud, Multicore Technology, Web 2.0 and Web 3.0, Pervasive Computing, Operating System, Application Environment

**UNIT - III**

**Virtualization, Programming Models for Cloud Computing:** MapReduce, Cloud Haskell, Software Development in Cloud

**UNIT - IV**

**Networking for Cloud Computing:** Introduction, Overview of Data Center Environment, Networking Issues in Data Centers, Transport Layer Issues in DCNs, Cloud Service Providers

**UNIT - V**

Security in Cloud Computing, and Advanced Concepts in Cloud Computing

**TEXT BOOK:**

1. Chandrasekaran, K. *Essentials of cloud computing*. CRC Press, 2014

**REFERENCE BOOKS:**

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley, 2011
2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

## S24CS745PE: AD-HOC & SENSOR NETWORKS (Professional Elective – IV)

B.Tech. IV Year I Sem.

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### Prerequisites

1. Computer Networks
2. Distributed Systems
3. Mobile Computing

### Course Objectives

- To understand the challenges of routing in ad-hoc and sensor networks
- To understand various broadcast, multicast and geocasting protocols in ad hoc and sensor networks
- To understand basics of Wireless sensors, and Lower Layer Issues and Upper Layer Issues of WSN

### Course Outcomes

- Understand the concepts of sensor networks and applications
- Understand and compare the MAC and routing protocols for adhoc networks
- Understand the transport protocols of sensor networks

### UNIT - I

#### Introduction to Ad Hoc Networks

Characteristics of MANETs, Applications of MANETs and Challenges of MANETs.

#### Routing in MANETs

Criteria for classification, Taxonomy of MANET routing algorithms, *Topology-based* routing algorithms- Proactive: DSDV, WRP; Reactive: DSR, AODV, TORA; Hybrid: ZRP; *Position-based* routing algorithms- Location Services-DREAM, Quorum-based, GLS; Forwarding Strategies, Greedy Packet, Restricted Directional Flooding-DREAM, LAR; Other routing algorithms-QoS Routing, CEDAR.

### UNIT - II

#### Data Transmission

Broadcast Storm Problem, Rebroadcasting Schemes-Simple-flooding, Probability-based Methods, Area-based Methods, Neighbour Knowledge-based: SBA, Multipoint Relaying, AHBP. Multicasting: Tree-based: AMRIS, MAODV; Mesh-based: ODMRP, CAMP; Hybrid: AMRoute, MCEDAR.

### UNIT - III

#### Geocasting

Data-transmission Oriented-LBM; Route Creation Oriented-GeoTORA, MGR.  
TCP over Ad Hoc TCP protocol overview, TCP and MANETs, Solutions for TCP over Ad hoc

### UNIT - IV

**Basics of Wireless Sensors and Lower Layer Issues**-Applications, Classification of sensor networks, Architecture of sensor network, Physical layer, MAC layer, Link layer, Routing Layer.

**UNIT - V**

**Upper Layer Issues of WSN**

Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.

**TEXT BOOKS**

1. Ad Hoc and Sensor Networks – Theory and Applications, *Carlos Corderio Dharma P. Aggarwal*, World Scientific Publications, March 2006, ISBN – 981-256-681-3
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kaufman)

**REFERENCE BOOKS:**

1. C. Siva Ram Murthy, B.S. Manoj Ad Hoc Wireless Networks: Architectures and Protocols.
2. Taieb Znati Kazem Sohraby, Daniel Minoli, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley.

## S24CS746PE: NEURAL NETWORKS & DEEP LEARNING (Professional Elective - VI)

IV Year B.Tech. CSE II -Sem

L T P C

3 0 0 3

### Course Objectives:

- To introduce the foundations of Artificial Neural Networks
- To acquire the knowledge on Deep Learning Concepts
- To learn various types of Artificial Neural Networks
- To gain knowledge to apply optimization strategies

### Course Outcomes:

- Ability to understand the concepts of Neural Networks
- Ability to select the Learning Networks in modeling real world systems
- Ability to use an efficient algorithm for Deep Models
- Ability to apply optimization strategies for large scale applications

### UNIT-I

**Artificial Neural Networks** Introduction, Basic models of ANN, important terminologies, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Back-propagation Network. Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks.

### UNIT-II

Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks. Special Networks-Introduction to various networks.

### UNIT - III

Introduction to Deep Learning, Historical Trends in Deep learning, Deep Feed - forward networks, Gradient-Based learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms

### UNIT - IV

**Regularization for Deep Learning:** Parameter norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised learning, Multi-task learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, tangent Prop and Manifold, Tangent Classifier

### UNIT - V

**Optimization for Train Deep Models:** Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second- Order Methods, Optimization Strategies and Meta-Algorithms

**Applications:** Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing

### TEXT BOOKS:

1. Deep Learning: An MIT Press Book By Ian Goodfellow and Yoshua Bengio and Aaron Courville
2. Neural Networks and Learning Machines, Simon Haykin, 3<sup>rd</sup> Edition, Pearson Prentice Hall.

**S24CS751PE: ADVANCED ALGORITHMS (Professional Elective – V)**

B.Tech. IV Year I Sem.

L T P C

3 0 0 3

**Pre-Requisites:** Algorithm Design and Analysis**Course Objectives:**

- To familiarize advanced methods on analysis of algorithms.
- To familiarize with graphs and algorithms related shortest path
- To understand matrix computations and modulo representations
- To introduce randomized, approximation algorithms and computational complexity topics

**Course Outcomes:**

- Familiarize with advanced methods on analysis of algorithms
- Familiarize with the graphs, graph matching and shortest path algorithms
- Understand matrix computations and modulo representations
- Understand randomized, approximation algorithms and computational complexity topics

**UNIT – I**

Introduction to Algorithms, Classification of Algorithms, Asymptotic Analysis, Introduction to Recurrence equations - Linear recurrences, Non-linear recurrences, Formulation of recurrence equations, techniques for solving recurrence equations, Solving recurrence equations using polynomial reduction, Master's theorem

**Graph:** Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, Multistage Graph, topological sorting

**UNIT – II**

**Graph Matching:** Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path, Bipartite matching problem

**Matroids:** Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set, Optimal tree problems- optimal merge, Huffman coding, tree vertex splitting problem.

**Shortest Path in Graphs:** Floyd-Warshall algorithm, Travelling Sales Person Problem and introduction to dynamic programming paradigm. Optimal Graph Problems - Minimum Spanning Tree, Single source shortest path.

**UNIT - III**

**Flow-Networks:** Maxflow - mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

**Matrix Computations:** Strassen's algorithm and introduction to divide and conquer paradigm, Chain Matrix Multiplication, Matrix operations - Gaussian Elimination method, LUP-decomposition, Crout's method of decomposition, inverse of a triangular matrix,

**UNIT - IV**

**Modulo Representation of integers/polynomials:** Chinese Remainder Theorem, Conversion between base-representation and modulo-representation, interpolation problem. Multiplication of long integers by using Divide and Conquer paradigm, Schonhage-Strassen's Integer Multiplication algorithm.

**String Algorithms:** Naïve String, Rabin Karp, KMP, Boyer Moore, Harspool algorithms

## **UNIT - V**

**Basics of Computational Complexity:** Introduction to computational complexity, complexity classes, Satisfiability problem and Cook's theorem, Examples of NP- Complete problems

**Randomized algorithms:** Introduction, Types of Randomized algorithms, Example of Randomized algorithms.

**Approximation algorithms:** Introduction, Types of Approximation algorithms, Examples of Approximation algorithms

### **TEXT BOOK:**

1. Design and Analysis of Algorithms, S. Sridhar, Oxford University Press.

### **REFERENCE BOOKS:**

1. Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein.
2. The Design and Analysis of Computer Algorithms, Aho, Hopcroft, Ullman.
3. Algorithm Design, Kleinberg and Tardos.

**S24CS752PE: AGILE METHODOLOGY (Professional Elective – V)**

B.Tech. IV Year I Sem.

L T P C

3 0 0 3

**Course Objectives:**

- Knowledge on concepts of agile development, releasing, planning and developing

**Course Outcomes:**

- Identify basic concepts of agile methodology and Extreme programming
- Analyze real customer involvement in collaboration
- Discuss risk management and iteration planning
- Understanding incremental requirements, refactoring, incremental design and architecture

**UNIT - I****Introduction Extreme Programming (XP) - Agile Development**

Why Agile?, Understanding Success, Beyond Deadlines, Importance of Organizational Success, Introduction to Agility, Agile methods-Scrum and XP, Manifesto for Agile Software Development, Principles of Agile Process. Understanding XP (Extreme Programming) - XP life cycle, XP team, XP Concepts, Adopting XP - Knowing whether XP is suitable, Implementing XP, assessing Agility, Practicing XP - Thinking, Pair Programming, Energized work, Informative Workspace, Root cause Analysis, Retrospectives.

**UNIT - II****Collaborating**

Trust, Sit together, Real customer involvement, Ubiquitous language, Stand-Up meetings, coding standards, Iteration demo, Reporting.

**UNIT - III****Releasing**

Bugfree Release, Version Control, Ten-Minute Build, continuous integration, Collective ownership and Documentation.

**UNIT – IV****Planning**

Version, Release Planning, The Planning Game, Risk Management, Iteration Planning, Slack, Stories, and Estimating

**UNIT - V****Developing**

Incremental requirements, Customer tests, Test driven development, Refactoring, Incremental design and architecture, spike solutions, Performance optimization, Exploratory testing.

**TEXT BOOK:**

1. The art of Agile Development, James Shore and Shane Warden, 11th Indian Reprint, O'Reilly, 2018.

**REFERENCE BOOKS:**

1. Learning Agile, Andrew Stellman and Jennifer Greene, O'Reilly, 4th Indian Reprint, 2018
2. Practices of an Agile Developer, Venkat Subramaniam and Andy Hunt, SPD, 5th Indian Reprint, 2015
3. Agile Project Management - Jim Highsmith, Pearson Low price Edition 2004

**S24CS753PE: ROBOTIC PROCESS AUTOMATION (Professional Elective – V)**  
B.Tech. IV Year I Sem.

L T P C

3 0 0 3

**Course Objectives:**

- Introduce robotic process automation, techniques of automation using UiPath RPA tool.

**Course Outcomes:**

- Understand the concepts of Robotic Process Automation.
- Apply the flow chart mechanism in various calculations.
- Applying UiPath tool for debugging process
- Design system managing techniques.
- Create application for process automation using UiPath tool.

**UNIT - I**

**Robotic Process Automation:** Introduction, Scope and techniques of automation, Robotic process automation, Components of RPA, RPA platforms, About UiPath

**UiPath Stack** UiPath Studio, UiPath Robot, Types of Robots, UiPath Orchestrator

**UiPath Studio** Projects, User interface

**The User Interface:** Task recorder, Advanced UI interactions: Input methods, Output methods

**UNIT - II**

**Sequence, Flowchart, and Control Flow:** Sequencing the workflow, Activities, Control Flow, various types of loops and decision making

**Data Manipulation:** Variables and scope, Collections, Arguments - Purpose and use, Data table usage with examples, File operation with step-by-step example, CSV/Excel to data table and vice versa

**UNIT - III**

**Taking Control of the Controls:** Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls - mouse and keyboard activities, Handling events, revisit recorder, When to use OCR, Types of OCR available, How to use OCR

**Plugins and Extensions:** Terminal Plugin, SAP Automation, Citrix automation and Credential management

**UNIT - IV**

**Handling User Events and Assistant Bots:** Assistant bots, Monitoring system event triggers, Monitoring image and element triggers, Launching an assistant bot on a keyboard event

**Exception Handling, Debugging, and Logging:** Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Errorreporting

**UNIT - V**

**Managing and Maintaining the Code:** Project organization, nesting workflows, Reusability of workflows, Commenting techniques, State Machine, When to use Flowcharts, State Machines, or Sequences, Using config files

**Deploying and Maintaining the Bot:** Publishing using publish utility, using Orchestration Server to control bots, deploy bots, License Management, Publishing and Managing updates

**TEXT BOOK:**

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath: Create Software robots. with the leading RPA tool – UiPath Kindle Edition

**REFERENCE BOOK:**

1. Robotic Process Automation A Complete Guide - 2020 Edition Kindle Edition.

**S24CS754PE: BLOCKCHAIN TECHNOLOGY (Professional Elective – V)**

B.Tech. IV Year I Sem.

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3 0 0 3

**Prerequisites:**

1. Knowledge in information security and applied cryptography.
2. Knowledge in Computer Networks

**Course Objectives:**

- To learn the fundamentals of Blockchain and various types of block chain and consensus mechanisms.
- To understand the public block chain system, Private block chain system and consortium blockchain.
- Able to know the security issues of blockchain technology.

**Course Outcomes:**

- Understanding concepts behind crypto currency
- Applications of smart contracts in decentralized application development
- Understand frameworks related to public, private and hybrid blockchain
- Create blockchain for different application case studies

**UNIT-I**

**Fundamentals of Blockchain:** Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.

**Blockchain Types and Consensus Mechanism:** Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol.

**Cryptocurrency – Bitcoin, Altcoin and Token:** Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

**UNIT-II**

**Public Blockchain System:** Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.

**Smart Contracts:** Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

**UNIT-III**

**Private Blockchain System:** Introduction, Key Characteristics of Private Blockchain, Need of Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E-commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.

**Consortium Blockchain:** Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.

**Initial Coin Offering:** Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

**UNIT-IV**

**Security in Blockchain:** Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security

Aspects in Hyperledger Fabric.

**Applications of Blockchain:** Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain In Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

#### **UNIT-V**

**Blockchain Case Studies:** Case Study 1 - Retail, Case Study 2 - Banking and Financial Services, Case Study 3 - Healthcare, Case Study 4 - Energy and Utilities.

**Blockchain Platform using Python:** Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

**Blockchain platform using Hyperledger Fabric:** Introduction, Components of Hyper ledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

#### **TEXT BOOK:**

1. "Blockchain Technology", Chandramouli Subramanian, Asha A. George, Abhilasj K A and Meena Karthikeyan, Universities Press.

#### **REFERENCE BOOKS:**

1. Michael Juntao Yuan, Building Blockchain Apps, Pearson, India.
2. Blockchain Blueprint for Economy, Melanie Swan, SPD O'reilly.
3. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gaur, Pearson.

**S24CS755PE: SOFTWARE PROCESS & PROJECT MANAGEMENT (Professional Elective – V)**

B.Tech. IV Year I Sem.

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**Course Objectives:**

- To acquire knowledge on software process management.
- To acquire managerial skills for software project development.
- To understand software economics.

**Course Outcomes:**

- Understand the software process change, assessment, project plans and Quality Standards.
- Examine the life cycle phases, artifacts, workflows and checkpoints of a process.
- Design and develop software products using conventional and modern principles of software project management.
- Identify the new project management process and practices.

**UNIT - I****Software Process Maturity**

Software maturity Framework, Principles of Software Process Change, Software Process Assessment, The Initial Process, The Repeatable Process, The Defined Process, The Managed Process, The Optimizing Process, Process Reference Models Capability Maturity Model (CMM), CMMI, PCMM, PSP, TSP).

**UNIT - II****Software Project Management Renaissance**

Conventional Software Management, Evolution of Software Economics, Improving Software Economics, Life-Cycle Phases and Process artifacts  
Engineering and Production stages, inception phase, elaboration phase, construction phase, transition phase, artifact sets, management artifacts, engineering artifacts and pragmatic artifacts, model-based software architectures.

**UNIT - III****Workflows and Checkpoints of process**

Software process workflows, Iteration workflows, Major milestones, minor milestones, periodic status assessments, Process Planning Work breakdown structures, Planning guidelines, cost and schedule estimating process, iteration planning process, Pragmatic planning.

**UNIT - IV****Project Organizations**

Line-of- business organizations, project organizations, evolution of organizations, process automation. Project Control and process instrumentation, The seven-core metrics, management indicators, quality indicators, life-cycle expectations, Pragmatic software metrics, metrics automation.

**UNIT - V**

CCPDS-R Case Study and Future Software Project Management Practices, Modern Project Profiles, Next-Generation software Economics, Modern Process Transitions.

**TEXT BOOKS:**

1. Managing the Software Process, Watts S. Humphrey, Pearson Education
2. Software Project Management, Walker Royce, Pearson Education

**REFERENCE BOOKS:**

1. An Introduction to the Team Software Process, Watts S. Humphrey, Pearson Education, 2000
2. Process Improvement essentials, James R. Persse, O'Reilly, 2006
3. Software Project Management, Bob Hughes & Mike Cotterell, fourth edition, TMH, 2006
4. Applied Software Project Management, Andrew Stellman & Jennifer Greene, O'Reilly, 2006.
5. Software Engineering Project Management, Richard H. Thayer & Edward Yourdon, 2nd edition, Wiley India, 2004.
6. Agile Project Management, Jim Highsmith, Pearson education, 2004.

**S24CS756PE: INFORMATION STORAGE MANAGEMENT (Professional Elective – V)**

B.Tech. IV Year I Sem

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**Course Objectives:**

- To understand various segments of storage technology and architectures
- To explore the inherent power of information
- To describe the different backup, recovery and replication strategies

**Course Outcomes:**

- Understand the evolution of storage technology and Intelligent Storage Systems
- Explore the key concepts of various Storage Networking Technologies - DAS, SANs, NAS and CAS
- Understand the basics of Storage Virtualization
- Understand the concepts of Storage security and Storage Infrastructure Management
- Analyze the purpose of backup, recovery and replication Strategies

**UNIT - I**

**Introduction to Information Storage and Management:** Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment - Data Protection: RAID - Intelligent Storage System.

**UNIT - II****Direct-Attached Storage and Introduction to SCSI**

Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, SCSI Command Model,

**Storage Area Networks**

Fibre Channel: Overview, The SAN and Its Evolution, Components of SAN, FC Connectivity, Fibre Channel Ports, Fibre Channel Architecture, Zoning, Fibre Channel Login Types, FC Topologies, Concepts in Practice: EMC Connectrix

**Network-Attached Storage**

General-Purpose Servers vs. NAS Devices, Benefits of NAS, NAS File I/O, Components of NAS, NAS Implementations, NAS File-Sharing Protocols, NAS I/O Operations, Factors Affecting NAS Performance and Availability, Concepts in Practice: EMC Celerra

**UNIT - III****Content-Addressed Storage**

Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples, Concepts in Practice: EMC Centera

**Storage Virtualization**

Forms of Virtualization, SNIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization, Concepts in Practice

#### **UNIT - IV**

##### **Backup and Recovery**

Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies, Concepts in Practice: EMC Net Worker

##### **Local Replication**

Local Replication, Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface, Concepts in Practice: EMC TimeFinder and EMC SnapView

##### **Remote Replication**

Modes of Remote Replication, Remote Replication Technologies, Network Infrastructure, Concepts in Practice: EMC SRDF, EMC SAN Copy, and EMC MirrorView

#### **UNIT - V**

##### **Securing the Storage Infrastructure**

Storage Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking

##### **Managing the Storage Infrastructure**

Monitoring the Storage Infrastructure, Storage Management Activities, Storage Infrastructure Management Challenges, Developing an Ideal Solution, Concepts in Practice: EMC ControlCenter

#### **TEXT BOOKS:**

1. Marc Farley Osborne, "Building Storage Networks", Tata McGraw Hill, 2001.
2. Robert Spalding and Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, 2003.
3. Meeta Gupta, "Storage Area Network Fundamentals", Pearson Education Ltd., 2002.

#### **REFERENCE BOOKS:**

1. Gerald J Kowalski and Mark T Maybury, "Information Storage Retrieval Systems theory & Implementation", BS Publications, 2000.
2. Thejendra BS, "Disaster Recovery & Business continuity", Shroff Publishers & Distributors, 2006.

**24CS721OE: OPERATING SYSTEMS (Open Elective –II)**

B.Tech. IV Year I Sem.

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**Prerequisites:**

1. A course on "Computer Programming and Data Structures".
2. A course on "Computer Organization and Architecture".

**Course Objectives:**

- Introduce operating system concepts (i.e., processes, threads, scheduling, synchronization, deadlocks, memory management, file and I/O subsystems and protection)
- Introduce the issues to be considered in the design and development of operating system
- Introduce basic Unix commands, system call interface for process management, interprocess communication and I/O in Unix

**Course Outcomes:**

- Will be able to control access to a computer and the files that may be shared
- Demonstrate the knowledge of the components of computers and their respective roles in computing.
- Ability to recognize and resolve user problems with standard operating environments.
- Gain practical knowledge of how programming languages, operating systems, and architectures interact and how to use each effectively.

**UNIT - I**

**Operating System - Introduction**, Structures - Simple Batch, Multiprogrammed, Time-shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, System components, Operating System services, System Calls

**Process** - Process concepts and scheduling, Operations on processes, Cooperating Processes, Threads

**UNIT - II**

**CPU Scheduling** - Scheduling Criteria, Scheduling Algorithms, Multiple -Processor Scheduling. System call interface for process management-fork, exit, wait, waitpid, exec

**Deadlocks** - System Model, Deadlocks Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock

**UNIT - III**

**Process Management and Synchronization** - The Critical Section Problem, Synchronization Hardware, Semaphores, and Classical Problems of Synchronization, Critical Regions, Monitors **Interprocess**

**Communication Mechanisms:** IPC between processes on a single computer system, IPC between processes on different systems, using pipes, FIFOs, message queues, shared memory.

**UNIT - IV**

**Memory Management and Virtual Memory** - Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging, Demand Paging, Page Replacement, Page Replacement Algorithms.

**UNIT - V**

**File System Interface and Operations** -Access methods, Directory Structure, Protection, File System Structure, Allocation methods, Free-space Management. Usage of open, create, read, write, close, lseek, stat, ioctl system calls.

**TEXT BOOKS:**

1. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley
2. Advanced programming in the UNIX environment, W.R. Stevens, Pearson education.

**REFERENCE BOOKS:**

1. Operating Systems- Internals and Design Principles, William Stallings, Fifth Edition–2005, Pearson Education/PHI
2. Operating System A Design Approach- Crowley, TMH.
3. Modern Operating Systems, Andrew S. Tanenbaum 2nd edition, Pearson/PHI
4. UNIX programming environment, Kernighan and Pike, PHI/ Pearson Education
5. UNIX Internals -The New Frontiers, U. Vahalia, Pearson Education.

**S24CS722OE: SOFTWARE ENGINEERING (Open Elective –II)**

B.Tech. IV Year I Sem.

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**Course Objectives**

- The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.
- Topics include process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management and UML diagrams

**Course Outcomes**

- Ability to translate end-user requirements into system and software requirements, using e.g. UML, and structure the requirements in a Software Requirements Document (SRD).
- Identify and apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices.
- Will have experience and/or awareness of testing problems and will be able to develop a simple testing report

**UNIT - I**

**Introduction to Software Engineering:** The evolving role of software, changing nature of software, software myths.

**A Generic view of process:** Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI)

**Process models:** The waterfall model, Spiral model and Agile methodology

**UNIT - II**

**Software Requirements:** Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document.

**Requirements engineering process:** Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management.

**UNIT - III**

**Design Engineering:** Design process and design quality, design concepts, the design model.

Creating an architectural design: software architecture, data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.

**UNIT - IV**

**Testing Strategies:** A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.

Metrics for Process and Products: Software measurement, metrics for software quality.

**UNIT - V**

**Risk management:** Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM

**Quality Management:** Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards.

**TEXT BOOKS:**

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, McGraw Hill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson Education.

**REFERENCE BOOKS:**

1. The unified modeling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.
2. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley.
3. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies.
4. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

**S24CS703PC: CRYPTOGRAPHY AND NETWORK SECURITY LAB**

B.Tech. IV Year I Sem.

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**Course Objectives:**

- Explain the objectives of information security
- Explain the importance and application of each of confidentiality, integrity, authentication and availability
- Understand various cryptographic algorithms.

**Course Outcomes:**

- Understand basic cryptographic algorithms, message and web authentication and security issues.
- Identify information system requirements for both of them such as client and server.
- Understand the current legal issues towards information security.

**List of Experiments:**

1. Write a C program that contains a string (char pointer) with a value 'Hello world'. The program should XOR each character in this string with 0 and display the result.
2. Write a C program that contains a string (char pointer) with a value 'Hello world'. The program should AND or XOR each character in this string with 127 and display the result.
3. Write a Java program to perform encryption and decryption using the following algorithms
  - a. Ceaser cipher
  - b. Substitution cipher
  - c. Hill Cipher
4. Write a C/JAVA program to implement the DES algorithm logic.
5. Write a C/JAVA program to implement the Blowfish algorithm logic.
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Write the RC4 logic in Java Using Java cryptography; encrypt the text "Hello world" using Blowfish. Create your own key using Java key tool.
8. Write a Java program to implement the RSA algorithm.
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.
11. Calculate the message digest of a text using the MD5 algorithm in JAVA

**TEXT BOOKS:**

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition
2. Cryptography and Network Security: Atul Kahate, McGraw Hill, 3rd Edition

**REFERENCE BOOKS:**

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, WileyIndia, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, McGraw Hill, 3rd Edition
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning
6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning

**S24CS704PC: COMPILER DESIGN LAB**

B.Tech. IV Year I Sem.

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**Prerequisites**

1. A Course on "Object Oriented Programming through Java".

**Co-requisites:**

1. A course on "Web Technologies".

**Course Objectives:**

- To understand the various phases in the design of a compiler.
- To understand the design of top-down and bottom-up parsers.
- To understand syntax directed translation schemes.
- To introduce lex and yacc tools.

**Course Outcomes:**

- Design, develop, and implement a compiler for any language.
- Use lex and yacc tools for developing a scanner and a parser.
- Design and implement LL and LR parsers.

**List of Experiments**

1. Implementation of symbol table.
2. Develop a lexical analyzer to recognize a few patterns inc (ex. Identifiers, constants, comments, operators etc.)
3. Implementation of lexical analyzer using lex tool.
4. Generate yacc specification for a few syntactic categories.
  - a) Program to recognize a valid arithmetic expression that uses operator +, -, \* and /.
  - b) Program to recognize a valid variable which starts with a letter followed by any number of letter or digits.
  - c) Implementation of calculator using lex and yacc.
5. Convert the bnf rules into yacc form and write code to generate abstract syntax tree.
6. Implement type checking
7. Implement any one storage allocation strategies (heap, stack, static)
8. Write a lex program to count the number of words and number of lines in a given file or program.
9. Write a 'C' program to implement lexical analyzer using c program.
10. write recursive descent parser for the grammar  $E \rightarrow E+T \quad E \rightarrow T \quad T \rightarrow T * F \quad T \rightarrow FF \rightarrow (E)/id$ .
11. write recursive descent parser for the grammar  $S \rightarrow (L) \quad S \rightarrow a$   
 $L \rightarrow L, S \quad L \rightarrow S$
12. Write a C program to calculate first function for the grammar  $E \rightarrow E+T \quad E \rightarrow T \quad T \rightarrow T * F \quad T \rightarrow F \quad F \rightarrow (E)/id$
13. Write a YACC program to implement a top down parser for the given grammar.
14. Write a YACC program to evaluate algebraic expression.

**TEXT BOOK:**

1. Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman.

**REFERENCE BOOKS:**

1. Lex & Yacc – John R. Levine, Tony Mason, Doug Brown, O'reilly
2. Compiler Construction, Loudon, Thomson.

**S24CS801PC: ORGANIZATIONAL BEHAVIOUR**

B.Tech. IV Year II Sem.

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**Course Objectives:**

- This course demonstrates individual, group behavior aspects: The dynamics of organizational climate, structure and its impact on Organizations.

**Course Outcomes:**

- Students understand their personality, perception and attitudes for overall development and further learn the importance of group behavior in the organizations.

**UNIT - I Organizational Behaviour**

Definition, need and importance of organizational behaviour - Nature and scope - Frame work - Organizational behaviour models.

**UNIT - II Individual Behaviour**

Personality - types - Factors influencing personality - Theories - Learning - Types of learners - The learning process - Learning theories - Organizational behaviour modification, Misbehaviour - Types - Management Intervention. Emotions - Emotional Labour - Emotional Intelligence - Theories. Attitudes - Characteristics - Components - Formation - Measurement- Values. Perceptions - Importance - Factors influencing perception - Interpersonal perception- Impression Management. Motivation - importance - Types - Effects on work behavior.

**UNIT - III Group Behaviour**

Organization structure - Formation - Groups in organizations - Influence - Group dynamics - Emergence of informal leaders and working norms - Group decision making techniques - Team building - Interpersonal relations - Communication - Control.

**UNIT - IV Leadership and Power**

Meaning - Importance - Leadership styles - Theories of leadership - Leaders Vs Managers - Sources of power - Power centers - Power and Politics.

**UNIT - V Dynamics of Organizational Behaviour**

Organizational culture and climate - Factors affecting organizational climate - Importance. Job satisfaction - Determinants - Measurements - Influence on behavior. Organizational change - Importance - Stability Vs Change - Proactive Vs Reaction change - the change process - Resistance to change - Managing change. Stress - Work Stressors - Prevention and Management of stress - Balancing work and Life. Organizational development - Characteristics - objectives -. Organizational effectiveness

**TEXT BOOKS:**

1. Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11<sup>th</sup> edition, 2008.
2. Fred Luthans, Organisational Behavior, McGraw Hill, 11<sup>th</sup> Edition, 2001.

**REFERENCE BOOKS:**

1. Schermerhorn, Hunt and Osborn, Organisational behavior, John Wiley, 9<sup>th</sup> Edition, 2008.
2. Udai Pareek, Understanding Organisational Behaviour, 2<sup>nd</sup> Edition, Oxford Higher Education, 2004.

**S24CS861PE: COMPUTATIONAL COMPLEXITY (Professional Elective – VI)**

B.Tech. IV Year II Sem.

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**Prerequisite:** Design and Analysis of Algorithms.**Course Objectives:**

- Introducing computational complexity-based algorithms and their implementations

**Course Outcomes:**

- Understand the complexity of time and space for computational models
- Understand optimizational problems
- Understand NP completeness problems
- Understand hierarchical theorems

**UNIT – I**

Introduction: Algorithms and complexity, Basic Complexity Classes-Deterministic time and the class P. Computational Tasks and models: Computational tasks – Search problems, Decision problems, Uniform models- Overview, General Principles, Concrete Model, Halting problem, restricted models.

**UNIT – II**

P vs. NP: Efficient Computation, The Search Version (Finding vs. Checking), The Decision Version (Proving Vs Verifying), Equivalence of the two formulations, Optimal Search Algorithms for NP Polynomial time reduction: The general notation of a Reduction, Reducing Optimization Problems to search problems, Self-Reducibility of search problems

**UNIT – III**

NP - Completeness: Definition, Cook's theorem, Existence of NP Complete Problems bounded halting and non-halting, Natural NP Complete Problems – The NP completeness of CSAT, The NP Completeness of SAT, Combinatorics and Graph Theory, additional properties of the standard reductions, Negative applications of NP Completeness, Positive applications of NP Completeness, NP Sets, Reflections on Complete problems, NP -complete optimization problems.

**UNIT –IV**

Diagonalization: Time Hierarchy theorem, Space Hierarchy theorem, Non-deterministic Time Hierarchy theorem, Ladner's theorem.

Space Complexity: Definition of space bounded computation, PSPACE completeness, NL Completeness, some space complexity classes- Savitch's theorem, Savitch's theorem, The essence of PSPACE

The polynomial time hierarchy and alternations: polynomial hierarchy, time versus alternations, properties of polynomial hierarchy, Complete problems in PH.

**UNIT – V**

Randomized computation: Probabilistic Turing machine, one sided and zero-sided error, Randomized reduction, Randomized space bounded computation.

Decision trees: Graphs and Decision Trees, Monotonic Graph properties, Topological criterion, Randomized decision trees.

**TEXT BOOKS:**

1. The Basics of Computational Complexity, Oded Goldreich, Cambridge University Press
2. Computational Complexity: A Modern Approach, Sanjeev Arora and Boaz Barak, Princeton University

**REFERENCE BOOKS:**

1. Computational Complexity, by Christos Papadimitriou
2. Theory of Computational Complexity, Ding-Zhu Du, Ker-I Ko, WILEY

**S24CS862PE: DISTRIBUTED SYSTEMS (Professional Elective –VI)**

B.Tech. IV Year II Sem.

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**Prerequisites:**

1. A course on "Operating Systems".
2. A course on "Computer Organization & Architecture".

**Course Objectives:**

- To provide an insight into Distributed systems.
- To introduce concepts related to Peer to Peer Systems, Transactions and Concurrency control, Security and Distributed shared memory.

**Course Outcomes:**

- Understand Transactions and Concurrency control.
- Understand distributed shared memory.
- Design a protocol for a given distributed application.

**UNIT - I**

**Characterization of Distributed Systems:** Examples of Distributed systems, Resource sharing and web, challenges

**System models:** Architectural and Fundamental models, Networking and Internetworking, Interprocess Communication

**Distributed objects and Remote Invocation:** Communication between distributed objects, RPC, Events and notifications, Case study-Java RMI.

**UNIT - II**

**Operating System Support-** OS layer, Protection, Processes and Threads, Communication and Invocation, Operating system architecture.

**Distributed File Systems-** Introduction, File Service architecture.

**UNIT - III**

**Peer to Peer Systems-** Napster and its legacy, Peer to Peer middleware

**Time and Global States-** Introduction, Clocks, events and Process states, Synchronizing physical clocks, logical time and logical clocks, global states, distributed debugging.

**Coordination and Agreement-** Distributed mutual exclusion, Elections, Multicast communication, consensus and related problems.

**UNIT - IV**

**Transactions and Concurrency Control-** Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering.

**Distributed Transactions-** Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions

**Distributed deadlocks:** Transaction recovery.

## **UNIT - V**

**Replication:** Introduction, System model and group communication, Fault tolerant services, Transactions with replicated data.

**Distributed shared memory:** Design and Implementation issues, Consistency models.

### **TEXT BOOKS:**

1. Distributed Systems Concepts and Design, G Coulouris, J Dollimore and T Kindberg, Fourth Edition, Pearson Education.
2. Distributed Systems, S. Ghosh, Chapman & Hall/CRC, Taylor & Francis Group, 2010.

### **REFERENCE BOOKS:**

1. Distributed Systems – Principles and Paradigms, A.S. Tanenbaum and M.V. Steen, Pearson Education.
2. Distributed Computing, Principles, Algorithms and Systems, Ajay D. Kshemakalyani and Mukesh Singhal, Cambridge, rp 2010.

**S24CS863PE: DEEP LEARNING (Professional Elective –VI)**

B.Tech. IV Year II Sem.

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**Course Objectives:**

- To understand deep Learning algorithms and their applications in real-world data

**Course Outcomes:**

- Understand machine learning basics and neural networks
- Understand optimal usage of data for training deep models
- Apply CNN and RNN models for real-world data
- Evaluate deep models
- Develop deep models for real-world problems

**UNIT -I****Machine Learning Basics**

Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Descent, Building a Machine Learning Algorithm, Challenges Motivating Deep Learning

**Deep Feedforward Networks** Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms

**UNIT -II****Regularization for Deep Learning**

Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop, and Manifold Tangent Classifier, Optimization for Training Deep Models, Learning vs Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates

**UNIT-III****Convolutional Networks**

The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features

**UNIT -IV****Recurrent and Recursive Nets**

Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory

## **UNIT -V**

**Practical Methodology:** Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition

**Applications:** Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications.

### **TEXT BOOK:**

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.

### **REFERENCE BOOKS:**

1. The Elements of Statistical Learning. Hastie, R. Tibshirani, and J. Friedman, Springer.
2. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.
3. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.
4. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
5. Golub, G., H., and Van Loan, C.,F., Matrix Computations, JHU Press, 2013.
6. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

**S24CS864PE: HUMAN COMPUTER INTERACTION (Professional Elective –VI)**

B.Tech. IV Year II Sem.

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**Course Objectives:**

- To gain an overview of Human-Computer Interaction (HCI)
- Understanding the alternatives to traditional "keyboard and mouse" computing.
- Getting familiarity with the vocabulary associated with sensory and cognitive systems
- Be able to apply models from cognitive psychology to predicting user performance
- Working in small groups on a product design with invaluable team-work experience.

**Course Outcomes:**

- Apply HCI and principles to interaction design.
- Design certain tools for blind or PH people
- Understand the social implications of technology and ethical responsibilities as engineers.
- Understand the importance of a design and evaluation methodology

**UNIT - I**

**Introduction:** Importance of user Interface - definition, importance of good design. Benefits of good design, A brief history of Screen design.

The graphical user interface - popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user - Interface popularity, characteristics- Principles of user interface.

**UNIT - II**

**Design process** - Human interaction with computers, importance of human characteristics, human consideration, Human interaction speeds, understanding business junctions.

Screen Designing: Design goals - Screen planning and purpose, organizing screen elements, ordering of screen data and content - screen navigation and flow - Visually pleasing composition - amount of information - focus and emphasis - presentation information simply and meaningfully - information retrieval on web - statistical graphics - Technological consideration in interface design.

**UNIT- III**

**Windows** - New and Navigation schemes selection of window, selection of devices based and screen-based controls. Components - text and messages, Icons and increases - Multimedia, colors, uses problems, choosing colors.

**UNIT- IV**

**HCI in the software process-** The software life cycle, Usability engineering, Iterative design and prototyping, Design Focus: Prototyping in practice, Design rationale, Design rules, Principles to support usability Standards, Golden rules and heuristics, HCI patterns, Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method, Universal design, Universal design principles Multimodal interaction

**UNIT- V**

**Cognitive models Goal and task hierarchies Design Focus:** GOMS saves money, Linguistic models, The challenge of display-based systems, Physical and device models, Cognitive architectures, Ubiquitous computing and augmented realities, Ubiquitous computing applications research, Design Focus: Ambient Wood - augmenting the physical, Virtual and augmented reality, Design Focus: Shared experience Design Focus: Applications of augmented reality Information and data visualization

**TEXT BOOKS:**

1. The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech.
2. Human – Computer Interaction. Alan Dix, Janet Finckay, Gregory's, Abowd, Russell Beag, Pearson Education.

**REFERENCE BOOKS:**

1. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen, Pearson Education.
4. Human –Computer Interaction, D. R. Olsen, Cengage Learning.
5. Human –Computer Interaction, Smith - Atakan, Cengage Learning.

**S24CS865PE: CYBER FORENSICS (Professional Elective –VI)**

B.Tech. IV Year II Sem.

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**Prerequisites:** Network Security.**Course Objectives:**

- A brief explanation of the objective is to provide digital evidence which is obtained from digital media.
- In order to understand the objectives of computer forensics, first of all, people have to recognize the different roles computers play in a certain crime.
- According to a snippet from the United States Security Service, the computer functions in different kinds of crimes.

**Course Outcomes:**

- Students will understand the usage of computers in forensic, and how to use various forensic tools for a wide variety of investigations.
- It gives an opportunity to students to continue their zeal in research in computer forensics

**UNIT- I**

**Introduction of Cybercrime:** Types, The Internet spawns crime, Worms versus viruses, Computers' roles in crimes, Introduction to digital forensics, Introduction to Incident - Incident Response Methodology – Steps - Activities in Initial Response, Phase after detection of an incident

**UNIT- II**

**Initial Response and forensic duplication,** Initial Response & Volatile Data Collection from Windows system -Initial Response & Volatile Data Collection from Unix system – Forensic Duplication: Forensic duplication: Forensic Duplicates as Admissible Evidence, Forensic Duplication Tool Requirements, Creating a Forensic. Duplicate/Qualified Forensic Duplicate of a Hard Drive

**UNIT- III**

**Forensics analysis and validation:** Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, performing remote acquisitions

Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project.

**UNIT- IV**

**Current Forensic tools:** evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-Mail Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.

**Cell phone and mobile device forensics:** Understanding mobile device forensics, understanding acquisition procedures for cell phones and mobile devices.

**UNIT- V**

**Working with Windows and DOS Systems:** understanding file systems, exploring Microsoft File Structures, Examining NTFS disks, Understanding whole disk encryption, windows registry, Microsoft startup tasks, MS-DOS startup tasks, virtual machines.

**TEXT BOOKS:**

1. Kevin Mandia, Chris Prorise, "Incident Response and computer forensics", Tata McGraw Hill, 2006.
2. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, NewDelhi.
3. Computer Forensics and Investigations by Nelson, Phillips Enfinger, Steuart, CENGAGE Learning

**REFERENCE BOOKS:**

1. Real Digital Forensics by Keith J. Jones, Richard Bejtich, Curtis W. Rose, Addison- Wesley Pearson Education
2. Forensic Compiling, A Tractitioneris Guide by Tony Sammes and Brian Jenkinson, Springer International edition.

**S24CS866PE: PRINCIPLES OF GAMIFICATION IN ENGINEERING****(Professional Elective –VI)****B.Tech. IV Year II Sem.****L T P C****3 0 0 3****Course Objectives:**

- Understand the genesis of Bharatiya civilization
- Examine the traditional knowledge system of India
- Analyze ancient engineering, technology, and architecture
- Learn the fundamentals of game design and gamification
- Explore the concepts of augmented ,virtual reality and multi media

**Course Outcomes:** Student will able to

- Comprehend the significance of Bharatiya civilization
- Demonstrate knowledge of India's ancient education system
- Identify technological advancements in ancient India.
- Design and evaluate basic games and game mechanics
- Apply augmented , virtual reality and multimedia principles

**Unit-1:** Bharatiya Civilization and Development of Knowledge System:

Genesis of the Land, Antiquity of civilization, on the trail of the lost river, Discovery of Saraswati river and Saraswati-Sindhu civilization, Traditional Knowledge System, Vedas and main school of Philosophy, Ancient Education system, The Takshasila and Nalanda universities, Knowledge export from Bharata.

**Unit-2:** Engineering,Technology and Architecture:

Pre-Harappan and Sindhu valley civilization, Laboratory and Apparatus,Juices, Dyes, Paints and Cements, Glass and Pottery, Metallurgy, Engineering Science and Technology in the Vedic age and post-vedic records.

**Unit-3:** Introduction to Game Design: Motivation, Types of games, Different aspects of game design; Different components in a game, Game engines, Design Schemas, Game Design Fundamentals.

Foundations of Gamification: Definition of Gamification, Why Gamify, Examples and Categories, Gamification in Context, Resetting Behavior, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.

**Unit-4:** Introduction to Augmented Reality: What Is Augmented Reality - Defining augmented reality, history of augmented reality, applications of augmented reality Augmented Reality Ingredients of an Augmented Reality Experience.

Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Applications of Virtual Reality

**Unit-5:** Fundamental concepts in Text and Image: Multimedia and hypermedia, world wide web, overview of multimedia software tools. Graphics and image data representation graphics/image data types, file formats, Color in image and video: color science, color models in images, color models in video.

**Text Books:**

1. The Knowledge System of Bharata by Bhag Chand Chauhan
2. Ernest Adams, "Fundamentals of Game Design", 3rd Edition, New Riders; ISBN-10: 0321929675, 2013
3. 1. Allan Fowler-AR Game Developmentl, 1st Edition, A press Publications, 2018, ISBN 9781484236178 2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016), ISBN-10: 9332578494
4. Fundamentals of Multimedia by Ze-Nian Li and Mark S. Drew PHI/Pearson Education.

**References:**

1. Pride of India-A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati(2006)
2. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN: 9781491962381.
3. Multimedia and communications Technology, Steve Heath, Elsevier(Focal Press).

**S24CS831OE: ALGORITHMS DESIGN AND ANALYSIS (Open Elective –III)**

B.Tech. IV Year II Sem.

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**Prerequisites:** Programming for problem solving and Data Structures**Course Objectives:**

- Introduces the notations for analysis of the performance of algorithms.
- Describes major algorithmic techniques (divide-and-conquer, backtracking, dynamic programming, greedy, branch and bound methods) and mention problems for which each technique is appropriate;
- Describes how to evaluate and compare different algorithms using worst, average, and bestcase analysis.
- Explains the difference between tractable and intractable problems, and introduces the problems that are P, NP and NP complete.

**Course Outcomes:**

- Analyze the performance of algorithms
- Choose appropriate data structures and algorithm design methods for a specified application
- Understand the choice of data structures and the algorithm design methods

**UNIT - I****Introduction:** Algorithm, Performance Analysis-Space complexity, Time complexity, Asymptotic Notations- Big oh notation, Omega notation, Theta notation and Little oh notation.**Divide and conquer:** General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.**UNIT - II****Disjoint Sets:** Disjoint set operations, union and find algorithms, Priority Queue- Heaps, Heapsort**Backtracking:** General method, applications, n-queen's problem, sum of subsets problem, graph Coloring, Hamiltonian cycles.**UNIT - III****Dynamic Programming:** General method, applications- Optimal binary search tree, 0/1 knapsack problem, All pairs shortest path problem, Traveling sales person problem, Reliability design.**UNIT - IV****Greedy method:** General method, applications- Job sequencing with deadlines, knapsack problem, Minimum cost spanning trees, Single source shortest path problem.**Basic Traversal and Search Techniques:** Techniques for Binary Trees, Techniques for Graphs, Connected components, Biconnected components.**UNIT - V****Branch and Bound:** General method, applications - Travelling sales person problem, 0/1 knapsack problem - LC Branch and Bound solution, FIFO Branch and Bound solution.**NP-Hard and NP-Complete problems:** Basic concepts, non-deterministic algorithms, NP - Hard and NP-Complete classes, Cook's theorem.

**TEXT BOOK:**

1. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekharan, University Press.

**REFERENCE BOOKS:**

1. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.
2. Introduction to Algorithms, second edition, T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C.Stein, PHI Pvt. Ltd./ Pearson Education.
3. Algorithm Design: Foundations, Analysis and Internet Examples, M.T. Goodrich and R.Tamassia, John Wiley and sons.

**S24CS832OE: INTRODUCTION TO COMPUTER NETWORKS (Open Elective – III)**

B.Tech. IV Year II Sem.

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**Prerequisites**

1. A course on “Programming for problem solving”
2. A course on “Data Structures”

**Course Objectives**

- Equip the students with the concepts and fundamentals of computer networks.
- Familiarize the students with the standard models for the layered approach to communication between machines in a network and the protocols of the various layers.

**Course Outcomes**

1. Gain the knowledge of the basic computer network technology.
2. Gain the knowledge of the functions of each layer in the OSI and TCP/IP reference model.
3. Understand subnetting and routing mechanisms.
4. Familiarity with the essential application protocols of computer networks

**UNIT - I**

Network hardware, Network software, OSI, TCP/IP Reference models, Example Networks: ARPANET, Internet.

**Physical Layer:** Guided Transmission media: twisted pairs, coaxial cable, fiber optics, Wireless Transmission.

**Data link layer:** Design issues, framing, Error detection and correction.

**UNIT - II**

**Elementary data link protocols:** simplex protocol, A simplex stop and wait protocol for an error-free channel, A simplex stop and wait protocol for noisy channel.

**Sliding Window protocols:** A one-bit sliding window protocol, A protocol using Go-Back-N, A protocol using Selective Repeat, Example data link protocols.

**Medium Access sub layer:** The channel allocation problem, Multiple access protocols: ALOHA, Carrier sense multiple access protocols, collision free protocols, Data link layer switching.

**UNIT - III**

**Network Layer:** Design issues, Routing algorithms: shortest path routing, Flooding, Hierarchical routing, Broadcast, Multicast, distance vector routing, Congestion Control Algorithms, Quality of Service, Internetworking

**UNIT - IV**

**Transport Layer:** Transport Services, Elements of Transport protocols, Connection management, TCP and UDP protocols.

**UNIT - V**

**Application Layer:** Domain name system, Electronic Mail; the World WEB, HTTP, Streaming audio and video.

**TEXT BOOK:**

1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 6th Edition. Pearson Education

**REFERENCE BOOKS:**

1. An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education
2. Data Communications and Networking – Behrouz A. Forouzan. Third Edition TMH.