School of Engineering and Applied Sciences
B. Tech Computer Science and Engineering

AY: 2017-2018

Department of Computer Science and Engineering
SRM University-AP, Amaravati
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<th>COURSE NAME</th>
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**Semester II**

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<td>MAT111</td>
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<td>PHY111</td>
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<td>Design and Analysis of Algorithms</td>
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SPECIALIZATION STREAMS

1. Artificial Intelligence and Machine Learning
   a. Introduction to Machine Learning
   b. Principle of Soft Computing
   c. Digital Image Processing
   d. Artificial Intelligence

2. Cyber Security
   a. Network Security
   b. Mobile and Wireless Security
   c. Internet Protocols and Networking
   d. Introduction to Cryptography

3. Data Science
   a. Introduction to Data Science
   b. Big Data
   c. Machine Learning
   d. Inference and Representation

GENERAL COMPUTER SCIENCE ELECTIVES

1. Data and Web Mining
2. Natural Language Processing
3. Image Processing
4. Human Computer Interaction
5. Advanced Computer Architecture
6. Distributed Operating Systems
7. Fog Computing
8. Parallel Algorithms
9. Web Services
10. Advanced Database Management Systems
11. Complexity Theory
13. Advanced Data Structures and Algorithms
**MINOR PROGRAMME**

CSE Departments offers Minor in Computer Science and curriculum is given below.

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<tr>
<th>Sl. No.</th>
<th>Subject Name</th>
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<td>2</td>
<td>Algorithm Analysis and Design</td>
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<td>3</td>
<td>Web Technology</td>
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<td>Database Management Systems</td>
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<td>Software Engineering</td>
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SEMESTER – I

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<tr>
<td>COM 101</td>
<td>Introduction to Communication</td>
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**Course Objective:** Introduction to Communication is designed to help students with the principles and practice of effective oral communication skills. This course will help students through formal and informal speaking activities. Strategies for effective communication in social, business, and professional situations are examined. In all speaking assignments, articulation and the best way to frame ideas will be covered. The course objectives are for students to demonstrate an understanding of the value of rhetorical speaking skills; Paraphrase and cite research correctly; write and speak well-developed, clear, unified ideas with appropriate college-level language choices; Demonstrate a growing understanding of critical thinking in speaking, writing and in public situations.

**UNIT I: Rhetoric and Public Speaking**

Rhetoric, Critical Thinking and Public Speaking; Thinking Outside the Box; How to Deliver a Speech; Fundamentals of Persuasion.

**UNIT II: Nonverbal Communication**

Nonverbal Communication; Spatial distance, eye contact and appearances; How nonverbal communication is more important than words.

**UNIT III: Communication and the Media**

Persuasion and the media; Radio, television, film, social media and the internet; How the media sells ideas, images, products and life styles; Fundamentals of Informative/Scientific Speeches and Research; The Heart of the Speech – Powerful Narratives; The Power of Narrative.

**UNIT IV: Small Group Communication**

Small group communication; Leadership, conflict and persuasion in groups; The importance of small groups in business; Dr. A. Fisher’s Fundamentals of Small Groups; Group Problem Solving; Learning to say no – don’t say you will when you won’t, don’t say yes and then don’t do it, be true to your word.

**UNIT V: Persuasion, Ideology and Media Bias**
Advanced Rhetoric; Ideology; Persuasive Fallacies; How to Construct a Persuasive Speech; How to Present Scientific Data in a Speech; Unmasking Media Bias and Ideology; Full circle – the dangers of rhetoric and ideology.

**Books of Study**


**Books of Reference**


**SEMESTER – I**

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<td>Principles of Economics</td>
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**UNIT I: Introduction**

Nature and scope of Economics, Principles of Economics, Production Possibility Frontier, opportunity Costs, Comparative Advantage and Scope for Trade. Demand and Supply curves, Equilibrium, Shift in curve versus movement along the curve, Elasticity of Demand and Supply. Changes in equilibrium in response to policy changes, income, tastes and supply “shocks”

**UNIT II: Consumer Behaviour**

Consumer preferences and Indifference curve analysis – substitution, income and price effect.

**UNIT III: Production and cost**

Production, short- run production function and returns to factor – Average-marginal relationship, long – run production function and laws of return to scale- role of technology. Cost function and cost structure of a firm in the short- run, long run cost function and cost structure.

**UNIT IV: Types of markets**
Perfect competition including shut-down and break-even points. Monopoly. Monopolistic competition and product differentiation.

**UNIT V: Equilibrium in the short, medium and long run**

Short-run equilibrium: The Goods market, the money market and General equilibrium (IS-LM)

Medium-run equilibrium: The labour market General Equilibrium (AD-AS)

Long-run equilibrium: Introduction to growth, capital accumulation and growth, technological progress and growth.

**Unit VI: The open economy (International trade)**

Openness in goods and financial markets, the goods market, the financial markets and General equilibrium. Exchange rate regime.

**Books of study:**


**Books of reference:**


**SEMESTER - I**

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<tr>
<td>BIO 101</td>
<td>Introduction to Biology</td>
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**UNIT I: Basic Cell Biology**


**UNIT II: Protein Structure and Function**

Protein structure: Amino acids, Primary, secondary and tertiary structures. Protein folding, protein secretion and localization, protein modification and degradation. Introduction to Enzymes: classification, kinetics, synthesis and characterization.
UNIT III: Basic Molecular Biology


UNIT IV: Cellular Signaling and Cancer

Cell cycle. Signaling molecules, Signaling pathways: Transmembrane receptor, Intracellular receptor, nuclear hormone receptor. Signaling to environmental stress: sensory systems and immune system. Introduction to Cancer Biology; nature, types, metastasis, diagnostics and treatment.

UNIT V: Applied Microbiology

Microbial Biotechnology: microbial growth and fermentation, large-scale production, generation of microbial-based antibiotics, microbial-based nanoparticles and their characterization. Industrial and environmental applications: dairy, bio-fuels, bioremediation.

Books of Study

1. Thrives in Biochemistry and Molecular Biology, Edition 1, 2014, Cox, Harris, Pears, Oxford University Press.
3. Thrives in Cell Biology, Ed. 1, 2013, Qiuyu Wang, Cris Smith and Davis, Oxford University Press.

Books of References

4. Kuby Immunology, Ed. 5, 2006, Kindt, Goldsby and Osborn, W. H Freeman & Co (Sd).

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**SEMESTER - I**

**Unit I: Chemical Bonding**


**Unit II: Phase Rule and Kinetics**

Phase rule: Introduction. Definition of the terms used in phase rule with examples. Application of phase rule to water system, sulphur system and lead-silver system. Kinetics: Order and molecularity of reactions, zero order, first order and second order reactions.

**Unit III: Water Technology**


**Unit IV: Polymer Chemistry**

Classification of polymers: Natural and synthetic. Thermoplastic and Thermosetting. Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of
polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

Unit V: Electrochemistry
Arrhenius theory of electrolytic dissociation, classification of electrolytes; degree of dissociation of acids, dissociation constant of weak acids, concept of pH and pOH, buffer solutions, solubility product, common ion effect, indicators and theory of acid-base indicators; conductance of solutions- specific, molar and equivalent conductance, variation of molar conductance with dilution for strong and weak electrolytes; Migration of ions-Kohlrausch’s law of independent migration of ions, Ostwald’s dilution law; Nernst equation for single electrode and electrochemical cells.

Books of Study


Books of Reference


SEMESTER - I

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<td>MAT 141</td>
<td>Discrete Mathematics</td>
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**Scope & Aim of this course:** This course is an introduction to discrete mathematics for the computer science engineers. The prerequisite for this course is the first course on set-theory. The objective is to equip the students with the mathematical definitions, proofs and applicable methods.

**Unit I: The Foundations: Logic and Proofs**
Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.

**Unit II: Set Theory**

**Unit III: Elementary number theory, Induction and Recursion**
Divisibility and Modular Arithmetic, Integer Representations and Algorithms, Primes and Greatest Common Divisors, Solving Congruences; Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction.

**Unit IV: Counting principles**

**Unit V: Introduction to Graph Theory**
Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems.

**Books of Study**


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<tr>
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**Unit I**
Introduction to Python: Knowledge, Machines, Languages, Types, Variables, Operators, and Branching -- Core elements of programs: Bindings, Strings, Input/Output, IDEs, Control Flow, Iteration, Guess and Check – Simple Programs: Approximate Solutions, Bisection Search, Floats and Fractions, Newton-Raphson – Functions: Decomposition and Abstraction, Functions and Scope, Keyword Arguments, Specifications, Iteration vs Recursion, Inductive Reasoning, Towers of Hanoi, Fibonacci, Recursion on non-numerics, Files

**Unit II**

**Unit III**
Classes and Inheritance: Object Oriented Programming, Class Instances, Methods, Classes Examples, Why OOP, Hierarchies, Your Own Types – An Extended Example: Building a Class, Visualizing the Hierarchy, Adding another Class, Using Inherited Methods, Gradebook Example, Generators

**Unit IV**
Computational Complexity: Program Efficiency, Big Oh Notation, Complexity Classes, Analyzing Complexity – Searching and Sorting Algorithms: Indirection, Linear Search, Bisection Search, Bogo and Bubble Sort, Selection Sort, Merge Sort

**Unit V**
Optimization and Knapsack Problem: Computational models, Intro to optimization 0/1 Knapsack Problem, Greedy solutions – Decision Trees and Dynamic Programming: Decision tree solution to knapsack Dynamic programming and knapsack, Divide and conquer – Graphs: Graph problems, Shortest path, Depth first search, Breadth first search

**Unit VI**

Unit VII

Books of Study

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT)

Books of References

SEMESTER-II
Course Objective: This course is designed to help students increase writing and verbal English skills with regular practice and analysis of effective writing. This course will cover English in social, business, scientific and professional situations as well as public speaking.

Unit I: Horizontal and Vertical Writing
Students learn the differences between Vertical and Horizontal Writing. Readings from the best writers illustrate the best English writing.

Unit II: Basic English Concepts and Introduction to Linguistics
Students learn by the practice of working on basic English concepts of writing and speaking.

Unit III: Creative Writing
Learning to express ideas in ways that persuasively and clearly help the readers/listeners understand the student’s experiences.

Unit IV: Research Writing
The basics of how to write a research paper. Most students were (shockingly) never required to do a bibliography. They learn about thesis paragraphs, research, outlines, rewriting, editing and creating a bibliography.

Unit V: English Presentations
In this Unit, students learn to combine and synthesize their writing with presentation skills. Research papers and ideas are shared and presented to small and large groups.

Text Books:
2. Streets of Laredo by Larry McMurty (A novel), Simon and Schuster, 2010

References:
1. Oxford English Language Dictionary
Course Objective: The course will talk about e-commerce—since we observe in today's world that a real market where producers and consumers interact are becoming less common. This course will provide a broad overview of the economic theory and empirical analysis in the area of e-commerce.

UNIT I: Introduction

Relevance and potential of E-Commerce in India (Lecture notes)
E-commerce and its relevance to labour, credit and health care markets (Lecture notes)

UNIT II: Background Concepts

Perfect competition- Meaning, revenue of a competitive firm, Profit maximization and firms supply curve Monopolistic competition and product differentiation Competition with differentiated products. (Mankiw, chapters 14, 15 and 16). Mono polypricing and price discrimination, Meaning, monopolies production and pricing decisions, price discrimination, advertisement. (PRN Sections 3.1, 3.2, 4.1) (SV Chapters 2, 3) Competition and oligopoly pricing, cost of producing information. Cost and competition, market structure for information goods, pricing your product. (Shapiro and Varian, Chapter 2)
Market leadership- Network and positive feedback, demand side economies of scale, network externalities, collective switching costs, Generic strategies in network markets (Shapiro and Varian, Chapters 5, 7), PRN Section 12.4, Time Paths in the Diffusion of Product Innovations

UNIT III: Select E-Industries (10 hours)
Auctions:
Why are some goods auctioned and others sold at fixed prices?
Retail stores
How does the internet affect retail markets? Comparison of these markets with the traditional markets in terms of search costs and patterns of competition. Required websurfing: Amazon, Dell, Pcboost, Z-shops, Yahoo! Shopping, Autobytel, & Wal-mart, Emerging Landscape for Retail E-Commerce

UNIT IV: Introduction to Statistics and Econometrics

Definition of basic statistical concepts: mean, median, probability, conditional expectation, conditional probability (Lecture notes), Introduction to regression analysis (Lecture notes), Statistical Models and Shoe Leather

UNIT V: Sales Taxes and E-Commerce

The effect of sales taxes on the development e-commerce, Demand and supply effects of sales taxes, Sales taxes and internet commerce, Tax Sensitivity and Home State Preferences in Internet Purchasing, In a World without Borders: the Impact of Taxes on Internet Commerce, Playing with Fire: Cigarettes, Taxes and Competition from the Internet, Taxation of Electronic Commerce

Books of study

1. Industrial Organization: Contemporary Theory and Practice by Pepall, Richards and Norman [PRN].
2. Information Rules by Shapiro and Varian [SV]

Books of reference

2. Electronic Commerce (Fourth Edition), Adesh k. Pandey: Pete Loshin
4. E-Commerce fundamentals and Applications, Chan, Wiley India, New Delhi
Course Description: This course is an introduction to Single Variable Calculus to all engineering students. The objective is to equip the students with the knowledge of calculus and its applications

Unit I: Derivatives and Differentiation

Limit, Continuity and limits of quotients, Derivatives and its geometrical Interpretation, Derivative as a function and calculating derivative, Leibnitz notation and higher derivatives, Trigonometric functions, Linear Approximations, Product and quotient rules, Chain rule, Implicit differentiation, Inverse, exponential and logarithm functions.

Unit II: Approximations and their Applications

Measurement error of linear approximation, Quadratic approximation, Newton’s method, 1st and 2nd derivative test, Limits and asymptotic, Max min problems, Related application in real-life problems.

Unit III: The Integral and Integration Theory

Mean Value Theorem, Differentials and anti-derivatives, Differential equations, The definite integral, First and Second Fundamental Theorem of Calculus.

Unit IV: Different Integration Techniques and Application of Calculus

Areas and Volumes, Average value, Probability, Numerical Integration, Integrals of Trigonometric Power, Trigonometric substitution, Partial fractions, Integration by Parts, Arc length and Surface area.

Unit V: Polar Co-ordinate systems and Infinite Series

Parametric curves, Polar co-ordinates, L’Hospital’s rule, Improper Integrals, Infinite Series, Taylor’s series.

Books of Study:
1. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, Third edition, Wiley India, 2005
2. S. R. Ghorpade and B. V. Limaye, An Introduction to Calculus and Real Analysis, Springer India, 2007

Books of Reference:


**SEMESTER - II**

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<td>PHY111</td>
<td>Introduction to Classical Mechanics</td>
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**Course Description:** The course aims to cover the fundamental formalism and applications of classical mechanics. It mainly includes basic Newtonian mechanics and special theory of relativity.

**Unit – I: Review of Newtonian Mechanics**
Review of Scalars, Vectors and Kinematics, Newton's Laws of Motion and applications, Contact Forces, Static Friction, worked examples, Tension and springs, Pushing Pulling and Tension, Solving Pulley Systems, Hooke’s Law and applications.

**Unit – II: Circular Motion**
Polar Coordinates, Position and Velocity Vectors, Angular Velocity, Uniform Circular Motion, Direction of the Acceleration, Period and Frequency, Angular Acceleration, Newton’s Second law and circular motion, worked examples

**Unit – III: Momentum and Impulse**
Momentum and Impulse, Impulse momentum theorem, Conservation of Momentum, Momentum Diagrams, worked examples, Center of Mass and Motion of the Center of Mass, Center of Mass of 3 Objects, Center of Mass of a Continuous System, Center of Mass of a Uniform Rod and different objects, Velocity and Acceleration of the Center of Mass, Reduction of a System to a Point Particle, Center of Mass Trajectory.

**Unit-IV: Work Energy and Collision**

Motion of a rigid body and moment of inertia, Parallel and perpendicular axis theorem, Moment of inertia of different objects, Torque and Angular momentum, worked examples

Unit-V: Gravitation


Books of Study:
1. MIT— 8.01X online course material

Book(s) of Reference:
1. Classical Mechanics (2011) - Herbert Goldstein (Publisher – Pearson Education)
Course Description: This course is designed to give basic understanding of basic principles of electronics/concepts and devices to all engineering students.

Unit I: Electrical Quantities and Their Measurement
Ohm’s law, permanent magnet moving coil (PMMC) instrument, Ammeter and Voltmeter using PMMC, Measurement of resistance using Wheat Stone’s Bridge and Kelvin’s double bridge, measurement of capacitance using Schering’s bridge and De Sautee’s bridge, and measurement of inductance using Maxwell’s bridge and Hay’s bridge. Operation of the oscilloscope.

Unit II: Semiconductor Devices
Forward and reverse bias characteristics of PN junction diode. Design of half-wave, fullwave, bridge rectifiers, clipping and clamping using PN junction diode. Bipolar junction transistors (BJTs), common-base, common-collector and common-emitter configurations using BJTs. Voltage and current gain, transistor as amplifier and buffer. Photodiode and phototransistor.

Unit III: A.C. Circuits and Operational Amplifier

Unit IV: Electronic Filters
Low and high frequency noise in electronic circuits, basic low-pass, high-pass, band-pass and band-reject passive filters design using resistor, capacitor and inductor. Fourier transform, magnitude and phase response, bandwidth, bode plots. Design and analysis of higher order filters. Active filter design using operational amplifier, applications of electronic filters.

Unit V: Digital Logic Fundamentals
Number systems: binary, decimal, octal and hexadecimal number systems, number system conversions. Logic gates: AND, OR, NOT, NAND, NOR, X-OR, X-NOR. Logic gates design using PN diodes. De Morgan’s laws, Karnaugh maps. Basic combinational logic
blocks: half adder, half subtractor, full adder, full subtractor, multiplexer and de multiplexer.

**Text books:**


**References:**


**SEMESTER - II**

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<td>CSE103</td>
<td>Introduction to Electrical Engineering and Computer Science</td>
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**Course Description:** This course gives some basic understanding of some advanced python programming concepts, circuit analysis, electrical network theorems and resonance and transient analysis

**Unit I: Object oriented Programming Concepts using Python**
Objects, Class, Method, Encapsulation, Data abstraction, Polymorphism, Inheritance. Object Oriented Design Principles and Patterns: Iterator Pattern, Decorator Pattern, Strategy Pattern

**Unit II: State Machines Basics and Design using Python**
Introduction to regular expressions, Finite state machines, Design state machine using python, Basic combination and abstraction of state machines, Terminating statemachines and sequential compositions, Use case of state machine design using python
Unit III: Circuit Analysis
Review of KCL and KVL, Basic Circuit Terminology-Node, loop, mesh, circuit, branch and path. Ideal sources, Source transformation, Star-Delta transformation. AC analysis - Phasor, Complex impedance, complex power, power factor, power triangle, impedance triangle, series and parallel circuits.

Unit IV: Network Theorems
Network Theorems (A.C. and D.C Circuits) - Mesh and Nodal analysis, Superposition theorem, Thevenin’s theorem, Norton theorem, Maximum Power transfer and, Reciprocity theorem.

Unit V: Resonance and Transient Analysis

Text Books:

Reference Books:
2. Automata Theory, Languages and Computation (Bundle - Set of 2 books) Paperback Apr 2016 by John E. Hopcroft (Author), Jeffrey D Ullman (Author), Rajeev Motwani (Author) Publisher: Pearson Education; Third edition (10 April 2016)
SEMESTER - II

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<td>CDC 1002</td>
<td>Soft Skills-1</td>
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UNIT I - Interpersonal Skills

Understanding the relationship between Leadership Networking and Team work, Realizing Ones Skills in Leadership, Networking & Team Work, and Assessing Interpersonal Skills Situation description of Interpersonal Skill. Team Work Necessity of Team Work Personally, Socially and Educationally

UNIT II - Leadership

Skills for a good Leader, Assessment of Leadership Skills, Change Management, Exploring Challenges, Risking Comfort Zone, Managing Change

UNIT III - Stress Management

Causes of Stress and its impact, how to manage & distress, Understanding the circle of control, Stress Busters. Emotional Intelligence What is Emotional Intelligence, emotional quotient why Emotional Intelligence matters, Emotion Scales. Managing Emotions.

UNIT IV - Conflict Resolution

Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.

UNIT V - Decision Making


Reference Books:
3. Thomas A Harris, I am ok, You are ok, New York-Harper and Row, 1972
Course Description: This is a basic subject on matrix theory and linear algebra. Emphasis is given to topics that will be useful in other disciplines, including systems of equations, vector spaces, determinants, eigenvalues, similarity, and positive definite matrices.

Unit I

Vector Space: Elimination, LU factorization, null-spaces and other subspaces, bases and dimensions, vector spaces, complexity

Unit II

Factorization: Orthogonality, projections, least-squares, QR, Gram–Schmidt, orthogonal functions

Unit III

Matrices: Eigenvectors, determinants, similar matrices, Markov matrices, ODEs, symmetric matrices, definite matrices,

Unit IV

Iterative methods: Defective matrices, SVD and principal-components analysis, sparse matrices and iterative methods, complex matrices, symmetric linear operators on functions.

Unit V

Applications: Matrices from graphs and engineering.

Books of Study:

Books of Reference:

SEMESTER – III
Course Description: This course provides an integrated, quantitative and interdisciplinary approach to the study of environmental systems. Topics include Environment, Structure and functions in an ecosystem; Biosphere, Broad nature of chemical composition of plants and animals; Natural Resources covering Renewable and Non-renewable Resources, Forests, water, minerals, Food and land; Energy, Growing energy needs, energy sources; Biodiversity and its conservation; Environmental Pollution; Environmental Biotechnology; Social Issues and Environment covering, problems relating to urban living, climate change, environmental regulation, and environmental ethics.

UNIT I: Environmental Education, Sustainability, and Ecological Systems: How ecosystems works

Environmental Education, Concept of sustainability, Tragedy of the commons; Root causes of environmental crisis, Earth systems at atmosphere, hydrosphere, Lithosphere, and Biosphere. Ecosystem structure and function, Ecological systems and major biomes, Water and nutrients cycles - Water cycle, phosphorous cycle, nitrogen cycle, Case study - Cape Town water crisis.

UNIT II: Biodiversity and its conservation

Biodiversity: - Why do we care? (Values of biodiversity); Threats to biodiversity; Saving Biodiversity - sustainable approaches; Case Study - The Last White Rhino; GMO; Technological advancement and biodiversity conservation.

UNIT III: Environmental Pollution and its role on global climate change and human health

Pollution - air, water, and soil pollution. Air pollution: Composition of air, Sources of air pollution, Primary and secondary pollutants, Air quality index (AQI), Effect of air pollution, Air pollution and infant mortality, Air pollution control: Sustainable strategies, Greenhouse gases; Carbon cycle; Global warming and climate change; Renewable and Non-renewable Energy sources; Water pollution: Surface water, Groundwater, and Ocean pollution; Point and Non-point sources; Organic and inorganic nutrients pollution; Eutrophication; Microbial contamination; Oil pollution in the seas -
ExxonValdezOilpill; Plasticpollution SoilPollution: Chemical contamination, Major contributors of soil pollution (Coal ash, sewerage, Pesticides and herbicides, etc.)

UNIT IV: Environmental Microbiology and Biotechnology

Environmental Microbiology: Microbes in our daily lives; Microbial life in air, water, and soil; Indicator microorganisms; Microbial interactions, signaling, biotransformation, and bioremediation; Molecular Ecology: Therare Biosphere; Microbial contribution to global climate change—Methane, and Nitrous oxide emissions; Global warming and microbial infectious disease.

UNIT V: Environmental ethics, Economics, policy development

Environmental ethics for a sustainable society; Economics of pollution control, Carbon credits, taxes, and role in environmental protection; Environmental movements; Environmental protection acts in India; Sustainable Economic Developments: Challenges of developing nations, Political decision making for Environmental Protections. Casestudy—Chinese Environmental Protection Tax, Water resource tax, CNG vehicles in Delhi/Delhiodd—or even rule.

Books of Study:

References:
SEMMETER – III

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<td>ENG101</td>
<td>Engineering Fundamentals</td>
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UNIT I

UNIT II

UNIT III
Heat Engines - External, Internal, Carnot, Rankine, Otto, Diesel Cycles; Steam Boilers - Fire Tube, Water Tube Boilers, Valves; ICEngine - Components, 2 Stroke, 4 Stroke, Engine Performance, Efficiency

UNIT IV
Pumps - Reciprocating, Rotary, Pump Efficiency; Air Compressors - Reciprocating/Rotary; Refrigeration and Air Conditioning - Principles of Working; Brakes, Clutches and Couplings, Drives - Transmission of Power - Belt Drive, Gear Drive, Chain Drive

UNIT V

Books of Study:

References:
2. Elements of Mechanical Engineering, B. L. Theraja, S. Chand Ltd. 1999.
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<tr>
<td>PHY 112</td>
<td>Introduction to Electricity and Magnetism</td>
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**Unit I**

Introduction to Vector Algebra: Gradient, Divergence and curl and their physical significances, Gauss and Stokes theorems, Vector operators in different coordinate (Curvilinear, Cartesian, Cylindrical and spherical) systems

**Unit II**

Electrostatics: Coulomb’s law, Gauss law, Electric field, Electrostatic Potential, Potential energy of system of charges. Boundary Value problems in electrostatics-solution of Laplace equation in Cartesian system, Method of image charge

**Unit III**

Dielectrics and Polarization: Electric dipole and dipole moment, Electric potential due to dipole, Electric intensity due to dipole, Polarization P, Electric displacement D, Electric susceptibility and dielectric constant, Bound volume and surface charge densities, Electric field at an exterior and interior point of dielectric.

**Unit IV**


**Unit V**

Electrodynamics: Time varying fields: Faradays law of induction, generalization of Amperes’ law, Maxwell’s equation (Differential and Integral form), Wave equation and plane waves in free space, Poynting theorem, Polarizations of plane wave, Microscopic form of ohm’s law (J=σ.E)

**Required Book:**
1. Introduction to Electrodynamics (4rd Edition) - David J. Griffiths (Publisher - PHI Learning, Eastern Economy Editions, 2012)

Reference Books:
1. Electricity and magnetism Edward M Purcell, David J Morin, “”, 3rd edition, Cambridge University, 2013

**SEMESTER - III**

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<tr>
<td>CSE 223</td>
<td>Data Structures and Algorithms using C</td>
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**Course Objectives:** The objective of the course is to teach programming (with an emphasis on problem solving) and introduce elementary data structures. The student should, at a rudimentary level, be able to prove correctness (loop invariants, conditioning, etc) and analyze efficiency (using the ‘O’ notation).

**UNIT I**
Introduction to C programming, identifiers, basic data types, constants, variables, keywords, operators: arithmetic, relational and logical, increment and decrement operators, conditional operator, assignment operators, Instruction: type declaration, Input-output, conditional, loop control, Arrays, Functions, pointers, dynamic memory management functions Derived types- structures- declaration, definition and initialization of structures, accessing member of structure, arrays of structures, structures and functions, pointers to structures, self-referential structures.

**UNIT II**
Introduction to data structures, Stacks and Queues: representation and application, implementation of stack and queue operations using C, Linked lists: Single linked lists, implementation of link list and various operation using C, Double linked list, circular list.

**UNIT III**
Trees: Tree terminology, Binary tree, Binary search tree, infix to postfix conversion, postfix expression evaluation. General tree, AVL Tree, Complete Binary Tree representation.
UNIT IV
Graphs: Graph terminology, Representation of graphs, Path matrix, BFS (breadth first search), DFS (depth first search), topological sorting, Shortest path algorithms.

UNIT V
Sorting and Searching techniques–Bubble sort, selection sort, Insertion sort, Quick sort, merge sort, Heap sort, Radix sort, implementation using C. Linear and binary search methods, implementation using C, Hashing techniques and hash functions.

Learning Outcomes:
After the successful completion of the course the student will be able to:
1. Design correct programs to solve problems.
2. Choose efficient data structures and apply them to solve problems.
3. Analyze the efficiency of programs based on time complexity.
4. Prove the correctness of a program using loop invariants, pre-conditions and post-conditions in programs.

Books of Study:

References:
1. Fundamentals of data structure in C” Horowitz, Sahani and Anderson Freed, Computer SciencePress.
3. Data Structure- A Pseudo code approach with C , Gilberg and Forouzan, byThomson publication

SEMESTER III

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<tr>
<td>CSE221</td>
<td>Digital Systems Design</td>
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UNITI
Digital Systems and Binary Numbers: Digital Systems
Number Systems and base conversions – Representation of signed Binary Numbers– Binary codes– Logic gates.
UNIT II
Boolean Algebra: Introduction to Boolean Algebra
- Axioms and Laws of Boolean Algebra
- Boolean Functions
- Canonical and Standard Forms
- Gate Level Minimization: Introduction to Two, Three, Four Variable K-map's
- Don't Care Conditions
- NAND and NOR Implementation

UNIT III
Combinational Logic: Introduction to combinational logic circuits
- Binary adder and subtractor
- Look Ahead Carry Adder
- Magnitude comparator
- Decoders
- Encoders
- Multiplexers
- DE multiplexers

UNIT IV
Synchronous Sequential Logic: Introduction to sequential circuits
- Latch
- Flip Flop
- SR, JK, T, D Flip Flops
- Flip Flop Excitation Tables
- Analysis of Clocked Sequential Circuits
- Registers and Counters: Registers, Shift Registers, Ripple Counters, Synchronous Counters
- Other counters

UNIT V
Memory and Programmable Logic: Introduction to Programmable Logic Devices (PLD's)
- Programmable ROM (PROM)
- Programmable Logic Array (PLA)
- Programmable Array Logic (PAL)

Books of Study:

References:
2. Digital Electronics by G.K. Kharate, Oxford University Press
Semester III

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<td>Soft Skills 2</td>
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**UNIT I: Motivation**
Soldiers’ Walk and The Japanese Fan (Activities on factors of motivation), Steps to ward off de-motivation

**UNIT II: Creativity and Innovation**
Short Film: Students would be encouraged to make a ten-minute documentary on various topics to enhance the power of aesthetics and precision. This activity is aimed at creating an interest in research and think out of the box.

**UNIT III: Critical and Lateral Thinking**
Fill Me Up, Stimulating Lateral Thinking, The Curious Case of Mary and Kevin (Activities triggering the different types of thinking), The Creative Collage. Critical and lateral thinking can be inculcated with a structured re programming of the neural pathways. These specially designed activities will enhance critical and lateral thinking

**UNIT IV: Team Dynamics**

Story boarding, Frenzy, Come to my Island, Striking Cars, Defend the Egg, Tallest Tower (Activities on the different stages of team building, team communication, coordination and collaboration)

**Unit V: Mini Project**
Individual projects on topics provided by faculties.
SEMESTER IV
**SEMESTER IV**

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<td>BS</td>
<td>Multi-variable Calculus</td>
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**Unit I**
Vector and Matrices, Vectors, Dot product, Determinants; cross product, Matrices; inverse matrices, Square systems; equations of planes, Parametric equations for lines and curves, Velocity, acceleration, Kepler's second law

**Unit II**
Partial Derivatives
Level curves; partial derivatives; tangent plane approximation, Max-min problems; least squares, Second derivative test; boundaries and infinity, Differentials; chain rule, Gradient; directional derivative; tangent plane, Lagrange multipliers, Non-independent variables, Partial differential equations

**Unit III**
Double integral and line integrals in the plane
Double integrals, Double integrals in polar coordinates; applications, Change of variables, Vector fields and line integrals in the plane, Path independence and conservative fields, Gradient fields and potential functions, Green's theorem, Flux; normal form of Green's theorem, Simply connected regions

**Unit IV**
Triple integrals in 3D
Triple integrals in rectangular and cylindrical coordinates, Spherical coordinates; surface area, Vector fields in 3D; surface integrals and flux, Divergence theorem: applications and proof.

**Unit V**
Surface integral in 3D
Line integrals in space, curl, exactness and potentials, Stokes' theorem, Topological considerations, Maxwell's equations.

**Books of Study:**

**Books of Reference:**
Objective: To provide an introduction to the concepts of signals and systems including a significant fraction of the course focusing on signal representation, signal processing, and basic concepts of linear systems.

UNIT I: Basic Introduction
Introduction to continuous-time (CT) and discrete-time (DT) signals and systems. Definitions and classification of signals. Definitions and classification of systems including linear-time-invariant (LTI) systems.

UNIT II: Representation of Periodic Signals
CT and DT Fourier series representation of periodic signals.

UNIT III: Representation of Aperiodic Signals
CT and DT Fourier Transforms as an extension to Fourier series. Laplace Transforms.

UNIT IV: Sampling and Signal Processing
NY Quist sampling theorem, Discrete Fourier Transforms, Fast Fourier Transforms, and introduction to filters

UNIT V: Linear Feedback Systems
Introduction to concepts of linear systems including stability and control

Books of Study:

References:
1. B. P. Lathi, Linear Systems and Signals, 2nd Ed, Oxford University Press, 2005
**Course outcomes:**

Understand and remember the complexity of certain sorting algorithms.

Understand and remember the complexity of advance data structures

Analyse the complexity of “Divide and Conquer” and “Greedy” based algorithms

Analyse the complexity of “Dynamic”, “Branch and Bound” and “Backtracking” based algorithms

Solve the classes P, NP, and NP-Complete and will be able to prove that a certain problem is NP-Complete.

Analyse different algorithms based on randomization and approximation.

**UNIT I**
Algorithmic thinking & motivation with examples, Reinforcing the concepts of Data Structures with examples.

**UNIT II**
Complexity analysis of algorithms: big O, omega, and theta notation, Analysis of Sorting and Searching: Insertion sort, Selection sort, Heap sort, Recursive and non-recursive algorithms

**UNIT III**
General Problem Solving (GPS) techniques: Divide and conquer: Merge sort, Quicksort, BST, Master method for Complexity analysis Greedy method: Fractional Knapsack, Minimum spanning trees (Prim’s & Kruskal’s), shortest paths: Dijkstra’s, Huffman coding- Dynamic Programming: 0/1 Knapsack, All-to-all shortest paths

**UNIT IV**
BFS & DFS, Backtracking: 8-Queens problem, Knights tour, Travelling Salesman Problem (TSP). Branch-and-bound: 16-puzzle problem, TSP

UNIT V
Non-polynomial complexity: examples and analysis, Vertex cover, Set cover, TSP, 3-SAT

Books of Study:

Reference books:
2. Algorithm Design, by J. Kleinberg and E. Tardos, Addison-Wesley, 2005

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<td>CSEC</td>
<td>Computer Organization and Architecture</td>
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Course Objective:

Students will be able to understand the organization of computer, performance evaluation of memory and CPU. They will also learn to design various components of computer system.

Course Outcomes:

Describe various data representations and explain how arithmetic and logical operations are performed by computers

Describe organization of digital computers
Explain the basic principles and operations of different components

Evaluate the performance of CPU, memory and I/O operations

Design a basic computer system using the major components

Describe architectural classification scheme of CPU

UNIT I: Basic Structure of Computers
Functional units – Bus structures – Instruction set architecture: Instruction formats - addressing modes - Architecture and instruction set of 8086/8088 microprocessor- Assembly language programming - Fixed point and floating point operations – ALU design

UNIT II: Basic Processing Unit
Fundamental concepts – Execution of a complete instruction – Hardwired control – Micro programmed control design - Nano programming- CISC-RISC- principles

UNIT III: Pipeline Processing
Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Pipeline optimization techniques: Compiler techniques for improving performance

UNIT IV: Memory System

UNIT V: I/O Organization

Books of Study:

References:
1. Structured Computer Organization, Andrew S. Tanenbaum
UNIT I: Object-Oriented Thinking
A way of viewing world – Agents and Communities, messages and methods, Responsibilities, Classes and Instances, Class Hierarchies- Inheritance, Method binding, Overriding and Exceptions, Summary of Object-Oriented concepts. Java buzzwords, An Overview of Java, Data types, Variables and Arrays, operators, expressions, control statements, Introducing classes, Methods and Classes, String handling. Inheritance– Inheritance concept, Inheritance basics, Member access, Constructors, Creating Multilevel hierarchy, super uses, using final with inheritance, Polymorphism-ad hoc polymorphism, pure polymorphism, method overriding, abstract classes, Object class, forms of inheritance-specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance.

UNIT II: Stream Based I/O
The Stream Classes-Byte streams and Character streams, reading console Input and Writing Console Output, File class, Reading and writing Files, Random access file operations, The Console class, Serialization, Enumerations, auto boxing, generics.

UNIT III: Exception Handling
Fundamentals of exception handling, Exception types, Termination or presumptive models, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception sub classes. Multithreading- Differences between thread-based multitasking and process-based multitasking, Java thread model, creating threads, thread priorities, synchronizing threads, inter thread communication.

UNIT IV: The Collections Framework
Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Accessing a Collection via an Iterator, using an Iterator, The For-Each alternative, Map Interfaces and Classes, Comparators, Collection algorithms, Arrays, The Legacy Classes and Interfaces- Dictionary, Hashtable, Properties, Stack, Vector More Utility classes, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner
UNIT V: GUI Programming with Swing
Event Handling- The Delegation event model- Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes.

Books of Study:

References:
2. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
Objective
A grasp over numeric skills enable an individual to apply the mathematical techniques to situations that call for the interpretation or evaluation of quantitative information. The logical ability is sharpened through the practice of quantitative reasoning. Emotional intelligence on the other hand enables the development of intra and interpersonal relationship skills. Both these disciplines are aimed at enhancing the professional and personal effectiveness of the students.

UNIT I Quantitative Reasoning (12 hours)
Number properties (3), Speed, Time and work (2), Powers and roots (1), Pipes, cisterns (1). Problems on Clock, Calendar and Cubes (3), Height and Distance (1), Logarithms (1)

UNIT II Non-Verbal Reasoning (7 hours)
Alpha-numerical sequence puzzle, Symbols and their relationships, Blood Relations, Seating Arrangement, Coding-Decoding, Input- Output, test Direction Sense Test

UNIT III Data Analysis and Interpretation (10 hours)
Sets and Functions (1), Data Sufficiency (2), Statistics: Average, Median, Mode, Range, Standard deviation (2), Graphical and Numerical Methods for Describing Data, Interpretation of data in tables and graphs (2), Permutations and Venn diagrams Counting Methods, Probability (3).

UNIT IV Emotional Intelligence II
Self-Awareness, Self-Regulation, Social Skills, Empathy and Motivation.

Books of Study:
1. R.S. Agarwal, A Modern Approach to Verbal & Non Verbal Reasoning, S. Chand Publication

References:
1. The Games People Play, Eric Berne; Grove Press; 1964
2. Of Human Interaction; Joseph Luft; Mayfield Publishing. 1969
3. Emotional Intelligence; Daniel Goleman; Bantam Books, 1995
SEMESTER V
**Unit I: Data and Descriptive Statistics**
Types of data, visualization of data, basic concepts of sample space, sample mean, and other statistics, introduction to regression

**Unit II: Probability and Random Variables**
Probability space, random variables, cumulative distribution function, probability density function, expectation, variance

**Unit III: Random Vectors & Random Processes**
Random vectors, joint PDF, covariance, correlation, independence, random processes, Markov chains

**Unit IV: Computer Simulations & Monte Carlo Methods**
Simulation of random variables, vectors, and processes; Monte Carlo method

**Unit V: Statistics**
First and higher order linear and nonlinear differential equations, existence, and solution methods

**Reference Books:**
1. M. Baron, Probability & Statistics for Computer Scientists, Chapman & Hall/CRC, 2018

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**SEMESTER V**

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<tr>
<td>ES</td>
<td>Probability and Statistics</td>
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**Course Objective:**
Design techniques, process management, processor scheduling; deadlocks, memory management, secondary memory management, file management; I/O systems, Unix systems.

**UNIT I: Operating Systems Overview**
UNIT II: Process Scheduling
Processes- Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; CPU Scheduling algorithms; OS – examples

UNIT III: Process Synchronization And Deadlocks
Threads- Overview, Multithreading Models; Process Synchronization – Critical Section Problem, Mutex Locks, Semaphores, Monitors; Deadlocks- OS examples

UNIT IV: Storage Management
Main Memory- Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory- Demand Paging, Page Replacement, Allocation, Thrashing; OS examples

UNIT V: I/O Systems

Learning Outcomes:
1. Master functions, structures and history of operating systems
2. Master understanding of design issues associated with operating systems
3. Master various process management concepts including scheduling, synchronization,
4. deadlocks
5. Be familiar with multithreading
6. Master concepts of memory management including virtual memory
7. Master system resources sharing among the users
8. Master issues related to file system interface and implementation, disk management
9. Be familiar with protection and security mechanisms
10. Be familiar with various types of operating systems including Unix.

Text Books:

Course Objectives: The course should provide a formal connection between algorithmic problem solving and the theory of languages and automata and develop them into a mathematical (and less magical) view towards algorithmic design and in general computation itself. The course should in addition clarify the practical view towards the applications of these ideas in the engineering part of computer science.

UNIT – I


UNIT – II


UNIT – III

Push Down Automata: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata. Equivalence of CFL and PDA.

UNIT – IV

Introduction to Turing Machines-Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Computable functions, recursively enumerable languages. Church’s hypothesis, counter machine, types of Turing machines.

UNIT – V
Undecidability: A Language that is Not Recursively Enumerable, An Undecidable Problem that is RE, Undecidable Problems about Turing Machines, Post’s Correspondence Problem, Other Undecidable Problems, Intractable Problems: The Classes P and NP, An NP-Complete Problem.

Learning Outcomes:

After completing the course, the student will be able to:

1. Model, compare and analyse different computational models using combinatorial methods.
2. Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
3. Construct algorithms for different problems and argue formally about correctness on different restricted machine models of computation.
4. Identify limitations of some computational models and possible methods of proving them.
5. Have an overview of how the theoretical study in this course is applicable to and engineering application like designing the compilers.

Text Books:


Reference Books:

1. Introduction to Languages and The Theory of Computation, John C Martin, TMH.
5. Theory of Computer Science – Automata languages and computation, Mishra and Chandrashekar, 2nd edition, PHI.
6. Logicomix - An Epic Search for Truth is a graphic novel about the foundational quest in mathematics, Apostolos Doxiadis
**Course Objective:**

This course is to provide students with an overview of the concepts and fundamentals of computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks (LAN, MAN, WAN and Wireless networks) and their protocols.

**Course Outcomes:**

| Understanding of computer networking fundamentals with data communication system and TCP/IP & OSI reference model |
| Analyze the requirements for a given organizational structure and selection of appropriate network architecture and topology |
| Specify and identify working limitation in existing protocols of networking layers and try to formulate new and better protocols |
| Explain the services and design issues of Transport layer, Session layer and Presentation layer and able to Compare and contrast TCP and UDP protocol. |
| State basic understanding of the use of cryptography and network security |
| Explain the functions of Application layer and Presentation layer paradigms and Protocols. |

**UNIT - I**

UNIT - II

Multi Access Protocols - ALOHA, CSMA, Collision free protocols, Ethernet- Physical Layer, Ethernet Mac Sub layer, data link layer switching & use of bridges, learning bridges, spanning tree bridges, repeaters, hubs, bridges, switches, routers and gateways.

UNIT - III

Network Layer: Network Layer Design issues, store and forward packet switching connection less and connection oriented networks-routing algorithms-optimality principle, shortest path, flooding, Distance Vector Routing, Control to Infinity Problem, Hierarchical Routing, Congestion control algorithms, admission control.

UNIT - IV

Inter-networking: Tunneling, Internetwork Routing, Packet fragmentation, IPv4, IPv6 Protocol, IP addresses, CIDR, IMCP, ARP, RARP, DHCP.

Transport Layer: Services provided to the upper layer's elements of transport protocol-addressing connection establishment, connection release, Connection Release, Crash Recovery.

UNIT - V:


Application Layer- Introduction, providing services, Applications layer paradigms, Client server model, Standard client-server application-HTTP, FTP, electronic mail, TELNET, DNS, SSH.

Text Books:


References Books:


**SEMESTER V**

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<tr>
<td>CDC</td>
<td>Soft Skills 4</td>
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**UNIT I: Quantitative Reasoning**
Number properties (3), Speed, Time and work (2), Powers and roots (1), Pipes, cisterns (1). Problems on Clock, Calendar and Cubes (3), Height and Distance (1), Logarithms (1)

**UNIT II: Non-Verbal Reasoning**
Alpha-numerical sequence puzzle, Symbols and their relationships, Blood Relations, Seating Arrangement, Coding-Decoding, Input-Output, test Direction Sense Test

**UNIT III: Data Analysis and Interpretation**
Sets and Functions (1), Data Sufficiency (2), Statistics: Average, Median, Mode, Range, Standard deviation (2), Graphical and Numerical Methods for Describing Data, Interpretation of data in tables and graphs (2), Permutations and Venn diagrams Counting Methods, Probability (3).

**UNIT IV: Emotional Intelligence II**
Self-Awareness, Self-Regulation, Social Skills, Empathy and Motivation.

**Books of Study:**
3. R.S. Agarwal, A Modern Approach to Verbal & Non Verbal Reasoning, S. Chand Publication

**References:**
4. The Games People Play, Eric Berne; Grove Press; 1964
5. Of Human Interaction; Joseph Luft; Mayfield Publishing. 1969
6. Emotional Intelligence; Daniel Goleman; Bantam Books, 1995
SEMESTER VI
The objective of this course is to introduce the fundamentals of database management systems concepts, with an emphasis on how to model, organize, maintain and retrieve information in a database efficiently.

**Course Objectives:**

- Explain the advantages of DBMS, its Characteristics, Concepts and ER-Model.
- Demonstrate Relational Database using SQL detailing the role of Relational Algebra and Relational Calculus
- Illustrate the normal forms of Relational DBMS detailing the process of normalization.
- Examine Transaction Management, Concurrency Control and data recovery.
- Create and Access Database for various Applications

**Course Outcomes:**

By the end of this course, a student will be able to

- Understand the advantages of DBMS over traditional file system and its Characteristics
- Design ER-models to represent simple database applications.
- Design relational database and execute various queries using SQL
- Understand various anomalies that can occur in databases and overcome those with the help of normal forms.
- Understand the concepts of Transaction Management, Concurrency Control and data recovery.

**UNIT I**

Introduction to data models and data base internals The hierarchical, network and relation models, relational schemas and introduction to data base internals.

**UNIT II**

Database operators and query processing, Relational algebra, calculus and introduction to SQL.

**UNIT III**
Database designER modelling, database design and Normalization (1NF, 2NF, 3NF and BCNF, 4NF)

UNIT IV
Transaction Management and Concurrency Control
Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management

UNIT V
Database Recovery and advanced concepts: Database recovery protocols, Logging, WAL and ARIES, Distributed databases, parallel databases and scientific databases

Text Books:

Books of reference:

SEMESTER VI

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<td>BS</td>
<td>Differential Equations</td>
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UNIT I: First Order Differential Equation
Geometric meaning of $y' = f(x, y)$, Direction Fields, Euler's Method, Classification of ODEs (Linear, Non-linear, Exact, Separable), Integrating Factor, Bernoulli Equations, Initial Value Problem, Modelling (Free falling object, Radioactivity, RL-circuit).

UNIT-II: Second and Higher Order Linear ODEs
Homogeneous Linear ODEs, Modelling of Free Oscillations of a Mass-Spring System, Euler-Cauchy Equations, Non-homogeneous ODEs, Variation of Parameters, Modelling (Forced Oscillations, Electric Circuits),

UNIT-III: System of ODEs:
Modelling Engineering problems (Electric Network, Mixing problem in two tanks etc.) as systems of ODEs, Wronskian, Phase-Plane Method, Critical Points & Stability, Qualitative Methods for Nonlinear Systems, Nonhomogeneous Linear Systems of ODEs.

UNIT-IV: Series Solutions of ODEs
Introduction to power series method, Legendre’s equation & polynomials, Frobenius Method, Bessel’s Equations & Functions.

UNIT-V: Laplace Transforms:

Book of Study:

Book of References:
2. G. F. Simmons, Differential Equation with Applications and Historical Notes, TATA McGraw Hill.

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<td>CSEC</td>
<td>Software Engineering</td>
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Course Objectives:

- Comprehend software development life cycle and prepare SRS document.
- Explain software design and development techniques
- Demonstrate various software modelling techniques.
- Illustrate various software testing techniques and their applicability.
- Detail the project management life cycle.

Course Outcomes:

By the end of the course, a student will be able to
● Understand the principles of software engineering, life cycle models.
● Specify, analyze and document software requirements through a productive working relationship with project stakeholders
● Understand the importance of software modeling and learn various modeling languages
● Understand the necessity of software testing and design various test cases for a software.
● Adapt Software maintenance and understand the concepts of project management.

UNIT I: Software Process and Agile Development

UNIT II: Requirements Analysis and Specification

UNIT III: Software Design

UNIT IV: Testing and Maintenance

UNIT V: Project Management

List of experiments:

| 1 | Develop requirements specification for a given problem |
Develop DFD Model (Level 0, Level 1 DFD and data dictionary) of the sample problem

To perform the function oriented diagram: DFD and Structured chart

To perform the user’s view analysis: Use case diagram

To draw the structural view diagram: Class diagram, object diagram

To draw the behavioral view diagram: Sequence diagram, Collaboration diagram

To draw the behavioral view diagram: State-chart diagram, Activity diagram

To draw the implementation view diagram: Component diagram

To draw the environmental view diagram: Deployment diagram

To perform various testing using the testing tool unit testing, integration testing

Text Books:

References:

SEMESTER VI

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<tr>
<td>CSEC</td>
<td>Compiler Design</td>
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<td>L 3 T 0 P 2 C 4</td>
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Course Objectives:

- Explain the phases of compiler.
- Illustrate the concepts of Lexical Analysis.
- Design and Implement parsers.
- Analyzing the methods to define syntax and semantics of languages
- Provide practical training for the usage of LEX and YACC tools
- Develop syntax directed translation schemes.

Course Outcomes:

By the end of the course, the student will be able to

- Delineate various phases of compiler design
- Understand the need and role of lexical analyser and design some lexical analysers using LEX
Understand and design parsers
Generate various forms of intermediate code
Enforce various schemes for optimizing code and describe the role of code generator and its design issues Code Generation

UNIT I: Introduction to Compilers

Translators-Compilation and Interpretation-Language processors-The Phases of Compiler-Errors Encountered in Different Phases-The Grouping of Phases-Compiler Construction Tools - Programming Language basics.

UNIT II : Lexical Analysis

Need and Role of Lexical Analyzer-Lexical Errors-Expressing Tokens by Regular Expressions- Converting Regular Expression to DFA- Minimization of DFA-Language for Specifying Lexical Analyzers-LEX-Design of Lexical Analyzer for a sample Language.

UNIT III: Syntax Analysis


UNIT IV : Syntax Directed Translation and Run Time Environment


UNIT V : Code Optimization and Code Generation


Books of Study

Books of References


OBJECTIVE: With the increase in the college graduation rates the competition for the job race is increasing exponentially. Failing at an interview can take a student a step behind. It is very important to create that lasting impression on the mind of the recruiter. The curriculum is meticulously structured to groom the students in way so that they can meet the three Cs – Competency, Compatibility and Chemistry – as expected by the corporate world.

UNIT I: Resume Writing
The difference between resume and CV, Types of resume, Inclusions in a resume, Technicalities of a resume.

UNIT II: Cover Letter
Resume Vs Cover Letter, Types of cover letter, Structure of cover letter, Content of cover letter

UNIT III: Business Writing
Four types of Business Writing: Instructional, Informational, Persuasive and Transactional

UNIT IV: Creating A Personal Brand
Creating a communication strategy based on:
Who are you?
What do you offer?
What makes you unique?

UNIT V: Practice Sessions and Assessments
SPECIALIZATION STREAMS

[Artificial Intelligence and Machine Learning]
Course Objectives:

This course provides an introduction to basic skill set required in this fast expanding field of machine learning. Students will learn relevant basics in machine learning such as regression, clustering and classification. In addition, this course introduces advanced Python programming as a standard and common language for machine learning. This course is proposed to meet a growing business needs of individuals skilled in artificial intelligence, data analytics, statistical programming and other software skills. The proposed course will combine theory and practice to enable the student to gain the necessary knowledge to compete in the ever changing work environment.

Course Outcomes:

1. Develop an appreciation for what is involved in learning models from data.
2. Understand a wide variety of learning algorithms.
3. Understand how to evaluate models generated from data.
4. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

UNIT I

UNIT II
Decision tree learning: Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning, Python exercise on Decision Tree.

Instance based Learning: K nearest neighbour, the Curse of Dimensionality, Feature Selection: forward search, backward search, univariate, multivariate feature selection approach, Feature reduction (Principal Component Analysis), Python exercise on kNN and PCA

Recommender System: Content based system, Collaborative filtering based

UNIT III
Probability and Bayes Learning: Bayesian Learning, Naïve Bayes, Python exercise on Naïve Bayes
Support Vector Machine: Introduction, the Dual formulation, Maximum margin with noise, nonlinear SVM and Kernel function, solution to dual problem, python exercise on SVM

UNIT IV
Artificial Neural Networks: Introduction, Biological motivation, ANN representation, appropriate problem for ANN learning, Perceptron, multilayer networks and the back propagation algorithm, python exercise on neural network
Introduction to Computational Learning Theory: Introduction, sample complexity, finite hypothesis space, VC dimension

UNIT V
Ensembles: Introduction, Bagging and boosting
Clustering: Introduction, K-mean clustering, agglomerative hierarchical clustering, Python exercise on k-mean clustering

Text Book

Reference Books
1. Introduction to Machine Learning Edition 2, by EthemAlpaydin

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<td>Principles of Soft Computing</td>
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Course Objectives:

Upon successful completion of the course, students will have an understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms. Provide the mathematical background for carrying out the optimization associated with neural network learning.

Course Outcome:
Upon completion of the course, the students are expected to

- To understand the fundamental theory and concepts of neural networks, identify different neural network architectures, algorithms, applications and their limitations
- Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
- Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
- Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
- Understand the Genetic Algorithm and able to identify the application area
- Reveal different applications of these models to solve engineering and other problems

UNIT - I

UNIT - II

UNIT - III
Fuzzy Logic : Fuzzy set theory: crisp sets, fuzzy sets, crisp relations, fuzzy relations, Fuzzy Systems: Crisp logic predicate logic, fuzzy logic, fuzzy Rule based system, Defuzzification Methods, Fuzzy rule based reasoning

UNIT - IV

UNIT - V
Hybrid Soft Computing Techniques Hybrid system, neural Networks, fuzzy logic and Genetic algorithms hybrids. Genetic Algorithm based Back propagation Networks: GA
based weight determination applications: Fuzzy logic controlled genetic Algorithms soft computing tools, Applications.

**Text Book:**

**Reference Book:**

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<td>Digital Image Processing</td>
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**Course Objective:**
- Develop an overview of the field of image processing.
- Understand the fundamental algorithms and how to implement them.
- Prepare to read the current image processing research literature.
- Gain experience in applying image processing algorithms to real problems.

**Course Outcome:**

**Students are able to**
- understand the need for digital image processing and various task involved in image processing pipeline.
- learn different techniques employed for the enhancement of images.
- learn different causes for image degradation and overview of image restoration techniques.
- understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.
- learn different feature extraction techniques for image analysis and recognition
- develop any image processing application.
- understand the rapid advances in Machine vision.

**UNIT – I**
Introduction: Digital Image fundamentals: Image sampling and quantization, relationship between pixels,

Image acquisition and Pre-processing: Intensity transformations and spatial filtering, some basic intensity transformation functions, Histogram processing, spatial filters for smoothing and sharpening

UNIT – II

Filtering in the Frequency Domain: basic filtering in the frequency domain, image smoothing and sharpening

Image Restoration: Image restoration/degradation model, noise models, restoration in the presence of noise only, estimating the degradation function

UNIT – III

Image segmentation: Fundamentals, point, line detection, basic edge detection techniques, Hough transform, Thresholding, basic global thresholding, optimal thresholding using Otsu’s method, multi-spectral thresholding, Region based segmentation, region growing, region splitting and merging.

UNIT – IV

Color Image Processing: color models, Color transformation
Image Compression: Fundamentals, Some basic compression methods

UNIT – V

Image Representation: Shape features (Region-based representation and descriptors), area, Euler’s number, eccentricity, elongatedness, rectangularity, direction, compactness, moments, convex hull, texture features, color features.
Object and Pattern Recognition: Pattern and pattern classes, Matching, minimum distance or nearest neighbor classifier, matching by correlation, Optimum statistical classifier, Neural network classifier.

Text Books:


Reference Books:
3. Computer Vision A modern approach, David A. Forsyth and Jeam Ponce, Pearson Education

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<td></td>
<td>Artificial Intelligence</td>
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Course Objective:

- To create understanding of both the achievements of AI and the theory underlying those achievements.
- To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems.
- To review the different stages of development of the AI field from human like behavior to Rational Agents.
- To impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
- To create an understanding of the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as minimal, resolution, etc. that play an important role in AI programs.
- To introduce advanced topics of AI such as planning, Bayes networks, natural language processing and Cognitive Computing.

Course Outcome:

- Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
- Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
- Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.
- Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
- Formulate and solve problems with uncertain information using Bayesian approaches.
- Apply concept Natural Language processing to problems leading to understanding of cognitive computing.

Unit-I

Introduction: What is Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents.
Unit-II
Search: Introduction to Search, Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, current-best-hypothesis search, least commitment search

Unit-III
Knowledge Representation and Reasoning: Inference, Propositional Logic, Predicate Logic (first order logic), Logical Reasoning, Forward &Backward Chaining, Resolution; AI languages and tools - Lisp, Prolog, CLIPS

Unit-IV

Unit-V
Learning:Overview of different forms of learning, decision trees, rule based learning, neural networks, reinforcement learning.
Game playing: Perfect decision game, imperfect decision game, evaluation function, minimax, alpha-beta pruning.

Text Books:
3. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson Education
SPECIALIZATION STREAMS

[Cyber Security]
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<td>Network Security</td>
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Unit-I:

Unit-II:

Unit-III:
Web Security Requirements, Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Electronic Transaction (SET), Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats.

Unit-IV:
Firewalls: Firewalls – Types, Comparison of Firewall Types, Firewall Configurations.

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<td></td>
<td>Mobile and Wireless Security</td>
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Course Objectives
1. Gaining factual knowledge (terminology, classifications, methods)
2. Understand the terminology and classification associated with wireless security.
3. Be familiar with current applications of wireless security networks and issues that might arise.
4. Describe the major software and hardware components and subcomponents used to secure mobile and wireless networks.
5. Be familiar with different wireless security protocols and algorithms for different mobile networks

UNIT I


UNIT II

Wireless and Mobile as a Cyber Physical Infrastructure (CPS), Denial of Service Attacks Cellular, WiFi, GPS, Implications to CPS: e.g., Electricity grid, Internet of Things

UNIT III

Security of Mobile Computing Platforms, Android and iOS security models, Threats and emerging solutions (e.g., side channel attacks)

UNIT IV


Course Outcome:

The students will be able to:

- understand the main security goals and adversarial models of wireless and mobile networks;
- gain a broad knowledge regarding real-world security architectures of WLANs, GSM/UMTS, WSNs, RFIDs, etc.;
- be able to reason about wireless security protocols and protection techniques, discuss proposed solutions and their limitations;
- have an overview of the recent advances regarding lightweight authentication, key management for wireless networks, secure localization, and wireless device pairing.

References:

Course Objective:

The broad objective of this course is to understand - (i) the architecture and principles of today's Internetworking of computer Networks (ii) the protocols and their functionalities, (iii) the requirements for the future Internet and its impact on the computer network architecture.

Unit I

Unit II

Unit III
Data Traffic, Congestion, Congestion Control, Congestion Control in TCP, Congestion Control in Frame Relay, Source Based Congestion Avoidance, DEC Bit Scheme, Quality of Service, Techniques to Improve QOS: Scheduling, Traffic Shaping, Admission Control, Resource Reservation, Integrated Services and Differentiated Services.

Unit IV
Concepts of Buffer Management, Drop Tail, Drop Front, Random Drop, Passive Buffer Management Schemes, Drawbacks of PQM, Active Queue Management: Early Random Drop, RED Algorithm.

Course Outcomes

Upon completion of this course students will be able to:

To understand the fundamentals of organisational interconnectivity, Internet technologies, and to relate them to a business environment. Recognise common Internet communication protocols and describe the services associated with them. Demonstrate understanding of manager role in developing a communication infrastructure.
References:


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<td>Introduction to Cryptography</td>
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Course Objective:

1. To introduce fundamental concepts of symmetric cipher models and asymmetric cipher models.
2. To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3. To understand how to deploy encryption techniques to secure data in transit across data networks
4. To understand the various key distribution and management schemes.

Expected Outcome:

The Students will be able to:

1. summarize different classical encryption techniques
2. identify mathematical concepts for different cryptographic algorithms
3. demonstrate cryptographic algorithms for encryption/key exchange
4. summarize different authentication schemes
5. demonstrate various digital signature schemes

UNIT I


UNIT II
Block ciphers, Attacks on block ciphers, Block Cipher Principles, The Data Encryption Standard (DES), Block Cipher Design Principles, Block cipher modes of operation, The Euclidean Algorithm, Finite Fields of the Form GF(2^n), Advanced Encryption Standard (AES), Stream Ciphers, RC4.

UNIT III

UNIT IV
Cryptographic Hash Functions, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3.

References:
3. Handbook of Applied Cryptography by A. Menezes, P. Van Oorschot, S. Vanstone
SPECIALIZATION STREAMS

[Data Science]
Introduction to Data Science | E | 3 | 0 | 2 | 4

**Course Objective:** This course will introduce the rapidly growing field of data science and equip the students with some of its basic principles and tools as well as its general mind-set.

**Course Description:** Data Science is the study of the generalizable extraction of knowledge from data. Being a data scientist requires an integrated skill set spanning mathematics, statistics, machine learning, databases and other branches of computer science. Students will learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration, exploratory data analysis, predictive modeling, descriptive modeling, data product creation, evaluation, and effective communication. The focus in the treatment of these topics will be on breadth, rather than depth, and emphasis will be placed on integration and synthesis of concepts and their application to solving problems. To make the learning contextual, real datasets from a variety of disciplines will be used. As prerequisites, students are expected to have basic knowledge of algorithms and reasonable programming experience and some familiarity with basic linear algebra and basic probability and statistics.

**Course outcome:** At the conclusion of the course, students should be able to:
- Describe what Data Science is and the skill sets needed to be a data scientist.
- Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.
- Use R to carry out basic statistical modeling and analysis.
- Explain the significance of exploratory data analysis (EDA) in data science. Apply basic tools (plots, graphs, summary statistics) to carry out EDA.
- Describe the Data Science Process and how its components interact.
- Use APIs and other tools to scrap the Web and collect data.
- Apply EDA and the Data Science process in a case study.
- Apply basic machine learning algorithms (Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes) for predictive modeling. Explain why Linear Regression and k-NN are poor choices for Filtering Spam. Explain why Naive Bayes is a better alternative.
- Identify common approaches used for Feature Generation. Identify basic Feature Selection algorithms (Filters, Wrappers, Decision Trees, Random Forests) and use in applications.

- Identify and explain fundamental mathematical and algorithmic ingredients that constitute a Recommendation Engine (dimensionality reduction, singular value
decomposition, principal component analysis). Build their own recommendation system using existing components.

- Create effective visualization of given data (to communicate or persuade).
- Work effectively (and synergically) in teams on data science projects.
- Reason around ethical and privacy issues in data science conduct and apply ethical practices.

UNIT I
Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R

UNIT II
Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: RealDirect (online real estate firm) - Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means

UNIT III
One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web - Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests

UNIT IV

UNIT V
Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex
dataset - Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists

**Books and Reference:**

6. Avrim Blum, John Hopcroft and Ravindran Kannan. *Foundations of Data Science*. (Note: this is a book currently being written by the three authors. The authors have made the first draft of their notes for the book available online. The material is intended for a modern theoretical course in computer science.)

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<td></td>
<td>Big Data</td>
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**Course Objectives:** The main goal of this course is to help students learn, understand, and practice big data analytics and machine learning approaches, which include the study of modern computing big data technologies and scaling up machine learning techniques focusing on industry applications. Mainly the course objectives are: conceptualization and summarization of big data and machine learning, trivial data versus big data, big data computing technologies, machine learning techniques, and scaling up machine learning approaches.

**Course Outcomes:**

- Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications.
- Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
● Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.
● Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
● Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
● Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies like hadoop and mapreduce.

UNIT I
Big Data introduction - Big data: definition and taxonomy - Big data value for the enterprise - Setting up the demo environment - First steps with the Hadoop “ecosystem” – Exercise- The Hadoop ecosystem - Introduction to Hadoop - Hadoop components: MapReduce/Pig/Hive/HBase - Loading data into Hadoop - Handling files in Hadoop - Getting data from Hadoop Exercises – Exercise

UNIT II
Querying big data with Hive - Introduction to the SQL Language - From SQL to HiveQL – Exercises

UNIT III
Querying big data with Hive - Introduction to HIVE e HIVEQL - Using Hive to query Hadoop files - Exercises

UNIT IV

UNIT V:
Big data and Machine learning - Big Data & Machine Learning (continued) - Next steps in the big data world Exercises - A case study- Software used : Apache Hadoop

Reference:
1. Big Data and Hadoop- Learn by Example Paperback – Import, 1 Jan 2018 by Mayank Bhushan (Author)
2. Data Analytics Made Accessible, by A. Maheshwari
3. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die by E. Siegel
UNIT I
Linear Regression: introduction, Linear regression, Python exercise on linear regression

UNIT II
Decision tree learning: Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning, Python exercise on Decision Tree
Instance based Learning: K nearest neighbour, the Curse of Dimensionality, Feature Selection: forward search, backward search, univariate, multivariate feature selection approach, Feature reduction (Principal Component Analysis), Python exercise on kNN and PCA
Recommender System: Content based system, Collaborative filtering based

UNIT III
Probability and Bayes Learning: Bayesian Learning, Naïve Bayes, Python exercise on Naïve Bayes
Support Vector Machine: Introduction, the Dual formulation, Maximum margin with noise, nonlinear SVM and Kernel function, solution to dual problem, python exercise on SVM

UNIT IV
Artificial Neural Networks: Introduction, Biological motivation, ANN representation, appropriate problem for ANN learning, Perceptron, multilayer networks and the back propagation algorithm, python exercise on neural network
Introduction to Computational Learning Theory: Introduction, sample complexity, finite hypothesis space, VC dimension

UNIT V
Ensembles: Introduction, Bagging and boosting
Clustering: Introduction, K-mean clustering, agglomerative hierarchical clustering, Python exercise on k-mean clustering

Text Book

Reference Books
1. Introduction to Machine Learning Edition 2, by EthemAlpaydin

SUBJECT CODE | SUBJECT TITLE | CORE/ELECTIVE | CREDITS | L | T | P | C
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Inference and Representation | E | 3 | 0 | 2 | 4

Course Objectives:
1. Course covers how to think about, formulate, and model data.
2. Introduces the tools of probabilistic graphical models as a means of representing and manipulating data, modeling uncertainty, and discovering new insights from data.
3. Will particularly emphasize latent variable models, examples of which include latent Dirichlet allocation (for topic modeling), factor analysis, and Gaussian processes.
4. Will also discuss modelling temporal data (e.g., hidden Markov models), hierarchical models, deep generative models, and structured prediction.

Course Outcomes:
Upon completion of the course, the students are expected to:

1. Take a new problem or data set, formulate an appropriate model, learn the model from data.
2. Answer their original question using inference in the model.

UNIT – I
Introduction- Bayesian networks- Probability review - Bayesian network basics-Probabilistic Programming and Bayesian Methods - Algorithm for d-separation-PyMC3 tutorial – Introduction to Probabilistic Topic Models - Probabilistic modelling in neuroscience - political science - Review of case studies and BN structure learning -
Undirected graphical models - Conditional random fields, Gaussian MRFs Case study: Astronomy (Dan Foreman-Mackey)- Some subtleties on BNs, MRF review, CRF introduction

UNIT II

Exact inference - Variable elimination, treewidth, belief propagation Graph separation in MRFs, revisiting CRFs, BP, pruning barren nodes - Unsupervised learning Expectation Maximization Case study - Monte-Carlo methods - Gibbs sampling - Causal inference & Bayesian additive regression trees

UNIT III


UNIT IV

Variational inference - Mean-field approximation - Graphical models, exponential families, and variational inference - Learning deep generative models - Stochastic variational inference, Variational auto-encoder - Structured prediction - Overview of structured prediction, parameterizing CRFs - Integer linear programming - MAP inference, linear programming relaxations, dual decomposition - Derivation relating dual decomposition & LP relaxations - Integer Programming for Bayesian Network Structure Learning

References

1. Kevin Murphy, Machine Learning: a Probabilistic Perspective, MIT Press, 2012. You can read this online for free from NYU Libraries. We recommend the latest (4th) printing, as earlier editions had many typos. You can tell which printing you have as follows: check the inside cover, below the “Library of Congress” information. If it says “10 9 8 ... 4” you’ve got the (correct) fourth print.
3. Mike Jordan’s notes on Probabilistic Graphical Models
4. MIT lecture notes on algorithms for inference.
5. Probabilistic Programming and Bayesian Methods for Hackers by Cam Davidson Pilon
7. David Barber, Bayesian Reasoning and Machine Learning, Cambridge University Press, 2012. (Can be downloaded as PDF file.)
GENERAL COMPUTER SCIENCE ELECTIVES
UNIT-I: Fundamentals of Digital Image Processing

UNIT-II: Image Enhancement
Introduction to image enhancement- Gray level transformations –Histogram processing –Enhancement using arithmetic and logic operations - Introduction to Spatial filtering - Smoothing spatial filters - Sharpening spatial filters-Image enhancement in the frequency domain- Smoothing and sharpening in frequency domain.

UNIT-III: Image Segmentation
Introduction to image segmentation - Applications of image segmentation - Point detection - Line detection - Edge detection techniques - Edge linking and boundary detection - Image thresholding for segmentation - Region growing segmentation - Region splitting and merging approach for segmentation

UNIT-IV: Morphological Image Processing
Erosion- Dilation - Opening- Closing - Hit or miss transform - Boundary extraction - Region filling algorithm – Thinning – Thickening – Skeletonization - Morphological reconstruction

UNIT-V: Image Compression

TextBook:

References:
COURSE OBJECTIVES:

The course objectives of the data and web mining course are given below:

- Discuss the need for data mining
- Discuss various stages in data mining process
- Learn about various data mining algorithms and its application domain
- Learn about web mining in detail and the need for web mining
- Discuss the use of web mining in social network analysis.

LEARNING OUT COMES:

- Identify appropriate data mining algorithms to solve the given real-world problems
- Compare and evaluate different data mining techniques like classification, prediction, clustering, association rule mining, etc.
- Know the basics of web crawling, web-page pre-processing and page ranking which will help to design and develop strategies in this domain
- Acquire data from social networking websites and they can analyze it for efficient recommendation purpose.

Unit I:


Unit II:

Data preprocessing: Data cleaning, Data transformation, Data reduction. Data mining knowledge representation, Attribute-oriented analysis. Data mining algorithms: Association rules: Motivation and terminology, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis.

Unit III:

Data mining algorithms: Classification, Basic learning/mining tasks, Inferring rudimentary rules: 1R algorithm, Decision trees, Covering rules. Data mining
algorithms: Prediction, The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), Linear models.

Unit IV:

Web crawling: Basic crawler algorithm, Focused crawlers, Topical crawlers, Web search: Web page pre-processing, Inverted index, HITS algorithm, Page ranking algorithm, Leadership algorithm,

Unit V:

Social network analysis: Co-citation and bibliographic coupling, Community discovery. Web usage mining: Recommender systems. Mining Twitter, Mining Face book, Mining Instagram.

Text books

2. Introduction to Data Mining, Vipinkumar, Michael Steinbach, Pang-Ning Tan, Person publications, 2016
3. Mining the Web, SoumenChakrabarti, Elseier publications, 2002

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<td>Natural Language Processing</td>
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COURSE OBJECTIVES:

The basic objectives of natural language processing course are the following:

- Learn the basics of natural language processing and understand various steps in it.
- To introduce the fundamentals of language processing from the algorithmic viewpoint.
- To discuss various issues that make natural language processing a hard task.
- To discuss some well-known applications of natural language processing
LEARNING OUTCOMES:

At the end of the course, the student should be able to:

- Appreciate the fundamental concepts of natural language processing.
- Design algorithms for natural language processing tasks.
- Develop useful systems for language processing and related tasks involving text processing.

UNIT I: Introduction


UNIT II: Word Level and Syntactic Analysis


UNIT III: Semantic Analysis and Discourse Processing


UNIT IV: Natural Language Generation and Machine Translation


UNIT V: Information Retrieval and Lexical Resources

Text Books:


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<td></td>
<td>Human Computer Interaction</td>
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COURSE OBJECTIVES:

The course objectives of the human computer interaction (HCI) course are as follows:

- Discuss the capabilities of both humans and computers from the viewpoint of human information processing.
- Demonstrate typical HCI models, styles and various historic HCI paradigms.
- Apply an interactive design process and universal design principles to designing HCI systems.
- Illustrate and utilize HCI design principles, standards and guidelines.
- Analyze and identify user models, user support, socio-organizational issues and stakeholder requirements of HCI systems.
- Discuss tasks and dialogues of relevant HCI systems based on task analysis and dialogue design.

LEARNING OUTCOMES:

After completion of this course, the student will be able to:
• Identify the user requirements for HCI and challenges
• Apply the theories and principles to design new Interface concepts
• Design and development of HCI interfaces for mobile applications and web interfaces

UNIT I : Foundations of HCI


UNIT II: Design and Software Process


UNIT III : Models and Theories

Cognitive models –Socio-Organizational issues and stake holder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT IV: Mobile HCI


UNIT V: Web Interface Design


Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, ”Human Computer Interaction”, Pearson Education.

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<td>Advanced Computer Architecture</td>
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Course objective: This course provides an introduction to the hardware side of high-performance computing, which became a necessary knowledge to fully exploit the performance of not only the high-end supercomputers, but general PCs, in the last decades.

Course outcome: Students will be able to understand the key issues to enhance, limit, or degrade the performance of modern computers, so that they can immediately apply this set of knowledge to improve the efficiency of their own program codes.

UNIT I: Instruction Level Parallelism
ILP – Concepts and challenges – Hardware and software approaches – Dynamic scheduling – Speculation - Compiler techniques for exposing ILP – Branch prediction.

UNIT II: Multiple Issue Processors
VLIW & EPIC – Advanced compiler support – Hardware support for exposing parallelism– Hardware versus software speculation mechanisms – IA 64 and Itanium processors–Limits on ILP.

UNIT III: Multiprocessors and Thread Level Parallelism

UNIT IV: Memory and I/O

UNIT V: Multi-Core Architectures

Text Book:

References:

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<td>Distributed Operating Systems</td>
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**Course Objective:**

1. To understand the concepts that underlie distributed computing systems along with design and implementation issues.
2. To study the key mechanisms and models for distributed systems.

**Expected Outcome:**

The Students will be able to:

1. Demonstrate various architectural models and design issues in distributed systems.
2. Illustrate various time services in distributed systems.
3. Explain different concurrent programming languages.
4. Identify various Inter Process Communication techniques.
5. Compare distributed scheduling algorithms.

**UNIT I**

Fundamentals: What is distributed operating system, issues in designing distributed operating system, Computer networks: Lan, WAN technologies, communication protocols, internetworking, Message passing: Issues in IPC by message passing, synchronization, buffering group communication, case study.

**UNIT II**

Remote procedure calls: The RPC model, Implementing RPC, RPCs in heterogeneous environment, lightweight RPC, case study. Distributed shared memory: General architecture of DSM systems, Design and implementation issues of DSM, Consistency models, Replacement strategies, Advantages of DSM.

**UNIT III**

UNIT IV
Distributed File system: Desirable features of a good DFS, file models, file accessing models, file sharing semantics, file caching schemes, file replication, fault tolerance, atomic transactions, Design principles, Case study: Google DFS and Hadoop DFS.

UNIT V
Naming: Desirable features of a good naming system, system oriented names, object locating mechanisms, human oriented names, name caches, naming and security.
Security: potential attacks, cryptography, authentication, access control, digital signatures, design principles.

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<td>Fog Computing</td>
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Course Objectives:

1. To understand the limitations of today’s Cloud computing models which are not designed for the volume, variety, and velocity of data generated by billions of IoT devices.
2. To understand the Fog Computing architecture and business model that address the challenges of resource management and optimization.
3. To analyse the requirements of Fog Computing model for handling IoT data: minimizing latency, conserving bandwidth, and data movement across geo-locations.
4. To familiarize with Fog applications that monitor real-time data from network-connected things and initiating action involving machine-to-machine (M2M) communication.
5. To understand how developers, write IoT applications for Fog Computing nodes that are closest to the network edge and ingest the data from IoT devices.
6. To understand how Fog Nodes, extend the Cloud to the Network Edge through the Case studies for Response time, Data storage time, coverage area, and kinds of applications.

Course Outcomes:

Upon completion of the course, the students are expected to:

1. Demonstrate various architectural models and design issues in Fog Computing.
2. Identify and mitigate Resource management and optimization challenges of Fog Computing model.
3. Learn and apply various Fog+IoT Programming paradigms and Fog+Edge Middleware.
4. Develop useful applications with examples: Smart Building, Predictive Analysis with FogTorch, and application of ML Techniques for defending IoT Devices, etc.
5. Will gain hands on experience with three Case studies for real-life Fog applications.

Unit I. Fog Computing


Unit II: Addressing the Challenges in Fog Resources


Unit III: Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds


Unit IV: Data Management and Analysis in Fog Computing


Unit V: Case Studies

Reference book:

2. Fog computing in the Internet of Things: Springer publications, 2018

(Other reference: Research papers from IEEE, ACM, Springer and Elsevier)

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<td>Parallel Algorithms</td>
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Course Objectives:
The course provides a modern introduction to design, analysis and implementation of sequential and parallel algorithms. In particular, the course is based on a pragmatic approach to parallel programming of message-passing algorithms through the C language and the MPI library. This course introduces critical methods and techniques related to parallel computing. Particularly, the course focuses on hardware, algorithms, and programming of parallel systems, providing students a complete picture to understand pervasive parallel computing.

Course Outcomes:
- An ability to apply knowledge of computing and mathematics appropriate to the discipline.
- An ability to analyze a problem and identify the computing requirements appropriate for its solution; an ability to design, implement and evaluate a computer-based system, process, component or program to meet desired needs.
- An ability to apply mathematical foundations, algorithmic principles and computer science theory to the modeling and design of computer based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- An ability to apply design and development principles in the construction of software systems of varying complexity.
- An ability to function effectively as a member of a team in order to accomplish a common goal.

UNIT I
Sequential model, need of alternative model, parallel computational 8 models such as PRAM, LMCC, Hypercube, Cube Connected Cycle, Butterfly, Perfect Shuffle Computers, Tree
model, Pyramid model, Fully Connected model, PRAM-CREW, EREW models, simulation of one model from another one.

UNIT II
Performance Measures of Parallel Algorithms, speed-up and 8 efficiency of PA, Cost- optimality, An example of illustrate Cost- optimal algorithms- such as summation, Min/Max on various models.

UNIT III
Parallel Sorting Networks, Parallel Merging Algorithms on on 8 CREW/EREW/MCC, Parallel Sorting Networks CREW/EREW/MCC/, linear array.

UNIT IV
Parallel Searching Algorithm, Kth element, Kth element in X+Y on 8 PRAM, Parallel Matrix Transportation and Multiplication Algorithm on PRAM, MCC, Vector-Matrix Multiplication, Solution of Linear Equation, Root finding.

UNIT V
Graph Algorithms - Connected Graphs, search and traversal, 8 Combinatorial Algorithms- Permutation, Combinations, Derrangements.

Text Books:
UNIT I
Introduction to Web Services - fundamental of web services, basic operational model of web services, Business motivations for web services, B2B, B2C, Technical motivations, basic steps of implementing web services, benefits and challenges of using web services, tools and technologies enabling web services, Web services Architecture and its characteristics, web services communication models, core building blocks of web services, web services technology stack.

UNIT II
Service-oriented Architecture (SOA), implementation view, logical view, process view, deployment view, composition of web services, from application server to peer to peer, life in the runtime. Fundamentals of SOAP-SOAP Message Structure, SOAP encoding, Encoding of different data types, SOAP communication and messaging, SOAP message exchange models, limitations of SOAP.

UNIT III

UNIT IV
Discovering Web Services, service discovery mechanisms, role of service discovery in a SQA, UDDI-UDDI registries, uses of UDDI Registry, UDDI data structures, Programming with UDDI, Publishing, searching and deleting information in a UDDI Registry, Publishing API, limitations of UDDI.

UNIT V

Text Book
1. Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh, Wiley India.

Reference Books:

1. Java Web Service Architecture, James McGovern, Sameer Tyagi etal., Elsevier
3. Java Web Services, D.A. Chappell & T. Jewell, O'Reilly,SPD.

Outcomes

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<td>Advanced Database Management Systems</td>
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UNIT I
Significance of Databases, Advantages and Disadvantages of different Database Management systems, Database System Applications, Comparison between DBMS, RDBMS, Distributed and Centralized Database. DCL Commands: Grant and Revoke, Transactional Control: Commit, Rollback, Save point
Types of locks: Deadlock, Shared lock, Exclusive lock, Table level locks, Row level locks

UNIT II
Synonym: Create synonym, Sequences: Create and alter sequences, Index: Unique and composite, Views: Create/Replace, Update and alter views.

UNIT III
Basics of Normalization, Normal Forms: First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), BCNF.

UNIT IV
Fundamentals of Database Triggers, Creating Triggers, Types of Triggers: Before, after for each row, for each statement.
Lossy Decomposition, Dependency-Preserving Decomposition, Lossless join decomposition.

UNIT V
Transaction processing: Introduction of transaction processing, advantages and disadvantages of transaction processing system, serializability and recoverability, view serializability, long duration transaction, high-performance transaction system, online transaction processing system, distributed locking, transaction management in multi-database system, resolving deadlock.

Text Books:

Reference Books:
1. K. V. Iyer, Lecture notes available as PDF file for classroom use.

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<td>Complexity Theory</td>
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Course Objectives:
The complexity of a problem describes whether the problem can be solved using algorithms, and how much resources (in form of time and space) it takes to solve a problem algorithmically. The course studies problems that cannot be solved and problems for which it is difficult to design efficient algorithms. We see how we can recognize such hard problems. The course gives a precise definition of what an algorithms is via Turing machines. The main focus is on central complexity classes, in particular NP-complete problems.

Course Outcomes:
- Understands what an algorithm is, and which problems that be solved by an algorithm.
- Understands the relationship between formal languages and Turing machines.
- Knows about various complexity classes and the relationship between them
- Recognize problems that cannot be solved computationally, and recognize NP-hard problems.
- Prove the NP-completeness of some of the most basic hard problems.
- Perform polynomial-time reductions
The student can recognize computationally hard problems, and contribute to research on classification of new problems as tractable or intractable.

UNIT I: Computability:

UNIT II: Time Complexity

UNIT III: Space Complexity
Space as a resource. PSPACE, L and NL. Reachability Problem, Completeness results. Savitch's theorem, Inductive Counting to show Immerman-Szelepscenyi theorem. Reachability Problems, Expander Graphs, SL=L

UNIT IV: Complexity of Counting & Randomization
Counting Problems. Theory of #P-completeness. The complexity classes PP, ParityP, BPP, RP, BPP is in P/poly, Toda's theorem.

Text Books:
1. Automata and Computability - Dexter Kozen
2. Theory of Computation - Dexter Kozen
3. Theory of Computational Complexity - Du and Ko - (Reviews), (Errata)

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<td>Computer Graphics and Multimedia</td>
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UNIT I
Overview of Graphics System: Video Display Units, Raster-Scan and Random Scan Systems, Graphics Input and Output Devices.
UNIT II
Two Dimensional Geometric Transformation: Basic Transformation (Translation, rotation, Scaling) Matrix Representation, Composite Transformations, Reflection, Shear, Transformation between coordinate systems.
Two Dimensional Viewing: Window-to- View port Coordinate Transformation.

UNIT III
Line Clipping (Cohen-Sutherland Algorithm) and Polygon Clipping (Sutherland-Hodgeman Algorithm).
Aliasing and Antialiasing, Half toning, Thresholding and Dithering, Scan conversion of Character.
Polygon Filling: Seed Fill Algorithm, Scan line Algorithm.
Two Dimensional Object Representation: Spline Representation, Bezier Curves and B-Spline Curves.

UNIT IV
Fractal Geometry: Fractal Classification and Fractal Dimension.
Three Dimensional Geometric and Modeling Transformations: Translation Rotation, Scaling, Reflections, shear, Composite Transformation.
Projections: Parallel Projection and Perspective Projection.

UNIT V
Illumination Models: Basic Models, Displaying Light Intensities.
Surface Rendering Methods: Polygon Rendering Methods: Gouraud Shading and Phong Shading.
Computer Animation: Types of Animation, Key frame Vs. Procedural Animation, methods of controlling Animation, Morphing.

Textbook:

Reference Books :
UNIT I
Advanced Data Structures: Importance and need of good data structures and algorithms Heaps, AVL Trees (Search, Insertion, Deletion) Red-Black Trees (Search, Insertion and Deletion), Splay Trees (Search, Insertion and Deletion), B-trees, B+ Trees (Search, Insertion and Deletion), Fibonacci heaps, Data Structures for Disjoint Sets, Augmented Data Structures

UNIT II
Algorithms Complexity and Analysis: Probabilistic Analysis with example, Amortized Analysis with example, Competitive Analysis with example, Internal and External Sorting algorithms like external merge sort, distribution sorts.

UNIT III

UNIT IV
Approximation algorithms: Need of approximation algorithms: Introduction to P, NP, NP-Hard and NP-Complete; Deterministic, non-Deterministic Polynomial time algorithms; Knapsack, TSP, Set Cover Problems.

UNIT V
Randomized algorithms: Introduction, Type of Randomized Algorithms, Quick Sort, Min-Cut, 2-SAT; Game Theoretic Techniques, Random Walks.

Text Books:

Reference Books:
MINOR PROGRAMME

CSE Dept. offers Minor in Computer Science and curriculum is given below.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Subject Name</th>
<th>L-T-P</th>
<th>Credit</th>
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<tbody>
<tr>
<td>1</td>
<td>Object oriented programming with Java</td>
<td>3-0-2</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Algorithm Analysis and Design</td>
<td>3-0-2</td>
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<tr>
<td>3</td>
<td>Web Technology</td>
<td>3-0-2</td>
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<tr>
<td>4</td>
<td>Database Management Systems</td>
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<tr>
<td>5</td>
<td>Software Engineering</td>
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