

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

Department of Computer Science Engineering
SRM University-AP

Semester I

CODE	COURSE NAME	CREDIT	L - T - P
COM101 (HS)	Introduction to Communication	3	3-0-0
ECO122 (HS)	Principle of Economics	3	3-0-0
BIO101 (BS)	Introduction to Biology	4	2-0-2
CHE101 (BS)	Principle of Chemistry	4	2-0-2
MAT141 (BS)	Discrete Mathematics	3	3-0-0
CSE 101 (ES)	Introduction to Computer Science and Programming	5	3-0-4
	Total	22	16-0-8

Semester II

CODE	COURSE NAME	CREDIT	L - T - P
EGL101 (HS)	English	3	3-0-0
ECO221 (HS)	Economics and E-commerce	3	3-0-0
MAT111 (BS)	Single-variable calculus	3	3-0-0
PHY111 (BS)	Introduction to Classical Mechanics	4	3-0-2
ENG111 (ES)	Basic Electronics	4	3-0-2
CSE103 (ES)	Introduction to Electrical Engineering and Computer Science	4	2-0-2
CDC1002 (HS)	Soft Skill 1	1	1-0-1
	Total	22	18-0-7

Semester III

CODE	COURSE NAME	CREDIT	L - T - P
MAT 211 (BS)	Linear Algebra and Differential equations	3	3-0-0
ENV 111 (HS)	Environmental Science	3	2-0-2
ENG 101 (ES)	Engineering Fundamentals	3	3-0-0
PHY 112 (BS)	Introduction to Electricity and Magnetism	3	2-0-2
CSE 223 (ES)	Data Structures and Algorithms using C	4	3-0-2
CSE 221 (ES)	Digital Systems Design	4	3-0-2
CDC 211 (HS)	Soft Skill 2	1	1-0-0
	Total	21	17-0-8

Semester IV

CODE	COURSE NAME	CREDIT	L - T - P
MAT 121 (BS)	Multi Variable Calculus	3	3-0-0
ENG 211 (BS)	Signals and Systems	3	3-0-0
CSE 234 (ES)	Algorithm Analysis and Design	4	3-0-2
CSE 235 (ES)	Computer Organization and Architecture	4	3-1-2
CSE 236 (ES)	Object Oriented Programming	4	3-0-2
CDC 212 (HS)	Soft Skill 3	1	1-0-0
	Total	19	16-0-6

Semester V

CODE	COURSE NAME	CREDIT	L - T - P
MAT 221(BS)	Probability and Statistics	3	3-0-0
CSE 301(ES)	Operating Systems	4	3-0-2
CSE 302(ES)	Formal Languages and Automata Theory	3	3-0-0
CSE 303(ES)	Computer Networks	4	3-0-2
CSE 311/ CSE 312 (CE)	CS Stream Elective 1	4	3-0-2
CDC 301(HS)	Soft Skill 4	P/F	1-0-0
PRJ 100	Project Internship	2	0-0-2
	Total	20	16-0-8

Semester VI

CODE	COURSE NAME	CREDIT	L - T - P
CSE 304 (ES)	Database Management Systems	4	3-0-2
MAT 131(BS)	Differential Equations	3	3-0-0
CSE 305(ES)	Software Engineering	4	3-0-2
CSE 313/ CSE 314/ CSE 315 (CE)	CS Stream Elective 2	4	3-0-2
CSE 306(ES)	Compiler Design	4	3-0-2
CSE 340(PR)	UROP	3	0-0-6
CDC 302(HS)	Soft Skill 5	P/F	1-0-0
	Total	22	16-0-14

Semester VII

CODE	COURSE NAME	CREDIT	L - T - P
CSE 410/ CSE 411/ CSE 412 (CE)	CS Stream Elective 3	4	3-0-2
CSE 321/322/323 (TE)	CS Technical Elective – 1	4	3-0-2
OE	Open Elective 1	3	3-0-0
OE	Open Elective 2	3	3-0-0
CSE 460	Capstone Project Phase I	6	0-0-12
		20	12-0-16

Semester VIII

CODE	COURSE NAME	CREDIT	L - T - P
CSE 413/ CSE 414/ CSE 415 (CE)	CS Stream Elective – 4	4	3-0-2
CSE 421/.../429 (TE)	CS Technical Elective 2	4	3-0-2
OE	Open Elective 3	3	3-0-0
CSE 461	Capstone Project Phase II	6	0-0-12
		17	9-0-16

List of Stream Electives

Artificial Intelligence and Machine Learning Stream

CSE 311	Introduction to Machine Learning
CSE 314	Digital Image Processing
CSE 410	Principles of Soft Computing
CSE 413	Artificial Intelligence

Cyber Security Stream

CSE 312	Introduction to Cryptography
CSE 315	Network Security
CSE 411	Mobile and Wireless Security
CSE 414	Internet Protocols and Networking

Data Science Stream

CSE 311	Introduction to Machine Learning
CSE 313	Introduction to Data Science
CSE 412	Introduction to Big Data
CSE 415	Inference and Representation

List of Technical Electives

1. CSE 321 Data and Web Mining
2. CSE 322 Complexity Theory
3. CSE 323 Advanced Computer Architecture
4. CSE 421 Natural Language Processing
5. CSE 422 Human Computer Interaction
6. CSE 423 Distributed Operating Systems
7. CSE 424 Fog Computing
8. CSE 425 Parallel Algorithms
9. CSE 426 Web Services
10. CSE 427 Advanced Database Management Systems
11. CSE 428 Computer Graphics and Multimedia
12. CSE 429 Advanced Data Structures and Algorithms

SEMESTER I

SEMESTER – I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
COM 101	Introduction to Communication	C	3	0	0	3

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

1. Communication: Principles for a Lifetime. Beebe, Beebe and Ivy, 6th Edition, Pearson Publishing.

Books of Reference

1. Qualitative Communication Research Methods (2011) Bryan C. Taylor and Thomas R. Lindlof. Sage Publications, New Delhi, India, 3rd Edition.
2. The Fundamentals of Small Group Communication (2008) Scott A. Myers and Carolyn M. Anderson. Sage Publications, New Delhi, India.

SEMESTER – I

SUBJECT CODE	SUBJECT TITLE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
ECO 122	Principles of Economics	Elective	3	0	0	3

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:

1. Principles of microeconomics, N. Gregory Mankiw, Publisher: Cengage Learning 5th edition.
2. Macroeconomics, Oliver Blanchard and David R Johnson, Publisher: Pearson; 6th edition.

Books of reference:

1. Intermediate Microeconomics: A Modern Approach, Hal R. Varian, Affiliated East-West Press Pvt. Ltd., 8th edition.
2. Principles of Macroeconomics with CourseMate, N. Gregory Mankiw, Cengage India, 6th edition.

SEMESTER - I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
BIO 101	Introduction to Biology	C	2	0	2	4

UNIT I: Basic Cell Biology

Cells: Cell theory, prokaryotes and eukaryotes, cell structure, composition and function, cellular organelles. Biomolecules: carbohydrates and lipids.

Cellular energy: ATP, Cellular transport: pumps, channels and transporters.

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

Nucleic acids, DNA: structure and function, RNA: types, structure and function. Flow of genetic information: replication, transcription and translation. Regulation of gene expression. Molecular biology tools: recombinant DNA (rDNA) technology and DNA sequencing.

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.
2. Exploring Proteins, Ed. 1, 2014, Price and Nairn, Oxford University Press.
3. Thrives in Cell Biology, Ed. 1, 2013, Qiuyu Wang, Cris Smith and Davis, Oxford University Press.
4. Metallic Nanocrystallites and their Interaction with Microbial Systems, Ed. 1, 2012, Anil K. Suresh, Springer Netherlands.

Books of References

1. The cell: a molecular approach. Cooper, G. M., Hausman, R. E. (2009). ASM Press, Washington D. C.

- Lehninger principles of biochemistry. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2000), Worth Publishers, New York.
- Principle and techniques of biochemistry and molecular biology, Wilson, K., Walker, J. (2005). 6th edn. Cambridge University Press, Cambridge.
- Kuby Immunology, Ed. 5, 2006, Kindt, Goldsby and Osborn, W. H Freeman & Co (Sd).
- Molecular Cell Biology, Ed. 8, 2016, Harvey Lodish, Arnold Berk and Chris A. Kaiser, W. H Freeman & Co (Sd).
- Microbial Biotechnology: Principles and Applications, Ed. 1, 2006, Yuan Kun Lee, World Scientific Publishing Co Pt. Ltd.

SEMESTER - I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CHE 101	Principles of Chemistry	C	2	0	2	4

Unit I: Chemical Bonding

Ionic, covalent, and metallic bonds. Theories of bonding: Valence bond theory, nature of covalent bond, sigma (σ) bond, Pi (π) bond. Hybridization: Types of hybridization, sp, sp², sp³, sp³d, d²sp³. Shapes of molecules (VSEPR Theory): BeCl₂, CO₂, BF₃, H₂O, NH₃, CH₄, PCl₅, XeF₂, SF₆, XeF₄. Molecular orbital theory: Linear combination of atomic orbitals (LCAO Method), bond order, homo- (H₂, O₂, N₂) and heteronuclear diatomic Molecules (NO, CO). Non-covalent interactions: Van der Waals interactions, dipole-dipole interactions, and hydrogen 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

Standards for drinking water. Methods of Treatment of water for domestic and industrial purposes: Sedimentation, Coagulation, Filtration, Sterilization, Break point chlorination. Determination of Hardness of water by EDTA method. Demineralization of water. Softening of water: Lime-soda Process, Ion exchange process, Zeolite

process. Boiler Troubles: Priming, Foaming, Scale, Sludge, Corrosion, Caustic Embrittlement.

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

1. A. Bahl and B. S. Bahl, G. D. Tuli, Essentials of physical chemistry, S Chand Publication, 2014, ISBN: 8121929784.
2. P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller and F.A. Armstrong Shriver and Atkins' Inorganic Chemistry, 5thEd., Oxford University Press,London, 2010, ISBN 978-1-42-921820-7.
3. Atkins, P.W.; de Paula, J. Physical chemistry, 8th ed., 2006 Oxford University Press. ISBN 0-19-870072-5.
4. B. R. Puri, L. R. Sharma & M. S. Pathania, Principles of Physical Chemistry, 46th Ed.,2013, Vishal Publication Company.
5. F.W. Billmeyer, Text Book of Polymer Science, 3rd Ed., John Wiley & Sons, New York, 2003.

Books of Reference

1. J. Bard and L.R. Faulkner, Electrochemical methods –Fundamentals andApplications, 2ndEd., John Wiley and Sons,2001.
2. Jain P.C. & Monika Jain, Engineering Chemistry, Dhanpat Roy & Sons, 2015, ISBN 10: 8187433175 / ISBN 13: 9788187433170.

SEMESTER - I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT 141	Discrete Mathematics	C	3	0	0	3

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

Laws of set theory, Set Operations, Functions, Sequences and Summations, Matrices.

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

The Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients and Identities, Applications of Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations.

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

1. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGraw-Hill, 2012.
2. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.

Books of Reference

1. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 3rd Ed., Tata McGraw-Hill, 1999.
2. M. K. Venkataraman, N. Sridharan, and N. Chandrasekaran, Discrete Mathematics, National Publishing Company, 2003.

SEMESTER - I

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 101	Introduction to Computer Science and Programming	C	3	0	4	5

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

Tuples and Lists: Tuples, Lists, List Operations, Mutation, Aliasing, Cloning - Dictionaries: Functions as Objects, Dictionaries , Example with a Dictionary, Fibonacci and Dictionaries, Global Variables - Debugging: Programming Challenges, Classes of Tests, Bugs, Debugging, Debugging Examples- Assertions and Exceptions, Assertions, Exceptions, Exception Examples

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

Stochastic Thinking: Rolling a Die, Random walks – Random Walks: Drunk walk, Biased random walks, Treacherous fields – Inferential Statistics: Probabilities, Confidence intervals – Monte Carlo Simulations: Sampling, Standard error Experimental Data: Errors in Experimental Observations, Curve Fitting, Goodness of Fit , Using a Model for Predictions

Unit VII

Machine Learning: Feature Vectors, Distance Metrics, Clustering – Statistical Fallacies: Misusing Statistics, Garbage In Garbage Out, Data Enhancement - Visualization of Data: Visualizing Results, Overlapping Displays, Adding More Documentation, Changing Data Display

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

1. Python Programming using problem solving Approach by ReemaThareja, Oxford University, Higher EducationOxford University Press; First edition (10 June 2017), ISBN-10: 0199480173
2. Data Structures and Algorithms in Python by Michael T Goodrich and RoberttoThamassia, Micheal S Goldwasser, Wiley Publisher(2016)
3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1stedition(6th February 2009)

SEMESTER-II

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
EGL 101	English	C	3	0	0	3

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 thereaders/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 theirwriting with presentation skills. Research papers and ideas are shared and presented to small and large groups.

Text Books:

1. Communicative English – (A workbook) Cambridge University Press
2. Streets of Laredo by Larry McMurty (A novel), Simon and Schuster, 2010

References:

1. Oxford English Language Dictionary

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ECO221	Economics and E-commerce	C	3	0	0	3

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). Monopoly pricing 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?

Different auction platforms and what explains success of some platforms and failures of other platforms. Changes in business of auctions over the past two decades. Required web surfing: eBay, Yahoo!, Auctions on the Internet: What's Being Auctioned and How, Vickrey auctions in practice: From Nineteenth Century Philately to Twenty-First Century, E-commerce, Trust Among Strangers in Internet Transactions: Empirical Analysis of eBay’s 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 webserving: 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, iTax 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, iTaxation 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]
3. Principles of microeconomics, N. Gregory Mankiw, Publisher: Cengage Learning fifth edition.

Books of reference

1. Intermediate Microeconomics: A Modern Approach, Hal R. Varian, Affiliated East-West Press Pvt. Ltd., eighth edition
2. Electronic Commerce (Fourth Edition), Adesh k. Pandey : Pete Loshin
3. E-Business and E-Commerce Management, Dave Chaffey, 3rd Edition, 2009, Pearson Education Inc., New Delhi
4. E-Commerce fundamentals and Applications, Chan, Wiley India, New Delhi

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT 111	Single Variable Calculus	C	3	0	0	3

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, SpringerIndia, 2007
3. Michael Spivak, Calculus, Third Edition, Cambridge University, 2008.

Books of Reference:

1. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 3rd Ed., Pearson Education India 9th Edition 1999.
2. P.M. Fitzpatrick, Advanced Calculus, 2nd Edition, AMS Indian Edition, 2010.

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
PHY111	Introduction to Classical Mechanics	C	3	0	2	4

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

Kinetic Energy and Work in 1D, Work by a Constant Force, Work by a Non-Constant Force, Work-Kinetic Energy Theorem and related problems, Kinetic Energy and Work in 2D and 3D, Work-Kinetic Energy Theorem in 2D and 3D, Worked Example, Conservative and Nonconservative Forces, Path Independence - Gravity, Path Dependence - Friction, Potential Energy due to gravity and of a spring, worked examples, Principle of energy conservation and worked examples, Collision and its type. Collision in 1D and worked examples Collision in 2D and worked examples

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

Central forces, Newton's Law of Gravitation, Principle of Superposition, Acceleration due to gravity and its variation, Gravitational Potential Energy, Kepler's Laws, hyperbolic and parabolic orbits, Satellites' Orbits and Energy, worked examples

Special Theory of Relativity : Michelson-Morley experiment, Postulates of special theory of relativity, Galilean and Lorentz transformations, Relative Velocity, Velocity in ground frame and moving frame. Length contraction and time dilation, Worked examples, Relativistic addition of velocities, Mass energy and Energy-momentum relation.

Books of Study:

1. MIT-- 8.01X online course material
2. University Physics with Modern Physics with Mastering Physics, (12th Edition) – Hugh D. Young, Roger A. Freedman and Lewis Ford (Publisher – Pearson Education)
3. Introduction to Classical Mechanics - R. G. Takwale, P. S. Puranik (Publisher – Tata McGraw- Hill Education)

Book(s) of Reference:

1. Classical Mechanics (2011) - Herbert Goldstein (Publisher – Pearson Education)
2. Classical Mechanics (2014) - J. C. Upadhyaya (Publisher – Himalaya Publishing House)

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ENG111	Basic Electronics	C	3	0	2	4

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

Phasor analysis, impedance and reactance, resonance, tuned circuits using R-L-C components, series reactance and resistance, parallel reactance and resistance. Characteristics of an operational amplifier, inverting and non-inverting op-amps, integrator and differentiator design using op-amp. Differential operational amplifier and commonmode rejection ratio.

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:

1. Principles of electronics by V K Mehta & Rohit Mehta, 2010 edition, S Chand and Co.Publisher, ISBN: 9788121924504.
2. Electronic devices and circuits by David A. Bell, 2008 edition, Oxford University Press, ISBN: 9780195693409.
3. Introduction to digital logic design by John P. Hayes, 1993 edition, Pearson Edition,ISBN: 9780201154610.

References:

1. Electronic measurements and Instrumentation by A K Sawhney, 2015 edition, Dhanpat Rai and Co., ISBN: 9788177001006.
2. Pulse, Digital and Switching waveforms by Mill man and Taube, 2011 edition, Tata McGraw Hill, ISBN: 9780071072724.

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE103	Introduction to Electrical Engineering and Computer Science	C	2	0	2	4

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 state machines 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

Introduction to Resonance-series and parallel, half power frequency, resonant frequency, Bandwidth, Q factor. Transient Analysis-Step response, Forced Response of RL, RC & RLC Series circuits – Time Constant & Natural frequency of Oscillation.

Text Books:

1. Object-Oriented Programming in Python, by Michael H Goldwasser, David Letscher, Pearson publication 1st edition (29 October 2007).
2. Theory of Computer Science: Automata, Languages and Computation, by Mishra K.L.P Publisher: Prentice Hall India Learning Private Limited; 3rd edition (2006)
3. Fundamentals of Electrical Engineering, Second Edition, by Leonard Bobrow, Oxford University press, 1996
3. Network Analysis, by G K Mithal, Khanna Publisher, Delhi (2003)
4. Fundamentals of Electric Circuits, by Charles K. Alexander and Matthew N.O. Sadiku, Publisher: McGraw Hill Education, 5th edition (1 July 2013).

Reference Books:

1. Programming Python: Powerful Object-Oriented Programming 4th, Kindle Edition by Mark Lutz (Author) Publisher: O'Reilly Media; 4 edition -14 December 2010)
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)
3. Electrical Engineering Fundamentals, Vincent Del Toro, Second edition, Prentice Hall India Learning Private Limited, 2014.

4. Fundamentals of Electric Circuits, Charles K. Alexander and Matthew N.O. Sadiku, Mc Graw Hill Higher Education, Fifth Edition, 2013.
5. Principles of Electric Circuits Conventional Current Version, Thomas L. Floyd, Education Limited, Ninth Edition, 2009.
6. Engineering Circuit Analysis, by William H. Hayt (Author), Jack Kemmerly (Author), Steven M. Durbin (Author), Publisher: McGraw Hill Education, Eighth edition (August 2013).

SEMESTER - II

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC 1002	Soft Skills-1	C	1	0	1	1

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

Importance and necessity of Decision Making, process of Decision Making, Practical way of Decision Making, Weighing Positives & Negatives.

Reference Books:

1. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers, 1998.
2. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.
3. Thomas A Harris, I am ok, You are ok , New York-Harper and Row, 1972
4. Daniel Coleman, Emotional Intelligence, Bantam Book, 2006.

SEMESTER - III

SEMESTER - III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT 151	Linear Algebra	C	3	0	0	3

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:

1. G. Strang, Linear Algebra and Its applications, Nelson Engineering, 4th Edn., 2007
2. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall of India, 1996

Books of Reference:

1. S. Axler, Linear Algebra Done Right, 2nd Edn., UTM, Springer, Indian edition, 2010.
2. G. Schay, Introduction to Linear Algebra, Narosa, 1997.

SEMESTER – III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
HS	Environmental Science	E	2	0	2	3

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, Concepts of sustainability, Tragedy of the commons; Root causes of environmental crisis, Earth systems 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), Effects 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, Ground water, and Ocean pollution; Point and Non-points sources; Organic and inorganic nutrients pollution; Eutrophication; Microbial contamination; Oil pollution in the seas- Exxon Valdez Oil spill; Plastic pollution Soil Pollution: 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: The rare 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. Case study-Chinese Environmental Protection Tax, Water resource tax, CNG vehicles in Delhi/Delhi odd-or-even rule.

Books of Study:

1. Basu.M, Xavier.S. "Fundamentals of Environmental Studies", 1st edition, Cambridge, University Press, 2016.
2. Raina.M, Maier, Ian L. Pepper, Charles.P. "Environmental Microbiology" 2nd edition, Academic Press, 2004.

References:

1. Danial. D. C. "Environmental Science", 8th edition, Jones and Barlett Publishers, MA, 2010.

SEMESTER – III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ENG101	Engineering Fundamentals	C	3	0	0	3

UNIT I

Sources of Energy, Types of Prime Movers, Force, Mass, Pressure, Work, Power, Energy, Heat, Temperature, Internal Energy, Enthalpy, Efficiency, Zeroth Law, First Law, Thermodynamic System, Different Types of Fuels, Non-Conventional Energy - Wind, Solar, Bio, Global Warming

UNIT II

Introduction-Fluids, Physical Properties of Fluids, Relationship Between Stress and Strain-Rate for Newtonian and Non-Newtonian Fluids, Description of Fluid Flow, Classification of Flows- Laminar and Turbulent Flows, Measurement of Flow.

UNIT III

Heat Engines- External, Internal, Carnot, Rankine, Otto, Diesel Cycles; Steam Boilers- Fire Tube, Water Tube Boilers, Valves; IC Engine- 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

Mechanics of Materials- Engineering Materials, Material Properties- Tensile Strength, Toughness, Malleability, Hardness, Ductility, Stiffness, Brittleness, Elasticity, Plasticity, Creep, Fatigue, Failure, Stress-strains plots, failures

Books of Study:

1. Elements of Mechanical Engineering, S. Trymbak Murthy, IK International Publishing, 2010.
2. Elements of Mechanical Engineering, RK Rajput, Laxmi Publications Ltd, 2005.

References:

1. Elements of Mechanical Engineering, V.K. Manglik, PHI Publications, 2013.
2. Elements of Mechanical Engineering, B. L. Theraja, S. Chand Ltd. 1999.
3. Elements of Mechanical Engineering, Sadhu Singh, S. Chand and Company Ltd. 2013.

SEMESTER - III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
PHY 112	Introduction to Electricity and Magnetism	C	2	0	2	3

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

Magnetostatics: Biot-savart law, Ampere's law for force between two current carrying loops, Ampere's circuital law, Equation of continuity, Magnetic vector potential A, Energy density in magnetic field, magnetization of matter (B,H,M)Magnetic susceptibility and permeability, Hysteresis loss, B-H curve, Diamagnetic, paramagnetic and ferromagnetic substances.

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 ($J=\sigma.E$)

Required Book:

1. Introduction to Electrodynamics (4rd Edition) - David J. Griffiths (Publisher - PHI Learning, Eastern Economy Editions, 2012)
2. Electricity and Magnetism (Reprints 2007, 1st Edition 2001) A. S. Mahajan, A. A. Rangwala, (Publisher - McGraw-Hill Education)

Reference Books:

1. Electricity and magnetism Edward M Purcell, David J Morin, "", 3rd edition, Cambridge University, 2013
2. Classical Electrodynamics (3rd Edition) - John David Jackson (Publisher - Wiley).

SEMESTER - III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 223	Data Structures and Algorithms using C	C	3	0	2	4

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:

1. Datastructure using C", Aaron M.Tenenbaum, YLangsamand MoscheJ. Augenstein, Pearson publication.
2. Data structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson publications, Second Edition Programming in C. P. Dey and M Ghosh ,Second Edition,Oxford University Press.
3. Programming with C, Byron Gottfried, Mcgrawhill Education, Fourteenthreprint, 2016

References:

1. Fundamentals of data structure in C" Horowitz, Sahani and Anderson Freed, Computer SciencePress.
2. Fundamental of Data Structures, (Schaums Series) Tata-McGraw-Hill.
3. Data Structure- A Pseudo code approach with C , Gilberg and Forouzan, byThomson publication

SEMESTER III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE221	Digital Systems Design	C	3	0	2	4

UNIT I

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 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 circuit, 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:

1. Digital Design with an Introduction to the Verilog HDL by M. Mano and Michael D. Ciletti, 5th Edition.
2. Digital Principles and Applications by Leach, Paul Malvino, 5th Edition.

References:

1. Fundamentals of Digital Logic Design by Charles H. Roth, Jr. 5th Edition,

Cengage

2. Digital Electronics by G.K. Kharate, Oxford University Press
3. Switching Theory and Logic Design by A. Anand Kumar, PHI, 2nd Edition.

Semester III

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC	Soft Skills 2	C	1	0	0	1

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

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
BS	Multi-variable Calculus	C	3	0	0	3

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:

1. Edwards, Henry C., and David E. Penney. Multivariable Calculus. 6th ed. Lebanon, IN: Prentice Hall, 2002.
2. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edn., Pearson Education India, 1996.

Books of Reference:

1. T. M. Apostol, Calculus - Vol.2, 2nd Edn., Wiley India, 2003.

SEMESTER IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
ENG 211	Signals and Systems	C	3	0	0	3

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:

1. V. Oppenheim, A. S. Willsky, and S. Hamid Nawab, Signals & Systems, 2nd Ed, Prentice Hall, 1996

References:

1. B. P. Lathi, Linear Systems and Signals, 2nd Ed, Oxford University Press, 2005
2. C. T. Chen, Signals and Systems, 3rd Ed, Oxford University Press, 2004

SEMESTER IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 234	Algorithm Analysis and Design	C	3	0	2	4

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:

1. Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms", 3rd Edition, MIT press, 2009
2. Parag Dave & Himanshu Dave, "Design and Analysis of Algorithms", Pearson Education, 2008

Reference books:

1. A V Aho, J E Hopcroft, J D Ullman, "Design and Analysis of Algorithms", Addison-WesleyPublishing.
2. Algorithm Design, by J. Kleinberg and E. Tardos, Addison-Wesley, 2005
3. Algorithms, by S. Dasgupta, C. Papadimitriou, and U. Vazirani, McGraw-Hill, 2006

SEMESTER IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSEC	Computer Organization and Architecture	C	3	1	2	4

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

Basic concepts – Semiconductor RAM – ROM – Speed – Size and cost – Cache memories – Improving cache performance – Virtual memory – Memory management requirements – Associative memories-Secondary storage devices.

UNIT V : I/O Organization

Accessing I/O devices – Programmed Input/output - Interrupts – Direct Memory Access– Interface circuits – Standard I/O Interfaces - I/ O devices and Processors.

Books of Study:

1. Computer System Architecture, Morris Mano, Third edition, Pearson publications
2. Computer Organization, Carl Hamacher, Zvonko Vranesic and Safwat Zaky, V Edition, McGraw-Hill publications
3. “Computer Organization and Architecture – Designing for Performance”, William Stallings, Ninth edition, Pearson publications

References:

1. Structured Computer Organization, Andrew S. Tanenbaum
2. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software interface”
3. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata McGraw Hill
4. V.P. Heuring, H.F. Jordan, “Computer Systems Design and Architecture”, Second Edition, Pearson Education

SEMESTER IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 236	Object Oriented Programming	C	3	0	2	4

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

Introduction, limitations of AWT, MVC architecture, components, containers. Understanding Layout Managers, Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout.

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.

A Simple Swing Application, Applets – Applets and HTML, Security Issues, Applets and Applications, passing parameters to applets. Creating a Swing Applet, painting in Swing, A Paint example, Exploring Swing Controls- JLabel and Image Icon, JText Field, The Swing Buttons- JButton, JToggleButton, JCheckBox, JRadioButton, JTabbedPane, JScrollPane, JList, JComboBox, Swing Menus, Dialogs.

Books of Study:

1. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.

References:

1. An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, JohnWiley & sons.
2. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
3. Object Oriented Programming through Java, P. Radha Krishna, Universities Press.
4. Programming in Java, S. Malhotra, S. Chaudhary, 2nd edition, Oxford Univ. Press.
5. Java Programming and Object Oriented Application Development, R. A. Johnson, Cengage Learning.

SEMESTER IV

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC 212	Soft Skills 3	C	1	0	0	1

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
2. P. Anand, Quantitative Aptitude, Wiley, 2015

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

SEMESTER V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT 221	Probability and Statistics	C	3	0	0	3

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
2. J. Johnson, Probability & Statistics for Computer Science, Wiley, 2004
3. S. Ross, Introduction to Probability & Statistics, Academic Press, 2004

SEMESTER V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 301	Operating Systems	C	3	0	2	4

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

Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization- Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

UNIT II : Process Scheduling

Processes-Process Concept, Process Scheduling, Operations on Processes, Inter process 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

UNITIV: Storage Management

Main Memory-Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory- Demand Paging, Page Replacement, Allocation, Thrashing; OS examples

UNIT V: I/O Systems

Mass Storage Structure- Overview, Disk Scheduling and Management; File System Storage-File Concepts, Directory and Disk Structure, Sharing and Protection; File System Implementation- File System Structure, Directory Structure, Allocation Methods, Free Space Management- OS examples

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:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc.
2. William Stallings, "Operating Systems – Internals and Design Principles", 9th Edition, Pearson publications. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson

SEMESTER V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 302	Formal Languages and Automata Theory	C	3	0	0	3

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

Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non-deterministic finite automaton, transition diagrams and Language recognizers. Finite Automata with output- Moore and Melay machines.

UNIT - II

Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, Ambiguity in context free grammars. Minimization of Context Free Grammars. Chomsky normal form, Greiback normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL.

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:

1. Introduction to Automata Theory, Languages, and Computation, 3rd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
2. Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage Learning.

Reference Books:

1. Introduction to Languages and The Theory of Computation, John C Martin, TMH.
2. Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
3. A Text book on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
4. Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan, Rama R, Pearson.
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

SEMESTER V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 303	Computer Networks	C	3	0	2	4

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

Overview of the Internet: Protocol, Layering Scenario, TCP/IP Protocol Suite: The OSI Model, Internet history standards and administration; Comparison of the OSI and TCP/IP

reference model. Physical Layer: Guided transmission media, wireless transmission media. Data Link Layer - design issues, CRC codes, Elementary Data Link Layer Protocols, sliding window protocol

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, ICMP, 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:

The Internet Transport Protocols UDP-RPC, Real Time Transport Protocols, The Internet Transport Protocols- Introduction to TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Connection Management Modeling, The TCP Sliding Window, The TCP Congestion Control, The future of TCP.

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

Text Books:

1. Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
2. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.

References Books:

1. An Engineering Approach to Computer Networks - S. Keshav, 2nd Edition, Pearson Edition.
2. Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.
3. Introduction to Computer Networks and Cyber Security, Chwan-Hwa (John) Wu, J. David Irwin, CRC Press.
4. Computer Networks, L. L. Peterson and B. S. Davie, 4th edition, Elsevier.
5. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.

SEMESTER V

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC 301	Soft Skills 4	C	1	0	0	P/F

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:

1. R.S. Agarwal, A Modern Approach to Verbal & Non Verbal Reasoning, S. Chand Publication
2. P. Anand, Quantitative Aptitude, Wiley, 2015

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 VI

SEMESTER VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 304	Database Management Systems	C	3	0	2	4

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 DBMS and Relational model

File Processing System, Advantages of DBMS over File Processing System, Database System Applications. DBMS Architecture: The three schema architecture, Data Independence : Logical and Physical, Data Models: Hierarchical, network and relation models, Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, Database constraints (Domain, Key constraints, integrity constraints) and their importance.

UNIT II : Query processing

Relational Algebra, Relational Calculus, Introduction to SQL: Database Objects- DDL Schema definitions, DML- Insert, select, update, delete, Views, exercise on SQL queries, Transaction support in SQL, Aggregate Functions, Null Values, Views, Complex Integrity Constraints in SQL, Assertions, Triggers

UNIT III : Conceptual model and database design

Entity Relationship model Entity types, Entity Sets, Attributes, and Keys Relationships, Relationship types and constraints, Weak Entity types, Enhanced ER (EER) Modeling : Super/Sub Classes Specialization and Generalization. Constraints and characteristics of Specialization and Generalization , Basics of Normalization, Normal Forms: First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), BCNF

UNIT IV: Transaction Processing, Concurrency Control and Recovery

Introduction of transaction processing, advantages and disadvantages of transaction processing system, Serializability and Recoverability of transaction, Concurrency Control, Lock based Protocols, Timestamp Based Protocols – Validation based Protocols - Multiple Granularity Locking, Recovery techniques

UNIT V: Overview of Storage and Indexing

Data on External Storage, File Organization and Indexing - Clustered Indexes, Primary and Secondary Indexes, Indexed Sequential Access Methods(ISAM) B+ Trees: Tree Structure, Search, Insert, Delete, Hash Based Indexing: Static Hashing, Extendable hashing, Linear Hashing, Extendible vs. Linear Hashing.

Text Books:

1. Ramakrishnan, Raghu, and Johannes Gehrke. Database Management Systems. 3rd ed. McGraw-Hill, 2002. ISBN: 9780072465631.

Books of reference:

1. Heller stein, Joseph, and Michael Stonebreaker. Readings in Database Systems (The RedBook). 4th ed. MIT Press, 2005. ISBN:9780262693141.

SEMESTER VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
MAT 131	Differential Equations	C	3	0	0	3

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:

Laplace transforms of standard functions, Shifting Theorems, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Inverse Laplace transforms, Convolution theorem (without proof). Application: Solutions of ordinary differential equations using Laplace transforms.

Book of Study:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

Book of References:

1. Mary L. Boas, *Mathematical Methods in Physical Sciences*, 3rd Edition, Wiley-India.
2. G. F. Simmons, *Differential Equation with Applications and Historical Notes*, TATA McGraw Hill.
3. S. Vaidyanathan, *Advanced Applicable Engineering Mathematics*, CBS Publishers.

SEMESTER VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 305	Software Engineering	C	3	0	2	4

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

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models -Introduction to Agility-Agile process-Extreme programming-XP Process.

UNIT II: Requirements Analysis and Specification

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, Petri Nets-Data Dictionary.

UNIT III: Software Design

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User

Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV : Testing and Maintenance

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

UNIT V : Project Management

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

List of experiments:

- 1 Develop requirements specification for a given problem
- 2 Develop DFD Model (Level 0, Level 1 DFD and data dictionary) of the sample problem
- 4 To perform the function oriented diagram : DFD and Structured chart
- 5 To perform the user’s view analysis : Use case diagram
- 6 To draw the structural view diagram : Class diagram, object diagram
- 7 To draw the behavioral view diagram : Sequence diagram, Collaboration diagram
- 8 To draw the behavioral view diagram : State-chart diagram, Activity diagram
- 9 To draw the implementation view diagram: Component diagram
- 10 To draw the environmental view diagram : Deployment diagram
- 11 To perform various testing using the testing tool unit testing, integration testing

Text Books:

1. Roger S. Pressman, Software Engineering – A Practitioner’s Approach, Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, Software Engineering, 9th Edition, Pearson Education Asia, 2011.

References:

1. Rajib Mall, Fundamentals of Software Engineering, Third Edition, PHI Learning Private Limited, 2009.
2. Pankaj Jalote, Software Engineering, A Precise Approach, Wiley India, 2010.
3. Kelkar S.A., Software Engineering, Prentice Hall of India Pvt Ltd, 2007.

4. Stephen R.Schach, Software Engineering, Tata McGraw-Hill Publishing Company Limited,2007.

SEMESTER VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 306	Compiler Design	C	3	0	2	4

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

Need and Role of the Parser-Context Free Grammars -Top Down Parsing -General

Strategies- Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser- LR Parser-LR (0)Item- Construction of SLR Parsing Table -Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC-Design of a syntax Analyzer for a Sample Language .

UNIT IV : Syntax Directed Translation and Run Time Environment

Syntax directed Definitions-Construction of Syntax Tree-Bottom-up Evaluation of S- Attribute Definitions- Design of predictive translator - Type Systems-Specification of a simple type checker- Equivalence of Type Expressions-Type Conversions. RUN-TIME ENVIRONMENT: Source Language Issues-Storage Organization-Storage Allocation-Parameter Passing-Symbol Tables-Dynamic Storage Allocation-Storage Allocation in FORTAN.

UNIT V : Code Optimization and Code Generation

Principal Sources of Optimization-DAG- Optimization of Basic Blocks-Global Data Flow Analysis- Efficient Data Flow Algorithms-Issues in Design of a Code Generator - A Simple Code Generator Algorithm.

Books of Study

1. Compilers – Principles, Techniques and Tools, Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, 2 nd Edition, Pearson Education, 2007.

Books of References

1. Optimizing Compilers for Modern Architectures: A Dependence-based Approach,Randy Allen, Ken Kennedy, Morgan Kaufmann Publishers, 2002.
2. Advanced Compiler Design and Implementation, Steven S. Muchnick, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 200
3. Engineering a Compiler,Keith D Cooper and Linda Torczon, Morgan Kaufmann Publishers Elsevier Science, 2004.
4. Crafting a Compiler with C,Charles N. Fischer, Richard. J. LeBlanc, Pearson Education, 2008.

SEMESTER VI

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CDC-302	Interview Handling Skills – I (Soft skills-5)	Mandatory	1	0	0	P/F

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

Specialization:

Artificial Intelligence and Machine Learning

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 311	INTRODUCTION TO MACHINE LEARNING	Core Elective	3	0	2	4

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

Introduction: Introduction to Machine Learning: Introduction. Different types of learning, Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation 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 TreeInstance based Learning: K nearest neighbour, theCurse 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 Books:

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.

Reference Books:

1. Introduction to Machine Learning Edition 2, by EthemAlpaydin
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
3. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 314	Digital Image Processing	E	3	0	2	4

Course Objective:

1. Develop an overview of the field of image processing.
2. Understand the fundamental algorithms and how to implement them.
3. Prepare to read the current image processing research literature.
4. Gain experience in applying image processing algorithms to real problems.

Course Outcomes:

Students are able to

1. understand the need for digital image processing and various task involved in image processing pipeline.
2. learn different techniques employed for the enhancement of images.
3. learn different causes for image degradation and overview of image restoration techniques.
4. understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.
5. learn different feature extraction techniques for image analysis and recognition
6. develop any image processing application.
7. 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:

1. R.C. Gonzalez, R.E. Woods, Digital Image Processing, 3rd Edition, Pearson Education

Reference Books:

1. S.Sridhar, Digital Image Processing, Oxford University Press, 2011
2. Milan Sonka, Vaclav Hlavac and Roger Boyele, Image processing, analysis, and machine vision. 3e, Cengage Learning, 2014.
3. Computer Vision A modern approach, David A. Forsyth and Jean Ponce, Pearson Education.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 410	PRINCIPLES OF SOFT COMPUTING	Core Elective	3	0	2	4

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

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

UNIT I

Introduction to Soft Computing, Artificial Neural Network (ANN) : Fundamentals of ANN, Basic Models of an artificial Neuron, Neural Network Architecture, Learning methods, Terminologies of ANN, Hebb network, Supervised Learning Networks: Perceptron, Adaline, Madaline, Multi-Layer Perceptron, Feed forward Back propagation Network : back propagation learning, Learning Effect of Tunning parameters of the Back propagation

UNIT II

RBF Network, Associative memory: Auto, hetero and linear associative memory, network, Adaptive Resonance Theory: ART1, ART2, Introduction to Computer vision, Introduction to Convolutional neural network, Popular architectures: Alex Net, Google Net, VGG Net

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

Genetic Algorithms: Fundamentals of genetic algorithms: Encoding, Fitness functions, Reproduction. Genetic Modeling: Cross over, Inversion and deletion, Mutation operator, Bitwise operators, Bitwise operators used in GA. Convergence of Genetic algorithm. Applications, Real life Problems. Particle Swarm Optimization and its variants.

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 Books:

Principles of Soft Computing- S.N. Sivanandan and S.N. Deepa, Wiley India, 2nd Edition, 2011

Reference Books:

1. Neuro Fuzzy and Soft Computing, J. S. R. JANG, C.T. Sun, E. Mizutani, PHI
2. Neural Networks, Fuzzy Logic, and Genetic Algorithm (synthesis and Application)
3. Rajasekaran, G.A. Vijayalakshmi Pai, PHI

SUBJECT CODE	SUBJECT TITLE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CSE 413	ARTIFICIAL INTELLIGENCE	Core Elective	4	0	0	4

Course Objective:

1. To create understanding of both the achievements of AI and the theory underlying those achievements.
2. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems
3. To review the different stages of development of the AI field from human like behavior to Rational Agents.
4. 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.
5. 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.
6. To introduce advanced topics of AI such as planning, Bayes networks, natural language processing and Cognitive Computing

Course Outcome:

1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing
4. Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
5. Formulate and solve problems with uncertain information using Bayesian approaches.
6. Apply concept Natural Language processing to problems leading to understanding of cognitive computing.
- 7.

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

Problem Solving: Formulating problems, problem types, Solving Problems by Searching, heuristic search techniques, constraint satisfaction problems, stochastic search methods.

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:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill
3. E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education
4. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufman, 2002

Specialization:
Cyber Security

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSES 312	Introduction to Cryptography	E	3	0	2	5

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.

Course Outcomes:

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

History and overview of cryptography, Overview of cryptography. What is a cipher? Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques.

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

Testing for Primality, The Chinese Remainder Theorem, The RSA Algorithm, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography.

UNIT IV

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

References:

Stallings, William. Cryptography and network security, 4/E. Pearson Education India, 2006.
D. Stinson Cryptography, Theory and Practice (Third Edition)
Handbook of Applied Cryptography by A. Menezes, P. Van Oorschot, S. Vanstone.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSES 315	Network Security	Core ELECTIVE	3	0	2	5

Course Objective:

1. To introduce fundamental concepts of security.
2. To introduce and discuss the relevance of security in operating system, web services etc.
3. To introduce fundamental concepts of secure electronic transactions.

Course Outcomes:

The Students will be able to :

1. Identify the common threats faced today
2. Appreciate the relevance of security in various domains
3. Identify security issues in network, transport and application layers and outline appropriate security protocols
4. Develop secure web services and perform secure e-transactions
5. Design a secure system

UNIT I

Need for Security, Security Attack, Security Services, Information Security, Methods of Protection. Network Concepts, Threats in Networks, Network Security Controls.

UNIT II

Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange.

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.

References:

1. Network Security and Cryptography, Bernard Menezes, CENGAGE Learning.
2. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
3. Cryptography and Network Security – Principles and Practice: William Stallings, Pearson Education, 6th Edition.
4. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition.

SUBJECT CODE	SUBJECT TITLE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CSE 411	Mobile and Wireless Security	Core Elective	3	0	2	4

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

Fundamentals of Wireless & Mobile Systems: key features and mechanisms of wireless and mobile systems, Security Standards in current Wireless & Mobile Systems: WiFi Security (WEP, WPA, WPA-Enterprise); Cellular Security (GSM, 3G, LTE); Internet of Things / Wireless Sensor Networks / RFID, Emerging Privacy concerns: location, tracking, traffic analysis, mobile and the cloud.

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

Security of GSM Network, Security of UMTS Networks, Android Security Model, IOS Security Model, Security Model of the Windows Phone, SMS/MMS, Mobile Geolocation and Mobile Web Security, Security of Mobile VoIP Communications, Emerging Trends in Mobile Security

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:

1. Nouredine Boudriga, Security of Mobile Communications, 2010.
2. Levente Buttyán and Jean-Pierre Hubaux, Security and Cooperation in Wireless Networks, 2008. [Available Online]
3. James Kempf, Wireless Internet Security: Architectures and Protocols, 2008.
4. Android Security Internals: An In-Depth Guide to Android's Security Architecture, Author: Nikolay Elenkov, No Starch Press, First Edition, Nov. 2014

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 414	Internet Protocols and Networking	E	3	0	2	5

Course Objective:

The broad objective of this course is to understand –

1. The architecture and principles of today's Internetworking of computer Networks
2. The protocols and their functionalities
3. The requirements for the future Internet and its impact on the computer network architecture

Course Outcomes:

Upon completion of this course students will be able to:

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

UNIT I

Network Models: Layered Tasks, The OSI Model, Layers in OSI Model, TCP/IP Protocol suite, Addressing. Connecting devices: Passive Hubs, Repeaters, Active Hubs, Bridges, Two Layer Switches, Routers, Three Layer Switches, Gateway, Backbone Networks.

UNIT II

Principles of Internetworking, Connectionless Interconnection, Application Level Interconnection, Network Level Interconnection, Properties of the Internet, Internet Architecture, Interconnection through IP Routers TCP, UDP & IP: TCP Services, TCP Features, Segment, A TCP Connection, Flow Control, Error Control, Congestion Control, Process to Process Communication, User Datagram, Checksum, UDP Operation, IP Datagram, Fragmentation, Options, IP Addressing: Classful Addressing, IPV6.

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.

References:

- 1) Douglas. E.Comer, “Internetworking with TCP/IP “, Volume I PHI
- 2) Behrouz A Forouzan, “TCP/IP Protocol Suite”, TMH, 3rd Edition
- 3) B.A. Forouzan, “Data communication & Networking”, TMH, 4th Edition.

Specialization:
Data Science and Analytics

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 311	INTRODUCTION TO MACHINE LEARNING	Core Elective	3	0	2	4

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

Introduction: Introduction to Machine Learning: Introduction. Different types of learning, Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation 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 TreeInstance based Learning: K nearest neighbour, theCurse 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 Books:

2. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.

Reference Books:

4. Introduction to Machine Learning Edition 2, by EthemAlpaydin
Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012

SUBJECT CODE	SUBJECT TITLE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CSE 313	Introduction to Data Science	Core Elective	3	0	0	3

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:

1. Describe what Data Science is and the skill sets needed to be a data scientist.
2. Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.
3. Use R to carry out basic statistical modeling and analysis.
4. Explain the significance of exploratory data analysis (EDA) in data science. Apply basic tools (plots, graphs, summary statistics) to carry out EDA.
5. Describe the Data Science Process and how its components interact.
6. Use APIs and other tools to scrap the Web and collect data.
7. Apply EDA and the Data Science process in a case study.
8. 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.
9. Identify common approaches used for Feature Generation. Identify basic Feature Selection algorithms (Filters, Wrappers, Decision Trees, Random Forests) and use in applications.
10. 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.
11. Create effective visualization of given data (to communicate or persuade).
12. Work effectively (and synergically) in teams on data science projects.

13. 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: Real Direct (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

Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system - Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighbourhood properties in graphs

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:

1. Cathy O’Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O’Reilly. 2014.

2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)
3. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
4. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
5. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. ISBN 0387952845. 2009. (free online)
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.)
7. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.
8. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 412	Introduction to Big Data	E	3	0	0	3

Course Objective:

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop
3. Provide HDFS Concepts and Interfacing with HDFS
4. Understand Map Reduce Jobs • Provide hands on Hadoop Eco System
5. Apply analytics on Structured, Unstructured Data.
6. Exposure to Data Analytics with R.

Course Outcomes:

1. The students will be able to:
2. Identify Big Data and its Business Implications.
3. List the components of Hadoop and Hadoop Eco-System
4. Access and Process Data on Distributed File System
5. Manage Job Execution in Hadoop Environment
6. Develop Big Data Solutions using Hadoop Eco System
7. Apply Machine Learning Techniques using R.

UNIT I

Big Data introduction - definition and taxonomy - Big data value for the enterprise - The Hadoop ecosystem - Introduction to Distributed computing- Hadoop ecosystem – Hadoop Distributed File System (HDFS) Architecture - HDFS commands for loading/getting data - Accessing HDFS through Java program.

UNIT II

Introduction to Map Reduce frame work - Basic Map Reduce Programming: - Advanced Map Reduce programming: Basic template of the Map Reduce program, Word count problem- Streaming in Hadoop- Improving the performance using combiners- Chaining Map Reduce jobs- Joining data from different sources.

UNIT III

Querying big data with Hive - Introduction to Hive QL- Hive QL: data definition- data manipulation

UNIT IV

Querying big data with Hive – Hive QL queries- Hive QL Views – Hive QL indexes

UNIT V

Data Analytics using R: Introduction to R, Creating a dataset, Getting started with graphs, Basic data management, Advanced data management.

Reference:

1. Big Data Fundamentals: concepts, Drivers and Techniques: Person Education, 2016
2. Hadoop The Definitive Guide, IV edition, O'Reilly publications
3. Hadoop in Action, Chuck lam, Manning publications
4. Programming, Hive, O'Reily publications,
5. Apache Hive Cookbook, PACKT publications
6. R in Action, Robert I. Kabacoff, Manning publications
7. Practical Data Science with R, Nina Zumel John Mount, Manning publications

SUBJECT CODE	SUBJECT TITLE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CSE 415	Inference and Representation	E	3	0	0	3

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, modelling uncertainty, and discovering new insights from data.
3. Will particularly emphasize latent variable models, examples of which include latent Dirichlet allocation (for topic modelling), 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

Topic modeling - Introduction to Probabilistic Topic Models - Case study: Musical influence via dynamic topic models - Modeling musical influence with topic models - Gaussian processes - Application to predicting wind flow - Learning Markov random fields - Moment matching, Chow-Liu algorithm, pseudo-likelihood - Case study: Cognitive science Idea - Exponential families, learning MRFs, and GPs - An Introduction to Conditional Random Fields - Approximate maximum entropy learning in MRFs

UNIT IV

Variation inference - Mean-field approximation - Graphical models, exponential families, and vibrational inference - Learning deep generative models - Stochastic vibrational inference, Variation auto-encoder - Structured prediction - Overview of structured prediction, parametrizing 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.
2. Daphne Koller and Nir Friedman, Probabilistic Graphical Models: Principles and Techniques, MIT Press, 2009.
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

TECHNICAL ELECTIVES

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 321	Data and Web Mining	E	3	0	0	3

Course Objectives:

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

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

Learning Outcomes:

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

UNIT I

Introduction to Data Mining: What is data mining? Related technologies - Machine Learning, DBMS, OLAP, Statistics. Data Mining Goals .Stages of the Data Mining Process, Data Mining Techniques , Knowledge Representation Methods. Data Warehouse and OLAP: Data Warehouse and DBMS, Multidimensional data model, OLAP operations.

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:

1. Han, J., Kamber, M., & Pei, J. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann publications.
2. Introduction to Data Mining, Vipinkumar, Michael Steinbach, Pang-Ning Tan, Person publications, 2016
3. Mining the Web, SoumenChakrabarti, Elseier publications, 2002
4. Web Data Mining, Bing Liu, Second Edition, Springer publications, 2011.
5. Mining the Social Web, Mathew A. Russel, Mikhail Klassen, Third edition, Oreily publications, 2018.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 322	Complexity Theory	E	3	0	0	3

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 algorithm is via Turing machines. The main focus is on central complexity classes, in particular NP-complete problems.

Course Outcomes:

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

UNIT I: COMPUTABILITY

Review of Turing Machines, view of PDAs, 2DFAs, FAs as restricted TMs and related theorems. Tape reduction, and robustness of the model. Encoding and Enumeration of Turing Machines, Undecidability. Rice-Myhill-Shapiro theorem. Relativisation. Arithmetic and Analytic Hierarchy of languages. Proof of Godel's incompleteness theorem based on computability. Kolmogorov Complexity. Resource bounded computation. Notion of a computational resource. Blum's Speedup theorem.

UNIT II: TIME COMPLEXITY

Time as a resource, Linear Speedup theorem. Crossing Sequences and their applications. Hierarchy theorems. P vs NP. Time Complexity classes and their relationships. Notion of completeness, reductions. Cook-Levin Theorem. Ladner's theorem. Relativization Barrier : Baker-Gill-Solovoy theorem.

UNIT III: SPACE COMPLEXITY

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

UNIT IV: COMPLEXITY OF COUNTING AND 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)
4. Complexity Theory: A Modern Approach - Sanjeev Arora and Boaz Barak.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 323	Advanced Computer Architecture	E	3	0	0	3

Course objectives:

This course introduces 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: FUNDAMENTALS OF COMPUTER DESIGN:

Fundamentals of Computer design - Quantitative principles of computer design-Instruction set principles and examples – Classifications of instruction set - memory addressing- type and size of operands – RISC vs CISC - Encoding an instruction set. MIPS Bench Mark Analysis.

UNIT –II: INTRODUCTION TO PIPELINING AND INSTRUCTION LEVEL PARALLELISM:

Introduction to pipelining – Types of pipelining – Hazards in pipelining - Introduction to instruction level parallelism (ILP) – Challenges in ILP - Basic Compiler Techniques for exposing ILP - Reducing Branch costs with prediction - Overcoming Data hazards with Dynamic scheduling - Hardware-based speculation - Exploiting ILP using multiple issue and static scheduling - Exploiting ILP using dynamic scheduling, multiple issue and speculation - Tomasulo’s approach, VLIW approach for multi-issue.

UNIT III: MULTIPROCESSORS AND THREAD –LEVEL PARALLELISM:

Introduction to multi processors and thread level parallelism - Characteristics of application domain - Systematic shared memory architecture - Distributed shared – memory architecture – Synchronization – Multithreading - Multithreading-fined grained and coarse grained, superscalar and super pipelining, hyperthreading. Vector architectures, organizations and performance tuning. GPU architecture and internal organization, Elementary concepts in CUDA programming

UNIT IV: MEMORY HEIRARCHY DESIGN

Introduction to cache performance - Cache Optimizations - Virtual memory - Advanced optimizations of Cache performance - Memory technology and optimizations - Protection: Virtual memory and virtual machines - multi-banked caches, critical word first, early restart approaches, hardware pre-fetching, write buffer merging.

UNIT –VI: INTER CONNECTION AND NETWORKS:

Introduction to inter connection networks and clusters - interconnection network media - practical issues in interconnecting networks- examples - clusters - designing a cluster – System on Chip (SoC) Interconnects – Network on Chip (NOC).

TEXT BOOK:

1. Dezsosima, Terence Fountain, Peter Kacsuk “Advanced Computer Architectures-A Design Space Approach”, Pearson Education India.

REFERENCES:

1. Hennessy, John L., and David A. Patterson. “Computer architecture: a quantitative approach”, Morgan Kaufman 4th and 5th edition
2. Shen, John Paul, and Mikko H. Lipasti. “Modern processor design: fundamentals of superscalar processors” Waveland Press
3. Hwang, Kai, and A. Faye. "Computer architecture and parallel processing.", Tata McGraw-Hill
4. Culler, D., Singh, J. P., and Gupta A, “Parallel computer architecture: a hardware/software approach”, Gulf Professional Publishing.
5. Dally, William James, and Brian Patrick Towles. Principles and practices of interconnection networks. Elsevier, 2004.
6. Online reference – Intel (will be specified during lecture)
7. Online reference – Nvidia (will be specified during lecture)

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 421	Natural Language Processing	E	3	0	0	3

Course Objectives:

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

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

Course Outcomes:

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

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

UNIT I: INTRODUCTION

Natural Language Processing tasks in syntax, semantics, and pragmatics – Issues – Applications – The role of machine learning – Probability Basics – Information theory – Collocations -N-gram Language Models – Estimating parameters and smoothing – Evaluating language models.

UNIT II: WORD LEVEL AND SYNTACTIC ANALYSIS

Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

UNIT III: SEMANTIC ANALYSIS AND DISCOURSE PROCESSING

Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure.

UNIT IV: NATURAL LANGUAGE GENERATION AND MACHINE TRANSLATION

Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation-

Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.

UNIT V: INFORMATION RETRIEVAL AND LEXICAL RESOURCES

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: WorldNet-Frame Net-Stemmers-POS Tagger- Research Corpora.

Text Books:

1. Daniel Jurafsky , James H. Martin , “Speech & language processing”, Pearson publications.
2. Allen, James. Natural language understanding. Pearson, 1995.

References:

1. Pierre M. Nugues, “An Introduction to Language Processing with Perl and Prolog” , Springer.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 422	Human Computer Interaction	E	3	0	0	3

Course Objectives:

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

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

Course Outcomes:

After completion of this course, the student will be able to:

1. Identify the user requirements for HCI and challenges
2. Apply the theories and principles to design new Interface concepts
3. Design and development of HCI interfaces for mobile applications and web interfaces

UNIT I: FOUNDATIONS OF HCI

The Human: I/O channels – Memory – Reasoning and problem solving - The computer: Devices – Memory – Processing and networks - Interaction: Models – frameworks – Ergonomics – styles – elements – Interactivity- Paradigms.

UNIT II: DESIGN AND SOFTWARE PROCESS

Interactive design basics – Process – Scenarios – Navigation – Screen design – Iteration and prototyping - HCI in software process – Software life cycle – Usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

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

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

UNIT V: WEB INTERFACE DESIGN

Designing Web Interfaces – Drag and Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Pearson Education.
2. Brian Fling, “Mobile Design and Development”, O’Reilly Media Inc. Bill Scott and Theresa Neil, “Designing Web Interfaces”, O’Reilly.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 423	Distributed Operating Systems	E	3	0	0	3

Course Objectives:

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.
3. 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

Process management: Introduction, Process migration, Threads. Synchronization: Clock synchronization, event ordering, Mutual exclusion, deadlock, Election Algorithms. Resource management: Global scheduling algorithm, Task assignment, Load sharing and balancing approaches.

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.

References:

1. Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007.
2. Advanced Concepts in Operating Systems, MukeshSinghal and NiranjanShivratri, McGrawhill publications, 2017
3. Andrew S. Tanenbaul, Maarten Van Steen, Distributed Systems, Principles and Paradigms, Pearson publications, 2nd edition.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 424	Fog Computing	E	3	0	0	3

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

Limitation of Cloud computing, Differences between Cloud and Fog computing, What is Fog? Advantages of Fog computing, Business Models, Architecture of Fog computing, Opportunities and Challenges

UNIT II: ADDRESSING THE CHALLENGE IN FOG RESOURCES

Introduction, Taxonomy and Characteristics, Resource Management Challenge , Optimisation challenges, Miscellaneous Challenges, IoT and Fog: Introduction . Programming paradigms for IoT+ Fog, Research challenges and Future Research Directions

UNIT III

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

Introduction, Background ,Network Slicing in 5G , Network Slicing in Software-Defined Clouds , Network Slicing Management in Edge and Fog , Future Research Directions: Middleware for Fog and Edge Computing: Design Issues , Introduction. Need for Fog and Edge Computing Middleware: Design Goals ,State-of-the-Art Middleware Infrastructures, System Model , Clusters for Lightweight Edge Clouds , Architecture Management – Storage and Orchestration , IoT Integration, Security Management for Edge Cloud Architectures, Future Research Directions

UNIT IV: DATA MANAGEMENT AND ANALYSIS IN FOG COMPUTING

Introduction, Background, Fog Data Management, Future Research and Directionm
Motivating Example: Smart Building, Predictive Analysis with Fog Torch, Survey of ML Techniques for Defending IoT Devices, Machine Learning in Fog Computing, Future Research Directions

UNIT V: CASE STUDIES

Uscase 1: Introduction, Human Object Detection, Object Tracking, Lightweight Human Detection. Use case 2: Introduction, Data-Driven Intelligent Transportation Systems, Mission-Critical Computing Requirements of Smart Transportation Applications, Fog Computing for Smart Transportation Applications, Case study 3: Intelligent Traffic Lights Management (ITLM) System, Testing Perspectives

Reference book:

1. Fog and Edge Computing, Rajkumar Buyya, Satish Narayana Srirama, Wiley Publications, 2019.
2. Fog computing in the Internet of Things: Springer publications, 2018
(Other reference: Research papers from IEEE, ACM, Springer and Elsevier)

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 425	Parallel Algorithms	E	3	0	0	3

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:

1. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
2. 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
3. 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.
4. An ability to apply design and development principles in the construction of software systems of varying complexity.
5. 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 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 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 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:

1. M.J. Quinn, "Designing Efficient Algorithms for Parallel Computer", McGrawHill.
2. S.G. Akl, "Design and Analysis of Parallel Algorithms" 3. S.G. Akl, "Parallel Sorting Algorithm" by Academic Press

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 426	Web Services	E	3	0	0	3

Course Objectives:

Students will try to learn:

1. To get familiar with the basics of the Service Oriented Architecture & Web Services.
2. To explore different web extensions and web services standards
3. To get familiar with Service Registry, Discovery, Selection and Composition.
4. To get familiar with semantic web

Course Outcome:

Students will able to:

1. Describe and differentiate different Web Extensions and Web Services.
2. Develop web service using SOAP and REST
3. Understand, and evaluate different service composition mechanism.
4. Semantic Web and Ontologies

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

Transport protocols for web services, messaging with web services, WSDL, Anatomy of WSDL, manipulating WSDL, web service policy, discovering web services, UDDI, Anatomy of UDDI, Web service inspection, Ad – Hoc Discovery, Securing web services.

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

Semantic Web – Role of Metadata in web content, Resource Description Framework, RDF schema, Architecture of semantic web.

Web Services Interoperability - Means of ensuring Interoperability, creating Java client for a Web service, Goals of Cryptography, Digital signature, Digital Certificate, Challenges in Web Services Interoperability. Web Services Security, XML security framework, XML Encryption.

Text Books:

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 et al., Elsevier
2. Building Web Services with Java, 2 Edition, S. Graham and others, Pearson Edn.
3. Java Web Services, D.A. Chappell & T. Jewell, O'Reilly, SPD.
4. Web Services, G. Alonso, F. Casati and others, Springer.Outcomes

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 427	Advanced Database Management Systems	E	3	0	2	4

Course Objectives:

Students will understand

1. To store data using fixed and variable length records in the file
2. To implement index structures in the file
3. To implement query parsing and execution
4. Concurrency control protocols used for transaction processing
5. Recovery techniques for recovering from transaction failures

Course Outcomes:

Students will be able to:

1. Store data in the files and to implement indexing schemes for the fast retrieval of data
2. Implement query compiler, planner and executor
3. Implement concurrency control protocols for transaction processing system

UNIT I

Overview of the DBMS, Introduction to DBMS implementation using Megatron 2000 database system, Data storage using main memory and hard disks, Disk failures, Recovery from disk crashes. Representing data elements: Record, Representing block and record address, Variable length data and records, Record modifications

UNIT II

Index structures: Indexes on sequential files, secondary indexes, B-Trees, Hash tables. Multidimensional indexes: Hash and tree like structures for multidimensional data, Bitmap indexes

UNIT III

Query execution: Algebra for queries, Introduction to Physical-Query-Plan Operators. One-Pass Algorithms for Database Operations, Nested-Loop Joins, Two-Pass Algorithms Based on Sorting Two-Pass Algorithms Based on Hashing, Index-Based Algorithms, Buffer Management, Algorithms Using More Than Two Passes, Parallel Algorithms for Relational Operations

UNIT IV

The query compiler: Parsing, Algebraic Laws for Improving Query Plans, From Parse Trees to Logical Query Plans, Estimating the Cost of Operations, Introduction to Cost-Based Plan Selection, Choosing an Order for Joins, Completing the Physical-Query-Plan Selection,

UNIT V

Concurrency control: Conflict-Serializability, view serializability, Enforcing Serializability by Locks, Locking Systems With Several Lock Modes, An Architecture for a Locking Scheduler, Concurrency control by timestamps and validation, Transactions that Read Uncommitted Data, Coping with system failures: Undo logging, Redo logging, Undo/Redo logging, Protecting media failures.

Books of Study:

1. Database System Implementation, Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, Person publications, First Edition, 2002

Books of References:

1. Database system the complete book: Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, Person New International Edition, Second Edition, 2013
2. Research papers on DBMS implementation

SUBJECT CODE	SUBJECT TITLE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CSE 428	Computer Graphics and Multimedia	E	3	0	0	3

Course Objectives:

1. To learn the basic principles of 3-dimensional computer graphics.
2. Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
3. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.
4. To discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
5. To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles

Course Outcomes:

At the end of this course, students will be able to

1. Understand the overview of Graphics system
2. Implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.
3. Describe the importance of viewing and projections.
4. Model, implement and apply fractal geometry concepts.
5. Understand and apply illumination models

UNIT I

Overview of Graphics System: Video Display Units, Raster-Scan and Random Scan Systems, Graphics Input and Output Devices.

Output Primitives: Line drawing Algorithms: DDA and Bresenham's Line Algorithm, Circle drawing Algorithms: Midpoint Circle Algorithm and Bresenham's Circle drawing Algorithm.

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.

Visible Surface Detection Methods: Back-face Detection, Depth Buffer, A- Buffer, Scan- line Algorithm and Painters Algorithm.

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.

Virtual Reality: Types of Virtual reality systems, Input and Output Virtual Reality devices.

Text Books:

1. Computer Graphics with Virtual Reality System, Rajesh K.Maurya, Wiley Dreamtech.
2. Computer Graphics, D. Hearn and M.P. Baker (C Version), Pearson Education

Reference Books:

1. Computer Graphics Principle and Practice , J.D. Foley, A.Dam, S.K. Feiner, Addison, Wesley.

SUBJECT CODE	SUBJECT TITLE	CORE/ ELECTIVE	CREDITS			
			L	T	P	C
CSE 429	Advanced Data Structures and Algorithms	E	3	0	0	3

Course Objectives:

1. To understand the techniques for analysing the complexity of algorithms
2. To learn the concepts of utilizing advanced data structures
3. To design algorithms for complex problem solving with appropriate data structures
4. To provide knowledge in various advanced data structures and algorithms for further research
5. To introduce various algorithm design methods for better programming skills

Course Outcomes:

On successful completion of this course, students should be able to:

1. Show the ability to analyse the efficiency of algorithms.
2. Explain a variety of advanced data structures and their implementations.
3. Identify different algorithm design techniques to solve problems.
4. Solve complex problems by implementing learned algorithm design techniques and data structures.
5. Explain approximation algorithms and NP-completeness.

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

Graphs & Algorithms: Representation, Type of Graphs, Paths and Circuits: Euler Graphs, Hamiltonian Paths & Circuits; Cut-sets, Connectivity and Separability, Planar Graphs, Isomorphism, Graph Coloring, Covering and Partitioning, Topological sort, Max flow: Ford Fulkerson algorithm, max flow – min cut, Dynamic Graphs, Few Algorithms for Dynamic Graphs, Union-Find Algorithms.

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:

1. Thomas Cormen, Introduction to Algorithms, PHI (2009).
2. David E. Goldberg, Genetic Algorithm, Pearson education (2005).
3. Roger Sedgewick and Kevin Wayne , Algorithms, Addison-Wesley Professional(2011) .

Reference Books:

1. Sahni, Sartaj, Data Structures, Algorithms and Applications in C++, MIT Press (2005)