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

Academic Batch: 2018-2022

Department of Computer Science Engineering
SRM University-AP, Andhra Pradesh.

Syllabus B. Tech in Computer Science Engineering

SEMESTER-I

S.No	Course Code	Course Name	L	T	P	C
1	ENL101	Communicative English	3	0	0	3
2	MAT 112	Mathematics-I	3	0	0	3
3	CHE101	Principles of Chemistry	2	0	2	3
4	HSE	Humanities Elective	3	0	0	3
5	CSE 102	Basic Computer Science and Programming	3	0	2	4
6	ECO 121	Principles of Economics	3	0	0	3
7	CDC 111	Soft Skills 1	1	0	0	1
Total Required Credits from this Semester						**20**

SEMESTER-II

S.No	Course Code	Course Name	L	T	P	C
1	MAT 121	Multi Variable Calculus	3	0	0	3
2	BIO 101	Introduction to Biology	2	0	2	3
3	ENG 101	Engineering Fundamentals	3	0	0	3
4	PHY 221	Electricity and Magnetism	2	0	2	3
5	CSE 223	Data Structures and Algorithms using C	3	0	2	4
6	ENG 111	Basic Electronics	3	0	2	4
7	CDC 102	Soft Skills - II	1	0	0	1
Total Required Credits from this Semester						**21**

SEMESTER-III

S.No	Course Code	Course Name	L	T	P	C
1	MAT 211	Linear Algebra	3	0	0	3
2	PHY 112	Classical Mechanics	2	0	2	3
3	ENV 111	Environmental Science	3	0	0	3
4	CSE 201	Design and Analysis of Algorithms	3	0	2	4
5	ECE 211	Digital Electronics	3	0	2	4
6	CDC 203	Verbal Ability	1	0	0	1
Total Required Credits from this Semester						**18**

SEMESTER-IV

S.No	Course Code	Course Name	L	T	P	C
1	MAT 141	Discrete Mathematics	3	0	0	3
2	CSE 202	Web Technology	3	0	2	4
3	CSE 203	Formal Languages and Automata Theory	3	0	0	3
4	CSE 204	Computer Organization and Architecture	3	0	2	4
5	CSE 205	Object Oriented Programming	3	0	2	4
6	CDC 204	Quantitative Aptitude	1	0	0	1
7	CSE 230	Industry Standard Coding Practice-1	0	0	4	1
Total Required Credits from this Semester						**20**

SEMESTER-V

S.No	Course Code	Course Name	L	T	P	C
1	MAT 221	Probability Statistics for Engineers	3	0	0	3
2	CSE 301	Operating Systems	3	0	2	4
3	CSE 306	Compiler Design	3	0	2	4
4	CSE 303	Computer Networks	3	0	2	4
5	CSE SE 1	CS Stream Elective 1	3	0	2	4
6	CSE 304	Database Management Systems	3	0	2	4
7	CSE 330	Industry Standard Coding Practice-2	0	0	4	1
8	CDC 331	Employability Skills	1	1	0	0
Total Required Credits from this Semester						**24**

SEMESTER-VI

S.No	Course Code	Course Name	L	T	P	C
1	MAT 131	Differential Equations	3	0	0	3
2	CSE 305	Software Engineering	3	0	2	4
3	CSE SE 2	CS Stream Elective 2	3	0	2	4
4	CSE TE 1	CS Technical Elective 1	3	0	0	3
5	OE	Open Elective 1	3/4	0	0	3/4
6	OE	Open Elective 2	3/4	0	0	3/4
7	CSE 340	UROP	0	0	6	3
8	ISES 312	Industry Specific Employability Skills-VI	1	1	0	0
9	CSE 331	Industry Standard Coding Practice-3	0	0	4	1
Total Required Credits from this Semester						**24/26**

SEMESTER-VII

S.No	Course Code	Course Name	L	T	P	C
1	CSE SE 3	CS Stream Elective 3	3	0	2	4
2	CSE SE 4	CS Stream Elective 4	3	0	2	4
3	CSE TE 2	CS Technical Elective 2	3	0	0	3
4	OE	Open Elective 3	3/4	0	0	3/4
5	OE	Open Elective 4	3/4	0	0	3/4
6	CSE 460	Capstone Project Phase-I	0	0	12	6
Total Required Credits from this Semester						**23/25**

SEMESTER-VIII

S.No	Course Code	Course Name	L	T	P	C
1	OE	Open Elective 5	3	0	0	3/4
2	CSE 461	Capstone Project Phase-II	0	0	12	6
Total Required Credits from this Semester						9/10
Total credits			**159/164**			

Course Category	Category Code	No of Courses	Credits in curriculum
Humanities and Social Sciences	HS	9	13
Basic Sciences	BS	8	24
Engineering Sciences	ES	9	24
Professional Core	C	12	46
Professional Elective	SE	4	16
	TE	2	6
Open Elective	OE	5	15/20
Project	PR	3	15
	Total	**52**	**159/164**

	List of Steam Specific Electives					
	Artificial Intelligence and Machine Learning Stream					
SE 1	CSE 311	Introduction to Machine Learning	3	0	2	4
SE 2	CSE 314	Digital Image Processing	3	0	2	4
SE 3	CSE 412	Principles of Soft Computing	3	0	2	4
SE 4	CSE 413	Artificial Intelligence	3	0	2	4
	Cyber Security Stream					
SE 1	CSE 312	Introduction to Cryptography	3	0	2	4
SE 2	CSE 315	Network Security	3	0	2	4
SE 3	CSE 410	Mobile and Wireless Security	3	0	2	4
SE 4	CSE 414	Internet Protocols and Networking	3	0	2	4
	Data Science Stream					
SE 1	CSE 311	Introduction to Machine Learning	3	0	2	4
SE 2	CSE 313	Introduction to Data Science	3	0	2	4
SE 3	CSE 411	Big Data Analytics	3	0	2	4
SE 4	CSE 419	Information Retrieval	3	0	2	4

List of Technical Electives					
CSE 321	Human Computer Interaction	3	0	0	3
CSE 322	Advanced Computer Architecture	3	0	0	3
CSE 323	Natural Language Processing	3	0	0	3
CSE 324	Computer Graphics	3	0	0	3
CSE 325	Advanced Data Structures and Algorithms	3	0	0	3
CSE 326	Distributed Operating Systems	3	0	0	3
CSE 420	Data and Web Mining	3	0	0	3
CSE 421	Complexity Theory	3	0	0	3
CSE 422	Software Project Management	3	0	0	3
CSE 423	Multimedia	3	0	0	3
CSE 424	Deep learning	3	0	0	3
CSE 425	Advanced Database Management Systems	3	0	0	3
CSE 426	Fog Computing	3	0	0	3
CSE 427	Parallel Algorithms	3	0	0	3
CSE 428	Web Services	3	0	0	3
CSE 429	Advances in Data Mining	3	0	0	3

SEMESTER-I

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
ENL101	Communicative English	HS	3	0	0	3

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: NON-VERBAL 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 lifestyles; 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.

TEXTBOOKS

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

REFERENCES

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.

LIST OF PRACTICAL EXPERIMENTS

1. Writing Journal 1.
2. Essay on Images.
3. Oral Presentation.
4. Writing Journal 2.
5. Essay on Community.

SEMESTER-I

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
MAT 112	Mathematics - 1	BS	3	0	0	3

UNIT I: LIMIT AND CONTINUITY

Limit of a function at a point. One-sided limits. Continuity. Limits involving infinity.

UNIT II: DIFFERENTIATION

Derivative at a point. Derivative as a function. Product rule, Quotient rule and chain rule. Implicit differentiation. Rolle's Theorem. Mean Value Theorem.

UNIT III: INTEGRATION

Area as a limit of finite sums. Definite and indefinite integral. Fundamental Theorem of Calculus. Integration by substitution. Integration by parts. Integration by partial fractions.

UNIT IV: APPLICATION OF CALCULUS

Maxima and minima. Concavity and curve sketching. Optimization problems in Physics. Economics & Mathematics. Area between curves. Volumes, Arc length, Moments and centres of mass. Newton's method to find roots.

UNIT V: SEQUENCE AND SERIES

Sequences, Sum of a series. Comparison test, Root test, Ratio test. Leibniz theorem on alternating series. Power series, Taylor's and Maclaurin series. Absolute and conditional convergence.

TEXTBOOKS/REFERENCES

1. Thomas' Calculus, 14th Edition, Joel R. Hass, Christopher E. Heil, Maurice D. Weir, 2018.
2. Introduction to Real Analysis 4th Edition, Robert G. Bartle, Donald R. Sherbert, 2014.
3. Calculus and Analytic Geometry, 9th Edition, George B. Thomas, Jr. Ross L. Finney. 2017.

SEMESTER-I

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CHE 101	Principles of Chemistry	BS	2	0	2	3

UNIT I: CHEMICAL BONDING

Introduction to basics such as ionization potential, electron affinity, and electronegativity. Ionic, covalent, and metallic boding with examples and properties of Ionic, covalent, and metallic compounds. Hydrogen bonding, classifications with examples. Nature of covalent bonds such as sigma and pi bonds. VESPER Theory: Hybridization with examples - I VESPER Theory: Hybridization with examples - II Introduction to Molecular Orbital theory. Molecular Orbital theory with examples. Molecular Orbital theory: bond order and magnetic properties.

UNIT II: PHASE RULE, THERMOCHEMISTRY, AND KINETICS

Definition of the terms used in phase rule with examples. Application of phase rule to one component system (eg Water) Application of phase rule to two component system (eg Pb-Sn) Standard terms in thermochemistry and their significance. Heat of combustion, formation, and sublimation (with examples in fuels and propellants) Order and molecularity of reactions, zero order, first order rate equations, and problems associated with Zero & First order.

UNIT III: CRYSTALLINE MATERIALS

Introduction to solid state materials, difference between crystalline and amorphous systems properties of crystalline materials. Crystal lattice, unit cells, types of crystal systems, types of unit cells (Bravais lattices) Miller indices, Bragg's law, problems associated theoretical density of crystals and Bragg's equation. Introduction to Band theory, metals, insulators, and semiconductors with examples. Classification of semiconductors, imperfections in crystals Frenkel and Schottky defects, doping and devices.

UNIT IV: MATERIALS CHEMISTRY

Introduction to Polymers, Classification of polymers Thermoplastic and Thermosetting polymers with examples, Tacticity of polymers. Properties of polymers: Tg, Molecular weight, weight average, Problems associated with Molecular weight, weight average. Degradation of polymers and biodegradable polymers, Common Polymers: Elastomer, Conducting polymer. Hardness in water, demineralization of water and Zeolite process.

UNIT V: ELECTROCHEMICAL DEVICES

Introduction to Electrochemical cells and classification of Electrochemical cells. Primary and secondary cells with examples. Lead-acid battery and Li^+ batteries. Li^+batteries and Fuel cells.

TEXTBOOKS/REFERENCES

1. Bahl, B.S. Bahl, G.D. Tuli, Essentials of Physical Chemistry, (2016), S Chand Publishing Company.
2. R. Puri, L. R. Sharma & M. S. Pathania, Principles of Physical Chemistry, 46th Edition. (2013), Vishal Publication Company.
3. F. Shriver, P. W. Atkins and C. H. Langford, Inorganic Chemistry, 3rd Ed., Oxford University Press, London, 2001.
4. V. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, New Age International, 1986. ISBN: 0-85226-307-4.

5. Atkins, P.W.; de Paula, J. (2006). Physical chemistry (8th ed.). Oxford University Press. ISBN 0-19-870072-5.

LIST OF PRACTICAL EXPERIMENTS

1. Volumetric titration of HCl vs NaOH.
2. Conductometric titration of HCl vs NaOH.
3. Standardization of potassium permanganate by Oxalic acid.
4. Iodometric Determination of Ascorbic Acid (Vitamin C).
5. Determination of hardness of water by EDTA method.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Estimation of iron content of the given solution using potentiometer.
8. Determination of sodium and potassium by flame photometry.

SEMESTER-I

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 102	Basic Computer Science and Programming	ES	3	0	2	4

UNIT I: INTRODUCTION TO PYTHON

Knowledge, Machines, Languages. Types, Variables Operators and Branching. Core elements of programs: Bindings, Strings, Input/Output, IDEs. Input/Output, IDEs. Control Flow, Iteration, Guess and Check. Simple Programs: Approximate Solutions. Bisection Search. Floats and Fractions. Newton-Raphson.

UNIT II: FUNCTIONS

Decomposition and Abstraction. Functions and Scope. Keyword Arguments, Specification. Iteration vs Recursion. Inductive Reasoning. Towers of Hanoi. Fibonacci. Recursion on non – Numerics. Files.

UNIT III: TUPLES AND LISTS

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 IV: 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 V: 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.

TEXTBOOKS

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

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 RobertoThamassia, 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).

LIST OF PRACTICAL EXPERIMENTS

1. A company decided to give bonus of 5% to employee if his/her year of service is more than 5 years. Ask user for their salary and year of service and print the net bonus amount.
2. Write a program that computes the real roots of a quadratic function. Your program should begin by prompting the user for the values of a, b and c. Then it should display a message indicating the nature of real roots, along with the values of the real roots (if any).
3. Write a Python program to find the factorial of the given number (Example: 5!= 5*4*3*2*1 =120).
4. Write a Python program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until "-10" is encountered.
5. Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings.
6. Write a python program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm? Explain with an example, where the list of elements is not sorted then what would be the output after each iteration/pass.
7. Write a python program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
8. Write a Program in python using object-oriented concept to make calculator which has the following operations: Addition, Subtraction, Multiplications, Divisions, Exponentials, Modulus.
9. Define is inheritance? Explain with suitable example: Single level inheritance, Multiple Inheritance, Multi-level Inheritance.
10. Write a Program in python using object-oriented concept to create a base class called Polygon and there are three derived classes named as triangle, rectangle and square. The base class consists of the input function for accepting sides length and the derived classes must have output function for displaying area of triangle, rectangle and square.

SEMESTER-I

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
ECO 121	Principles of Economics	HS	3	0	0	3

UNIT I: INTRODUCTION TO ECONOMICS

Why study economics? Scope and method of economics; the economic problem: scarcity and choice; the question of what to produce, how to produce and how to distribute output.Science of economics; the basic competitive model; prices.Science of economics; the basic competitive model; prices,Property rights and profits; incentives and information; rationing;Opportunity sets; economic systems; reading and working with graphs.

UNIT II: DEMAND AND SUPPLY

Determinants of individual demand/supply; demand/supply schedule and demand/supply curve; market versus individual demand/supply; Shifts in the demand/supply curve, demand and supply together;How prices allocate resources; elasticity and its application;How prices allocate resources; elasticity and its application;Controls on prices; taxes and the costs of taxation;Controls on prices; taxes and the costs of taxation;Consumer surplus; producer surplus and the efficiency of the marketsConsumer surplus; producer surplus and the efficiency of the markets.

UNIT III: CONSUMER THEORY

The consumption decision - budget constraint, The consumption decision - budget constraint, consumption and income/price changes. Demand for all other goods and price changes; Utility and preferences (indifference curves); properties of indifference curves; Utility and preferences (indifference curves); properties of indifference curves; Consumer ‘s optimum choice Income and substitution effects; Applying consumer theory: Labour Applying consumer theory: Labour

UNIT IV: PRODUCER THEORY

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 V: TYPES OF MARKET

Perfect competition –features Perfect competition- profit maximization Shut-down and break-even points. Monopoly: marginal revenue; marginal cost; profit maximization; Shutdown rule; market power; price discrimination. Monopolistic competition and product differentiation.

TEXBOOKS:

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

REFERENCES:

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

SEMESTER-I

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CDC 111	Soft Skills-1	HS	1	0	0	1

UNIT I: KNOW THYSELF

Grooming & Social etiquette, SWOT Analysis, Psychometric Analysis using simple tests.

UNIT II: PERSONALITY DEVELOPMENT

Personality construct, The KSAB Model, Components of perception, perceptual errors, perception as a precursor of attitude and behavior.

UNIT III: COMMUNICATION

Verbal and Non-Verbal Communication. Three V's of communication. Visual or Kinesics. Vocal (Articulation), Verbal, Active listening, Barriers to listening, GARF (Giving and Receiving Feedback) Activity.

UNIT IV: PRESENTATION SKILLS

The four Ps of presentation. Different types of presentations and importance. Handling different types of target audience. Techniques and Tips to give an effective presentation. Activity.

UNIT V: TIME MANAGEMENT & GOAL SETTING

Pressure Cooker (Activity based on Planning, Organizing and Prioritization), Roller Coaster (Activity on setting SMARTER goals, planning & organizing, short- & long-term goals).Activity.

TEXTBOOKS/REFERENCES

1. Mitchell S. Green – 2017, Know Thyself: The Value and Limits of Self-Knowledge.
2. Debbie Hindle, Marta Vaciago Smith - 2013, Personality Development: A Psychoanalytic Perspective.
3. Lani Arredondo - 2000, Communicating Effectively.
4. Patsy McCarthy, Caroline Hatcher - 2002, Presentation Skills: The Essential Guide for Students.
5. Martha Davis, Elizabeth Robbins Eshelman, Matthew McKay - 2008, Time Management and Goal Setting: The Relaxation and Stress..

SEMESTER-II

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
MAT 121	Multi-Variable Calculus	BS	3	0	0	3

UNIT I: VECTOR AND MATRICES

Three-dimensional coordinate system. Vectors. Dot products. Vector products. Lines and planes.

UNIT II: PARTIAL DERIVATIVES

Functions of several variables. Limits and continuity for several variable functions. Partial derivatives. The chain rules. Directional derivatives. Gradient.

UNIT III: DOUBLE INTEGRAL AND LINE INTEGRALS IN THE PLANE

Extreme values. Saddle points. Lagrange multipliers.

UNIT IV: TRIPLE INTEGRALS IN 3D

Double and integrated integrals. Area by double integration.

UNIT V: SURFACE INTEGRAL IN 3D

Triple integration and applications.

TEXTBOOKS:

1. Edwards, Henry C Thomas- Calculus, 14th edition. Chapters 12 to 16relevant sections**.**
2. Apostol, Calculus - Vol.2, 2nd Edn., Wiley India, 2003.

SEMESTER-II

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
BIO 101	Introduction to Biology	BS	2	0	2	3

UNIT I: BASIS OF LIFE AND DIVERSITY

Molecular evolution. Elements to molecules: water, carbohydrates, lipids, Proteins, nucleic acids, Vitamins and minerals, Diversity of life: virus, bacteria, archaea and eukarya, Concept of terrestrial, Aquatic and amphibians, Mode of energy & carbon utilization-auto, Hetero and lithotrophs.

UNIT II: CELL BIOLOGY

Cell: morphology Cell organelles and functions, Concept of unicellular and multicellular organisms, Cell cycle and cell division: mitosis and meiosis, Basis of cell-cell communication and signaling.

UNIT III: BASIC MOLECULAR BIOLOGY

DNA and Chromosomes: structure and organization. DNA replication. Transcription. Translation. Introduction to genetic engineering.

UNIT IV: ENZYMES AND APPLICATIONS

Introduction to enzymes; classification Parameters influencing the enzyme activity; Mechanism of enzyme action and enzyme inhibition, Commercial applications of microorganisms and enzymes.

UNIT V:BIOLOGICAL SEQUENCES AND DATABASES

DNA and Protein sequences. Concept of genomics, transcriptomics. Proteomics and metabolomics. File formats of sequence storage: FASTA file, GenBank. Biological databases – NCBI and EMBL browsers. KEGG and UniProtdatabases. Usefulness of biological Metadata-Array expression and 1000 genomes. Application of BLAST and Protein/Gene ID conversion.

TEXTBOOKS/REFERENCES

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. Cooper, G. M., Hausman, R. E. The cell: a molecular approach. (2009). ASM Press, Washington D. C.
5. Lehninger, A. L., Nelson, D. L., & Cox, M. M. Lehninger principles of biochemistry. (2000). Worth Publishers, New York.
6. Wilson, K., Walker, J. Principle and techniques of biochemistry and molecular biology, (2005). 6th edn. Cambridge University Press, Cambridge.
7. Harvey Lodish, Arnold Berk and Chris A. Kaiser, Molecular Cell Biology, Ed. 8, 2016, W. H Freeman & Co (Sd).
8. Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. 2014. Molecular Biology of the Cell. (Sixth Edition). W. W. Norton & Company.
9. Scott Freeman, Kim Quillin, Lizabeth Allison, Michael Black, Emily Taylor, Greg Podgorski and Jeff Carmichael. 2016. Biological Science. (6th Edition). Pearson.
10. Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece. 2016.

Campbell Biology (11th Edition). Pearson.
11. Peter H Raven, George B Johnson, Kenneth A. Mason, Jonathan Losos and Susan Singer. 2016. Biology. (11th Edition). McGraw-Hill Education.

LIST OF PRACTICAL EXPERIMENTS:

1. Isolation of starch from potato.
2. Estimation of carbohydrates.
3. Determination of enzyme activity (amylase assay).
4. Observation of various stages of mitosis in onion root tips.
5. Isolation, purification and observation of microbes from different sources.
6. Microbial gram staining.
7. Purification of DNA, restriction digestion, agarose gel electrophoresis and visualization.
8. Isolation of proteins and determination of protein concentration using Bradford's method.
9. Separation of proteins using SDS-PAGE and Coomassie staining.

SEMESTER-II

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
ENG 101	Engineering Fundamentals	ES	3	0	0	3

UNIT I: THERMODYNAMICS

Sources of Energy, Types of Prime Movers. Basic concepts, Microscopic and macroscopic approach. Thermodynamic system and surrounding. Properties of a system, Intensive and extensive, Specific and total quantities, Path and point functions. Thermodynamic process, cycle and equilibrium, Quasi-static, Reversible and Irreversible processes. Heat and work transfer, displacement work, flow work and other modes of work, p-V diagram, Zeroth law of thermodynamics, concept of temperature.

First law of thermodynamics, energy, enthalpy, specific heats, limitations of first law, cyclic heat engine, energy reservoirs. Applications of first law, Statements of second law and their equivalence. Reversibility, Irreversibility and Causes of irreversibility. Carnot cycle, Carnot theorem, Clausius theorem, Concept of entropy.

UNIT II: HEAT ENGINES

Classification of energy sources, Introduction to fuels and combustion, Classification of fuels, calorific value, Global warming, Thermal prime movers, elementary heat engines, working substances, classification of heat engines, Heat engine cycles – Carnot cycle and its efficiency.

Properties of water, ideal Rankine cycle (vapor power cycle), methods to improve Rankine cycle efficiency. Air standard cycles, Piston cylinder geometry and arrangement. Ideal Otto cycle. Ideal Diesel cycle, differences between petrol and diesel engines 2 stroke engines, differences between 2 stroke and 4 stroke engines, IC Engine components

UNIT III: FLUID MECHANICS

Introduction, 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 viscosity.

UNIT IV: MECHANICAL ENGINEERING EQUIPMENT

Pump basics – Classification, Centrifugal, Positive displacement, Reciprocating; Compressor basics - Air compressors, compressor cycle, centrifugal, axial compressor, Refrigeration basics – vapor compression refrigeration cycle, refrigerant properties, COP; Air conditioning (AC) principle and AC ratings.

Basics of brakes, couplings and clutches: types of couplings, clutches and brakes, Basics of power transmission elements – types of belt, chain, rope and gear drive systems.

UNIT V: MATERIALS AND PROPERTIES

Engineering materials and their classification – plastics, wood, composites, ceramics, metals, fabrics, smart materials, Stress-strain relationship, tensile test, compression test, tensile vs compression test. Mechanical properties of materials, material failure

ENGINEERING ESSENTIALS

Business ethics and values (Guest lecture) Basics of Engineering graphics - Projections of points, lines and planes, Orthographic Projections: front, top, side; sectional views (Guest lecture)

DESIGN PROJECT

Selection of team project; guidance in project execution

TEXTBOOKS

1. Elements of Mechanical Engineering, Sadhu Singh, S. Chand and Company Ltd. 2013.
2. Elements of Mechanical Engineering, V. K. Manglik, PHI Publications, 2013.
3. An Introduction to Mechanical Engineering, Jonathan Wickert, Cengage Learning India Private Limited, 3rd edition, 2015.

REFERENCES

1. Basic Mechanical Engineering, C.M. Agrawal, Basant Agrawal, Wiley, 2008
2. Elementary Engineering Drawing (First Angle Projection), Bhatt, N.D., Charotar Publishing Co., Anand, 1999.
3. Studying Engineering: A Road Map to a Rewarding Career, Landis, R.B., Discovery Press, (1995)
4. A Foundation Course in Human Values and Professional Ethics, R.R. Gaur, R. Sangal and G.P. Bagaria, Excel Books, 2010.

SEMESTER-II

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
PHY 221	Electricity and Magnetism	ES	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, Electric Potential. Potential Energy. Conductors under Electrostatic Equilibrium. Capacitors.

UNIT III: DIELECTRICS AND POLARIZATION

Introduction to Electric Dipole and dipole Moment. Potential and field due to electric dipole. Polarization in dielectrics. Modification of Gauss's Law in terms of electric displacement. Electric Susceptibility and dielectric constant. Bound charges.

UNIT IV: MAGNETOSTATICS

Magnetic force and cyclotron. Biot-Savart Law for magnetic fields. Magnetic field due to various current loops. Ampere's circuital law. Equation of Continuity. Magnetization in Materials.

UNIT V: INTRODUCTION TO ELECTRODYNAMICS

Introduction to time-varying fields. Faraday's law of induction. Generalization of Ampere's law. Maxwell's equations. Derivation of wave equation. Planar Waves in free space.

TEXTBOOKS

1. Introduction to Electrodynamics (4th 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)

LIST OF PRACTICAL EXPERIMENTS

1. To find the dielectric constant of the medium using parallel plate capacitor.
2. To find the band gap energy of a semi-conductor using Four-probe method.
3. To find the band gap energy of a semi-conductor using Four-probe method.
4. Find the magnetic field due to Helmholtz coils and verify its relation by varying the distance.
5. Use Faraday's law for finding the total magnetic flux through the coil.
6. To find the type and concentration of charge carriers using hall probe.
7. Verify the Biot-Savart law for a given circular coil.
8. To find the fill factor of a given solar cell using I-V characteristics.
9. To find the type of material using the deflection in magnetic field.
10. To study the Hysteresis curve for a given magnetic material.

11. Practice session I and remedial session.
12. Practice session II and remedial session.
13. Model Exam.

SEMESTER-II

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 223	Data Structures and Algorithms using C	ES	3	0	2	4

UNIT I: INTRODUCTION TO C PROGRAMMING

Basic elements of C: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: representation and application, implementation of stack operations using C. Queues: Representation and application, implementation of queue operations using C. Example applications on Stacks and Queues. Linked lists: Single linked lists representation. Implementation of linked list various operation using C. Double linked list representation. Implementation of double linked list various operation using C. Circular list. Implementation of Circular linked list various operation using C.

UNIT III: TREES

Tree terminology, Binary tree, Binary search tree, infix to post fix 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

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.

TEXTBOOKS

1. "Data structure using C", Aaron M. Tenenbaum, Y Langsam and Mosche J. Augenstein, Pearson pu blication.
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.

REFERENCES

1. Programming with C, Byron Gottfried, McGraw hill Education, Fourteenth reprint,2016.
2. "Fundamentals of data structure in C" Horowitz, Sahani & Anderson Freed, Computer SciencePress.
3. "Fundamental of Data Structures", (Schaums Series) Tata-McGraw-Hill.
4. G. A. V. Pai: "Data Structures & Algorithms; Concepts, Techniques

&Algorithms" Tata McGraw Hill.
5. Gilberg and Forouzan, "Data Structure- A Pseudo code approach with C" byThomsonpublication.

LIST OF PRACTICAL EXPERIMENTS

1. Write a C program to find the factorial of the given number (Example: 5!= 5*4*3*2*1 =120).
2. Write a C program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until "-10" is encountered.
3. Write a C program for implementation of Stack operations using arrays.
4. Write a C program for implementation of Queue operations using arrays.
5. Write a C program for Linked list implementations and problems related to linked list such as inverting list, concatenation, etc.
6. Write a C program for Linked list-based implementation of stack and queue operations.
7. Write a C program for Evaluation of expressions.
8. Write a C program for implementation of Binary tree traversals techniques.
9. Write a C program for implementation of Graph traversals techniques (BFS and DFS).
10. Write a C program for Linear search and Binary search algorithms. What is the best case and worst-case time complexity of those searching algorithms?
11. Write a C program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm?
12. Write a C program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
13. Write a C program for Insertion sort algorithm. What is the worst case or average case time complexity of Insertion sort algorithm?
14. Write a C program for Quick sort algorithm. What is the worst case or average case time complexity of Quick sort algorithm?
15. Write a C program for Merge sort algorithm. What is the worst case or average case time complexity of Merge sort algorithm?

SEMESTER-II

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
ENG 111	Basic Electronics	ES	3	0	2	4

UNIT I: BASIC ELECTRONIC CIRCUIT CONCEPTS

Introduction to Units, Scales, Charge, Current, Voltage, Power. Voltage and Current Sources, Dependent and Independent Sources Ohm's Law, Resistance, Conductance, Resistivity, Conductivity Introduction to Nodes, paths, Branches, Loop and KCL, Numericals Single Loop and node pair circuits analysis Series and Parallel connected sources, Resistors in series, parallel Voltage and Current Division, Numericals. Thevenin Equivalent Circuits. Norton Equivalent Circuits.

UNIT II: SEMICONDUCTOR BASICS AND DIODE MODELS

Introduction to Semiconductors- Si, Ge, GaAs, Covalent bonding and Intrinsic Semiconductors, Difference in band Diagrams of Insulators, conductors, Semiconductors.

Doped Semiconductor, n-type and p-type. Current mechanisms in Semiconductor-Drift and Diffusion with expressions, Resistivity of a semiconductor, Numericals. PN Junction Diode Operation under No Bias, Forward bias, Reverse Bias conditions, I-V characteristics.

Reverse Breakdown, Effect of Temperature on Diode characteristics. I-V Characteristics of Ideal vs Practical diodes, Diode Resistance levels.Diode Equivalent circuits- Piecewise, Simplified and Ideal Diode models and I-V Characteristics. Diode Capacitances and Reverse recovery time. Zener Diode operation.

UNIT III: **DIODE APPLICATIONS**

Load line Analysis, Series and Parallel Diode Configurations and analysis of circuits with application of KCL, KVL, etc.Diode based AND/OR Logic gates design and analysis.Half wave Rectifier Operation; Circuit, waveforms, DC output, Peak output, Ripple factor with a filter circuit, PIV.Full wave Rectifier Operation; Circuit, waveforms, DC output, Peak output, Ripple factor, PIV. CT Full wave Rectifier Operation; Circuit, waveforms, DC output, Peak output, Ripple factor with a filter circuit, PIV. Analysis and Design with Series and Parallel configuration of Clipper circuits. Clamper Circuits and analysis with DC sources. Zener Diode as Voltage Regulator circuit.

UNIT IV: BJT and MOSFETs

BJT structure and Physical operation. Large signal models and Operation in Saturation. BJT Current-Voltage characteristics and Graphical Representation. Early effect and model. Analysis of BJT circuits at DC. Analysis of BJT circuits at DC MOSFET structure and operation. P-MOSFET and CMOS introduction. MOSFET I-V Characteristics, Large signal model. Channel Length modulation and Characteristics, Model. Analysis of MOSFET circuits at DC.

UNIT V: SINGLE STAGE TRANSISTOR AMPLIFIERS

Basic Principles of Amplification: BJT vs MOSFET.BJT and MOSFET small signal operation and models. Analysis of CS and CE Amplifiers. Analysis of CS (CE) Amplifiers with source (Emitter) Resistance, Analysis of CG and CB Amplifiers. Analysis of Source and Emitter followers. BJT and MOSFET biasing arrangements. Amplifier Frequency Response Introduction.

TEXTBOOKS

1. Engineering Circuit Analysis, by William Hayt, J E Kemmerly and S.M. Durbin, 8th Edition, Mc Graw Hill.
2. "Electronic Devices and Circuit Theory" by R L Boylestad, L Nashelsky, 11th edition.

3. “Microelectronic Circuits Theory and Applications”, by Sedra and Smith, 7th Edition, Oxford.

LIST OF PRACTICAL EXPERIMENTS

1. Verification of KCL, KVL and Ohm’s Laws.
2. Analysis of a Given Circuit with Resistors and Sources and Verification.
3. Verification of PN Junction Diode I-V Characteristics in FB and RB Operation.
4. Diode based Rectifier Circuits.
5. Introduction to PCB design.
6. Diode based Clipper and Clamper Circuits.
7. Zener Diode As Voltage Regulator.
8. BJT CE Configuration Input and Output Characteristics.
9. MOSFET CS Configuration Input and Output Characteristics.
10. MOSFET Single stage CS Amplifier Frequency Response.

SEMESTER-II

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CDC 102	Soft Skills - 2	HS	1	0	0	1

UNIT I: MOTIVATION

Maslow's theory of Motivation. Soldiers' Walk and The Japanese Fan (Activities on factors of motivation), Steps to ward off de-motivation.

UNIT II: CREATIVITY & INNOVATION

Activity on Brain Storming, Types of Creativity, Common Barriers of creativity. Sources of New Idea. Activity topics to enhance the power of aesthetics and precision. Aim is to create interest in research. Activity.

UNIT III: CRITICAL & LATERAL THINKING

Importance's of Critical and Lateral thinking. Fill Me Up, Stimulating Lateral Thinking. Activity to enhance critical and lateral thinking.

UNIT IV: TEAM DYNAMICS

Importance of Team Dynamics. Story boarding, Frenzy. Activities 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.

TEXTBOOKS/REFERENCES

1. Maslow, A. H. (1943) A Theory of Human motivation. In R. J. Lowry (1973) Dominance, Self-Esteem, Self-Actualization: Germinal Papers of A.H. Maslow (pp. 153-173). Belmont, California: Wadsworth Publishing Company, Inc.
2. Sparking Student Creativity, Practical ways to promote innovative and problem solving, Patti Drapeau.
3. Teach yourself to think, Edward de Bono, 1995.

SEMESTER-III

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
MAT 211	Linear Algebra	BS	3	0	0	3

UNIT I: MATRICES AND GAUSSIAN ELIMINATION

Introduction, Geometry of Linear Equations. Gaussian Elimination. Matrix Notation and Matrix Multiplication. Triangular Factors and Row Exchanges. Inverses and Transposes.

UNIT II: VECTOR SPACES

Vector spaces and Subspaces. Solving $Ax = 0$ and $Ax = b$ Linear Independence, Basis and Dimension. The Four Fundamental Subspaces. Graphs and Networks, Linear Transformations.

UNIT III: ORTHOGONALITY

Orthogonal Vectors and Subspaces. Cosines and Projections onto Lines. Projections and Least Squares. Orthogonal Bases and Gram-Schmidt.

UNIT IV: DETERMINANTS

Introduction. Properties of the Determinant. Formulas for the Determinant. Applications of Determinants.

UNIT V: EIGENVALUES AND EIGENVECTORS

Introduction, Diagonalization of a Matrix. Difference Equations and Powers A^k Differential Equations and e^{At} Complex Matrices, Similarity Transformations.

TEXTBOOKS/REFERENCES

1. Gilbert Strang, Linear Algebra and Its applications, Nelson Engineering, 4th Edn., 2007
2. S. Axler, Linear Algebra Done Right, 2nd Edn., UTM, Springer, Indian edition, 2010.
3. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall of India, 1996

SEMESTER-III

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
PHY 112	Classical Mechanics	BS	2	0	2	3

UNIT I: REVIEW OF NEWTONIAN MECHANICS

Review of Scalars, Vectors, Kinematics: Equations of motion for constant acceleration and non-constant acceleration. Dynamics: Contact forces, Static friction, kinetic friction and worked examples. Free body force diagram: Applications of Newton's law, worked examples, Tension, Pulley systems, worked examples, solving various pulley systems using free body force diagram and Newton's law.

UNIT II: CIRCULAR MOTION

Polar Coordinates; conversion between Cartesian and polar coordinates, Angular position, velocity and acceleration, Angular motion for a constant angular acceleration, Radial and tangential acceleration, uniform Circular Motion, Period and Frequency, Free body force S diagrams.

Application of Newton's law in circular motion with worked examples. Worked examples, conversion from revolution per minute to angular Velocity, worked examples, Flat curved roads and Banking, Conical pendulum, circular motion in vertical plane.

UNIT III: MOMENTUM AND IMPULSE

Momentum and Impulse, Impulse momentum theorem, Average force, worked examples, Conservation of Momentum, Momentum Diagrams, Worked examples, Center of Mass of point objects and continuous systems, worked examples, enter of Mass of a Uniform Rod, rectangular sheet and different objects.

Motion of the Center of Mass; Velocity and Acceleration of the Center of Mass, education of a System to a Point Particle, Center of Mass Trajectory, projectile blast problem.

UNIT IV: WORK ENERGY AND COLLISION

Kinetic Energy and Work in 1D, 2D and 3D; Work by a Constant and a non- Constant Force.

Work-Kinetic Energy Theorem and worked examples. Conservative and Non-conservative Forces with examples, Potential Energy due to gravity and Potential Energy of a spring.

Principle of energy conservation; worked examples. Collision and its type. Collision in 1D and 2D, Elastic and inelastic collision; worked examples.

UNIT V: ROTATIONAL MOTIONS, GRAVITATION

Rigid body, Rotational Motion, moment of inertia.Moment of inertia of various objects, worked examples, Parallel and perpendicular axis theorem. Torque and Angular momentum, conservation of angular momentum, worked examples.

Rolling motion, worked examples, Conservation of energy in rotational motion. Central forces, Newton's Law of Gravitation. Acceleration due to gravity and its variation, Gravitational Potential Energy.

TEXTBOOKS

1. MIT-- 8.01X online course material.
2. Physics for Scientist and Engineers, Ninth edition (2017) - Raymond A. Serway, John W. Jewett (Publisher - Cengage India Private Limited)

REFERENCES

1. University Physics with Modern Physics with Mastering Physics, (12th Edition) - Hugh D. Young, Roger A. Freedman and Lewis Ford (Publisher – Pearson Education).
2. Laboratory manuals.

LIST OF PRACTICAL EXPERIMENTS

1. Experimental data analysis.
2. Error Analysis.
3. Revisions of Vernier caliper.
4. Revisions of Screw Gauge.
5. Determination of Young's modulus of the material.
6. Determination of rigidity modulus of the material - torsional pendulum.
7. Determine moment of inertia of a flywheel.
8. Determination of spring constant.
9. Compound Pendulum.
10. Determination of velocity of Sound in a medium.
11. Determination of thermal conductivity of a given material.
12. Measurement of specific heat capacity of any given material.
13. Verification of Stefan`s Law.
14. Determination of Joule's Constant.

SEMESTER-III

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
ENV 111	Environmental Science	BS	3	0	0	3

UNIT I: ENVIRONMENTAL CRISIS AND SUSTAINABLE DEVELOPMENT

Global environmental crisis and its causes, man-environment relationship. Ecological footprint, what is sustainable development, why you should study environmental science?

UNIT II: ECOSYSTEMS

What is an ecosystem? Structure and functions of an ecosystem. Energy flow in an ecosystem, biomass flow in an ecosystem, food chain and web. Ecological pyramid, water cycle, carbon cycle, Sulphur cycle. Forest ecosystems: tropical rain forest, coniferous forests, tundra forests, temperate forests. Grasslands and desert ecosystems. Aquatic ecosystems: zones in ocean, ocean activities, coastal zones. Aquatic ecosystems: freshwater zones, wetlands, estuaries, rivers, streams, mangroves, state of rivers in India.

UNIT III: RENEWABLE AND NON-RENEWABLE RESOURCES

What is a renewable resource? What is a non-renewable resource? Water usage, scarcity. Why is water getting scarce? Water for irrigation, water situation in India. Energy resources: Global energy crisis, energy sources, energy needs, global energy consumption. Energy resources: fossil fuel vs renewable fuels, peak oil. conventional and unconventional oil, oil price determination. Energy resources: Types of energy – Coal, natural gas. Energy resources: hydrogen, hydropower, solar, wind energy.

UNIT IV: BIODIVERSITY

What is biodiversity? Species in the world, current state of biodiversity. Biological hotspot, aquatic biodiversity, level of biodiversity in India. Endangered species causes of biodiversity loss. Threats to biodiversity, biodiversity conservation. Role of zoo in biodiversity conservation, seed banks, botanical gardens. Biodiversity conservation: marine biodiversity protection, international efforts. Biodiversity conservation: conservation in India, protecting wild flora and fauna.

UNIT V: POLLUTION AND POLICIES

Solid waste management in cities, hazardous waste, effluent treatment, liquid waste. Water pollution, eutrophication of lakes, ground water pollution, water quality measurement, sewage water treatment, water purification. Air and noise pollution, sources of air pollution, smog, urban heat island, air pollution in India, effects of noise pollution Climate change, IPCC assessment, carbon dioxide concentration, ozone layer depletion, international initiatives. Environmental laws, environmental laws in India for water, air, wildlife protection, forests, environment. Disaster management, global disasters, tsunami, landslides, floods, cyclones, nuclear disasters, state of

disaster management in India. Summary of environmental issues, conflicts, problems, and solutions.

LIST OF PRACTICAL EXPERIMENTS FOR DEMONSTRATION

1. Water parameters- Test for alkalinity and turbidity of water.
2. Determination of dissolved oxygen in water.
3. Test for total suspended solids and total dissolved solids.
4. Determination of total hardness of water by EDTA titration
5. Determination of biological oxygen demand of wastewater.
6. Determination of chemical oxygen demand of wastewater.
7. Test for iron content in river water.

TEXTBOOKS

1) Environmental Studies (3rd edition) by R. Rajagopalan in Oxford University Press, 2016. ISBN: 9780199459759.

SEMESTER-III

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 201	Design and Analysis of Algorithms	C	3	0	2	4

UNIT I: INTRODUCTION

Algorithmic thinking & motivation with examples, Reinforcing the concepts of Data Structures with examples. Complexity analysis of algorithms: big O, omega, and theta notation, Analysis of Sorting and Searching, Hash table, Recursive and non-recursive algorithms.

UNIT II: 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 algorithm, Huffman coding Dynamic Programming: 0/1 Knapsack, All-to-all shortest paths

UNIT III

BFS & DFS, Backtracking: 8-Queens problem, Knights tour, Travelling Salesman Problem (TSP), Branch-and-bound: 16-puzzle problem, TSSP, Randomized algorithms: Playing Cards, Scheduling algorithms.

UNIT IV: PATTERN MATCHING ALGORITHMS

Brute-force, Boyer Moore, KMP algorithms. Algorithm analysis: Probabilistic Analysis, Amortized analysis, Competitive analysis.

UNIT V: NON-POLYNOMIAL COMPLEXITY

Examples and analysis, Vertex cover, Set cover, TSP, 3-SAT Approximation Algorithms: Vertex cover, TSP, Set cover

TEXTBOOKS

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.

REFERENCES

1. Michel Goodrich, Roberto Tamassia, "Algorithm design-foundation, analysis & internet examples", Wiley., 2006.
2. A V Aho, J E Hopcroft, J D Ullman, "Design and Analysis of Algorithms", Addison-Wesley Publishing.
3. Algorithm Design, by J. Kleinberg and E. Tardos, Addison-Wesley, 2005.
4. Algorithms, by S. Dasgupta, C. Papadimitriou, and U. Vazirani, McGraw-Hill, 2006.

LIST OF PRACTICAL EXPERIMENTS

1. Selection sort, Insertion sort, Heap sort.
2. Creating singly linked list + Hash table as a set of linked lists.
3. Towers of Hanoi (Recursive& Non-recursive).
4. Merge sort.
5. Quicksort.

6. Fractional Knapsack.
7. Minimum-spanning tree.
8. One-to all shortest paths.
9. All-to-all shortest paths.
10. 0/1 knapsack.
11. Transitive closure/ Reachability problem.
12. Eight queens' problem.
13. 16-puzzle.
14. TSP approximation algorithm.
15. Vertex cover: Approximate algorithm.

SEMESTER-III

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
ECE 211	Digital Electronics	C	3	0	2	4

UNIT I: DIGITAL LOGIC FUNDAMENTALS

Digital signals, Number systems and binary codes. Logic gates and arithmetic operations. Boolean algebra, functions, theorems and practice. K-Map method upto 4, 5 variables. SOP and POS simplification and don't care conditions. Quine McClusky method. 1's and 2's complement arithmetic. Code conversions: Binary, BCD, Gray and Excess 3 Alphanumeric codes: ASCII, EBCDIC & Unicode.

UNIT II: COMBINATIONAL LOGIC DESIGN

Introduction to combinational logic circuits. Analysis of combinational circuits. Design procedure of combinational circuits. Binary adder/subtractor carry look ahead adder. Decimal adder. Multiplexer and Demultiplexer. Encoder and Decoder. Magnitude comparator. Priority encoder.

UNIT III: **SEQUENTIAL LOGIC CIRCUITS AND APPLICATIONS**

Sequential logic circuits: Latches & Flip-flops. SR, JK, T and D latches and Flipflops and their operation. Master and Slave Flip-flop - Operation and Excitation table. Analysis and design procedure of clocked sequential logic circuits. Sequential circuit design: Moore and Mealy models. State minimization, state assignment and circuit implementation. Design of Ripple counter, Ring counter and Johnson counter. Analysis and procedure of synchronous counter design. Shift Registers and universal shift registers.

UNIT IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS

Stable and Unstable states. Meta stable states. Output specifications, cycles and races. State reductions and race free assignments. Introduction to Hazards. Classification of Hazards. Analysis of circuits to avoid hazards. Design of hazard free circuits. MOSFET I-V Characteristics, Large signal model. Channel Length modulation and Characteristics, Model. Analysis of MOSFET circuits at DC.

UNIT V: MEMORY DEVICES

Introduction and classification of storage element. ROM organization: PROM, EPROM, EEPROM and EAPROM. RAM organization: SRAM, DRAM. Programmable logic device (PLD). Programmable logic array (PLA). Programmable array logic (PAL). Field Programmable Gate Arrays (FPGA). Implementation of combinational logic circuits using ROM. Implementation of combinational logic circuits using PLD.

TEXTBOOKS

1. M. Morris Mano, Digital Design, 5th Edition, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2014
2. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, 6th Edition, TMH, 2006.

LIST OF PRACTICAL EXPERIMENTS

1. Realization of Basic Logic Gates.
2. Design of Code Converters (Binary to Gray) & (Gray to Binary).
3. Design of
   a) Half-Adder/Subtractor
   b) Full-Adder/Subtractor
   c) Multiplexers/De Multiplexers
   d) ALU Design
4. Design of Decoder and Encoder/ BCD 7SSD
5. Design of Magnitude Comparator (2-bit)
6. Design and Verification of Flip-Flops using IC
7. Design of Asynchronous Counter (Any Mod, Up and Down, Jhonson and Ring)
8. Design of Synchronous Counter (Any Mod, Decade counter 74ls90)
9. Design of Universal Shift Register (Serial to Parallel, Parallel to Serial, Serial to Serial and Parallel to Parallel Converters)
10. Design & Verification of Memory (SRAM)
11. FSM Based Design Project.

SEMESTER-III

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CDC 203	Verbal Ability	HS	1	0	0	1

UNIT I: QUANTITATIVE REASONING

Number properties, Percentage, Ratio and proportion, Profit and loss, Simple and compound interest, Averages, Speed, Time and work, Powers and roots, Linear equations, Quadratic equations, Pipes, cisterns.

UNIT II: VERBAL REASONING

Proposition, Premise: Syllogism: Verbal Analogies, Verification of truth of the statement, Assertion and reason, Situation reaction test, Decision making, Alpha-numerical sequence puzzle.

UNIT III: VERBAL ABILITY

Preposition, Articles, Adverbs, Adjectives, Conjunctions and Parallel Structures.

UNIT IV: DATA ANALYSIS AND INTERPRETATION

Statistics: Average, Median, Mode, Range, Standard deviation.

TEXTBOOKS

1. R.S. Agarwal, A Modern Approach to Verbal &Non-Verbal Reasoning, S. Chand Publication.
2. P. Anand, Quantitative Aptitude, Wiley, 2015.
3. Archana Ram, Placementor, Oxoford Publication, 2018.

SEMESTER-IV

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
MAT 141	Discrete Mathematics	C	3	0	0	3

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.

UNITIII: ELEMENTARY NUMBER THEORY, INDUCTION AND RECURSION

Divisibility and Modular Arithmetic, Integer Representations and Algorithms, Primes and Greatest Common Divisors, Solving Congruence's; Mathematical Induction, Strong Induction and Well- Ordering, Recursive Definitions and Structural Induction.

UNITIV: COUNTING PRINCIPLES

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

UNITV: NTRODUCTION TO GRAPH THEORY

Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Eulerand Hamilton Paths, Shortest-Path Problems.

TEXTBOOKS

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.

REFERENCES

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

SEMESTER-IV

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 202	Web Technology	C	3	0	2	4

UNIT I: WEB ESSENTIALS

Introduction to World Wide Web (WWW) Introduction to Communication Models. Web site design principles, planning the site and navigation. Introduction to Hypertext Markup Language (HTML) Form design using HTML. Basics of Extensible Hypertext Markup Language (XHTML) Basics of W3C Markup Validation Service.

UNIT II: CLIENT-SIDE SCRIPTING

Introduction to Cascading Style Sheets (CSS) Style sheets in HTML. Introduction to Java scripts. Syntax variables and data types in Java scripts. Operators in Java scripts. Arrays and user defined functions in Java script. Java script objects.

UNIT III: HOST OBJECTS: BROWSERS AND THE DOM

XML-Documents and Vocabularies. XML Namespaces. Ajax in web development. Event based parsing in XML. XPath and XSLT. Introduction to JSP. JSP and Servlets. Standard Tag Library in JSP.

UINT V: WEB SERVICES

Web Servers (IIS, PWS and Apache).HTTP Request Types. Accessing Web Servers. Database connectivity. Applets and Servlets. JDBC connectivity. JSP and Web development Frameworks. Application programming interface (API) for Remote Procedure Calls (RPC). Simple Object Access Protocol (SOAP) and Representational State Transfer (REST) APIs.

TEXTBOOKS/REFERENCES

1. Deitel, Deitel and Nieto, Internet, and Worldwide Web - How to Program, 5th Edition, PHI, 2011.
2. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education.
3. Marty Hall and Larry Brown," Core Web Programming" Second Edition, Volume I and
4. II, Pearson Education, 2001. 4. Bates, "Developing Web Applications", Wiley, 2006.
5. Kalin, Martin. Java Web Services: Up and Running: A Quick, Practical, and Thorough Introduction. " O'Reilly Media, Inc.", 2013.

LIST OF PRACTICAL EXPERIMENTS

1. Familiarize all the basic HTML tags.
2. Implement a static HTML personal webpage by using all the possible basic tags. [Each student can develop his own bio-data page].

3. To create an html file to link to different html page which contains images, tables, and also link within a page use Frames, Forms, etc. also.
4. Create an HTML file by applying the different styles using inline, external and internal style sheets.
5. a. Create an html page to change the background color for every click of a button using Java script.write a Java script program to define a user defined function for sorting the values in an array.

   b. Create an html page with 2 combo box populated with month & year, to display the calendar for the selected month & year from combo box using javascript.
6. Develop a webpage with HTML and Java Script to read name and marks of five subjects obtained for that particular student using forms. Further, it should compute the Grade and display it as a message box.
7. Create a form to collects the name, email, user id, password and confirms password from the user. All the inputs are mandatory and email address should be entered in standard format. Also, the values entered in the password and confirm password textboxes should be the same. For the security reasons make sure that the password entered by the contains both small letters and capital letters, digits, special symbols also. If the given password does not contain all these give an error message to the user. After validating all the details using JavaScript display a message like “You have successfully entered all the details”.
8. Design an XML document to store information about the student of SRM University AP. The information must include Roll No, Name, Branch, Year of Joining, and email id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document.
9. Develop a registration form with various graphical user component interfaces like Text boxes (Roll No), Text boxes (Name) option buttons (gender), Qualification (Check boxes), State (Combo), etc. and store the information given by the user into a MySql database using JSP.
10. Develop a webpage to display the details of a student. For this the user will enter Roll Number in the text box given and the details of that particular student should be retrieved from the database and display it on the same webpage. Use JSP to solve this problem.

SEMESTER-IV

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 203	Formal Languages and Automata Theory	C	3	0	0	3

UNIT I: BACKGROUND AND MOTIVATION

Fundamental Capabilities and Limitations of computers. Complexity Theory (Intro): Can all algorithms be made more efficient? Computability Theory (Intro): Can all problems be solved using a computer? Automata Theory (Intro): Given a computational problem, what is the simplest computer that can solve it? What qualifies as a 'proof' in mathematics? What are the types of proofs? Examples. Mathematical Notation: Alphabet, String, and Language. Cardinality: Countable and uncountable sets. Decision Problems, conversion of computational problems into their decision variants. Classes of languages, class of computing machines.

UNIT II - REGULAR LANGUAGES

Finite state machines, Deterministic Finite Automata. Regular languages; Closure properties; limitations of DFAs. Necessity of non-determinism; Complete set of closure properties of regular languages. Regular Expressions, Generalized Non-deterministic Finite Automata, Equivalence of Regular expressions and NFAs. Cardinality of set of regular languages; Non-regular languages. Pumping lemma for regular languages; Examples 1 Pumping lemma for regular languages; Examples 2 Myhill-Nerode theorem. Minimization of finite state machines.

UNIT III: GRAMMARS AND CONTEXT-FREE LANGUAGES

Grammar (Formal Definition); Generation of languages from a grammar. Types of grammars, and Chomsky hierarchy Regular Grammar; Equivalence with NFAs. Context free Grammars; Context free Languages; Examples. Parsing, CYK Algorithm. Pushdown Automaton. Equivalence of Context Free Grammars and Pushdown automata. Pumping Lemma for context free Languages. Pumping Lemma for context free Languages Examples.

UNIT IV: CHURCH TURING THESIS

Turing Machines (Formal Definition). Examples of Turing Machines. Variants of Turing Machines. Non-Deterministic Turing Machines. Equivalence with other models. The Definition of Algorithm; Hilbert's Problems. Terminology for describing Turing machines.

UNIT V: DECIDABILITY AND REDUCIBILITY

Decidable Languages. Decidable Problems concerning Regular languages. Decidable Problems concerning Context-free languages. The Halting Problem. History: Crisis in Mathematics; Relevance of Godel's incompleteness theorems; their relation with Church Turing thesis. Reducibility; Relevance and Examples. Undecidable Problems from Language Theory. Mapping Reducibility. Computable functions. Complexity Theory – Overview; Formal mathematical definitions of Class-P; Class-NP. NP-completeness; The Cook-Levin Theorem, Examples of NP-complete problems.

TEXTBOOKS/REFERENCES

1. Introduction to the Theory of Computation, by Michael Sipser, Cengage Learning India.
2. Introduction to Automata Theory, Languages and Computation by J Hopcroft, JD Ullman, R Motwani; Pearson India.
3. Automata and Computability (Undergraduate Texts in Computer Science) by Dexter Kozen; Springer.
4. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1st edition(6th February 2009).

SEMESTER-IV

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 204	Computer Organization and Architecture	C	3	0	2	4

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

Execution of a complete instruction. Hardwired control design. Micro programmed control design. Nano programming. CISC and 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

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

UNIT V: I/O ORGANIZATION

Different types of I/O devices and I/O transfer schemes. Programmed Input/output. Interrupts. Direct Memory Access. Interface circuits. Standard I/O Interfaces. I/ O Processors.

TEXTBOOKS

1. Computer System Architecture, Morris Mano, Third edition, Pearson publications.
2. Computer Organization, Carl Hamacher, ZvonkoVranesic and SafwatZaky, 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. An Introduction to 8086/8088 Assembly Language Programming, Thomas P. Skinner, John Wiley & Sons, 1985.

LIST OF PRACTICAL EXPERIMENTS

1. Assembly language programming.
2. Development of simulator for a hypothetical CPU.

3. Development of Assembler for hypothetical CPU.
4. Design of Hardwired control unit for a hypothetical CPU.
5. Design of Microprogrammed control unit for a hypothetical CPU.

SEMESTER-IV

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 205	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, JToggle Button, JCheck Box, JRadio Button, JTabbed Pane, JScroll Pane, JList, JCombo Box, Swing Menus, Dialogs.

TEXTBOOKS

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, John Wiley & 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.

LIST OF PRACTICAL EXPERIMENTS

1. Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Write a function to read the values of the class variables. The values of the variable will be stored in a FILE (text file). The values will be stored in a structured format of your own choice.
   Further, read the content of the FILE and display the content in an ordered form (First Name, Last Name).
   Concept Learning:
   1. FILE manipulation.
   2. Use try catch blocks.
   3. Use multiple try catch block.
   4. Finally statement.
2. Create a three-classes named Student, Teacher, Parents. Student and Teacher class inherits Thread class and Parent class implements Runnable interface. These three classes have run methods with statements. The task of the teacher class of the first assignment has to be synchronized.
3. Similarly, the other two classes should have run methods with few valid statements under synchronized.
4. Create two classes named Student and Teacher with required data members. Assume that the information about the Student and Teacher is stored in a text file. Read n and m number of Student and Teacher information from the File. Store the information in Arraylist of type Student and Teacher ArrayList<Student> and ArrayList<Teacher>. Print the information of Teacher who taught OOPS and Maths. Use Iterator and other functions of util in your program.
5. Watch any of the favorite movie of your choice (any language is fine, preferably English). Create a Text file to store at least 10 meaningful dialogs from the movie and store it in a text file. Process the file to remove the stop words (eg. the, is, was, …….) and 1create another file to have clean text (word).

6. Write a java program to create HashTable to act as a dictionary for the word collection. The dictionary meaning of the words, including synonyms, etchas to be displayed.
7. Create GUI for the above program to upload the dialog FILE, clean the FILE. The GUI should take input from the user for invoking the dictionary for displaying dictionary meaning.
8. Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice.
9. Have an option in the GUI to search the name of the students by roll number and display the content in the test field.
10. Create two classes named Student and Teacher with required data members. Read the information about the student and teacher using text fields. Use checkbox to choose the option to feed either teacher information or student information. Store the information about the Student and Teacher in a text file. Read n and m number of Student and Teacher information from the File. Show in the GUI about a Teacher who taught two subjects to a section. Develop at least one of the application (AWT problem) using swing package.
11. Create a Window based applications using various controls to handle subject registration for exams. Have a List Box to display the subject of semesters. Have one more List box having subject codes. Have a combo box to select the Semester, which will change the list of course and code in the list boxes. Display the subject registered for the examination on the right side of the window.
12. Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice.
13. Have an option in the GUI to search the name of the students by roll number and display the content in the test field. Develop at least one of the application (AWT problem) using swing package.
14. Create a Window based application for displaying your photo album. Create a Frame and Canvas. Change the border, foreground and background colors of canvas and other controls. Have buttons to start the image show, pause the image show and end the image show. Explore the options to play background music.
15. Create a Window application with menu bar and menu. The frame will also have a text area with scroll bar. In the menu, have File related options. Open a file and its content has to be displayed in the text area.

SEMESTER-IV

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CDC 204	Quantitative Aptitude	C	1	0	0	1

UNIT I: QUANTITATIVE REASONING

Speed. Time and work. Powers and roots. Pipes, cisterns. Problems on Clock. Calendar and Cubes. Height and Distance. Logarithms.

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

Graphical and Numerical Methods for Describing Data. Interpretation of data in tables and graphs. Permutations and Venn diagrams. Counting Methods. Probability.

UNIT IV EMOTIONAL INTELLIGENCE II

Self-Awareness, Self-Regulation, Social Skills, Empathy and Motivation.

UNIT V: VERBAL ABILITY

Conditionals. Tense Forms. Verb Forms; Phrasal Verbs. Cohesion and Coherence.

TEXTBOOKS/REFERENCE

1. R.S. Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication
2. P. Anand, Quantitative Aptitude, Wiley, 2015
3. Archana Ram, Placementor, Oxoford Publication, 2018

SEMESTER-IV

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 230	Industry Standard Coding Practice -1	ES	0	0	4	1

UNIT I

Problem Solving with - Basic coding practices, Expression Evaluation, Operators Usage, Expressions, Control Structures, Loop & Iterations for all test case scenarios.

UNIT II

Problem Solving using time efficient logics, linear list data, Array problems, 2D Arrays and Matrix Data for all test case scenarios.

UNIT III

Problem Solving with - Pointers & Memory referencing, String Handling, functions for all test case scenarios.

UNIT IV

Problem Solving with - parameter passing, Recursions, Recursion Analysis, Structures and unions, Enumerations & Memory allocation for all test case scenarios.

UNIT V

Problem solving with - String manipulations. Lists, display patterns, strings, matrix, tuples, dictionaries, modules, packages, exception handling using Python.

TEXTBOOKS

1. Problem solving with C++ -9e- Walter Savitch – Pearson.
2. The complete Reference C, Fourth REdition – Herbert Schildt – MC Graw Hill.
3. Programming in Python 3, A complete introduction to Python language - 2e - Mark Summerfield – Addison-Wiley.

SEMESTER-V

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
MAT 221	Probability and Statistics for Engineers	ES	3	0	0	3

UNIT I

Basic principle of counting, permutations, combinations. Multinomial coefficients, sample space and events. Axioms of probability, sample spaces having equally likely outcomes Conditional probability. Bayes` theorem, independent events.

UNITII

Random variable, discrete random variable, expected value. Expectation of a function of a random variable, variance. Discrete probability distributions- Bernoulli, Binomial, Poisson, Geometric, negative. Binomial distributions expected value of sums of random variables. Cumulative distribution function and its properties.

UNIT III

Continuous random variables. Expectation and variance – their properties. Continuous probability distributions – uniform, normal, exponential distributions. Distribution functions.

UNIT IV

Joint distribution functions. Independent random variables and their sums, conditional distributions. Joint probability distribution of functions of random variables. Covariance, correlation.

UNIT V

Definition of statistics, population and sample. Representative sample. Descriptive statistics – classification and tabulation of univariate data. Graphical representation, frequency curves.

TEXTBOOKS

1. Sheldon Ross, A First course in probability (Ninth edition).
2. Michael Baron, Probability and Statistics for computer scientists.

SEMESTER-V

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 301	Operating Systems	C	3	0	2	4

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.

UNIT IV: STORAGE MANAGEMENT

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

UNIT V: I/O SYSTEMS

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.

TEXBOOKS/REFERENCES

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, 9th Edition, John Wiley and Sons Inc.
2. Operating System, Harvey M. Dietel, Paul J. Deitel and David R. Choffnes, Pearson Publications, Third Edition
3. William Stallings, “Operating Systems – Internals and Design Principles”, 9th Edition, Pearson publications. Andrew S. Tanenbaum, “Modern Operating Systems”, Fourth Edition, Pearson
4. Andrew S. Tanenbaum, “Modern Operating Systems”, Fourth Edition, Pearson publications
5. Mastering Unix Shell scripting, Randal K. Michael, Wiley Publications, Second Edition
6. Linux system programming, Robert Love, O’Reily Publications, First Edition, 2007

LIST OF PRACTICAL EXPERIMENTS

1. Shell Programming exercises.
2. Implementing Linux system commands using system calls.
3. CPU Scheduling Algorithms.
4. Computing page faults for various page replacement algorithms.
5. Simulation of Demand Paging System.

6. Implement producer, consumer problem using semaphores.
7. Implement deadlock avoidance and detections algorithms.
8. Project Development.

SEMESTER-V

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 306	Compiler Design	C	3	0	2	4

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 -TopDown Parsing -General Strategies-Recursive Descent Parser Predictive Parser-LL (1) Parser-Shift Reduce 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 TIMEENVIRONMENT

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.

TEXTBOOKS

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

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 CCharles N. Fischer, Richard. J. LeBlanc, Pearson Education, 2008.

LIST OF PRACTICAL EXPERIMENTS

1. Language recognizer.
2. Conversion of NFA to DFA.
3. Minimization of DFA.
4. Design of lexical analyzer using C.
5. Design of lexical analyzer using LEX.
6. Implementation of Recursive Descent Parser using C.
7. Computation of FIRST and FOLLOW for a given CFG using C.
8. Implementation of Predictive Parser using C
9. Implementation of Shift Reduce Parser using C
10. Implementation of SLR Parser using C
11. Implementation of LALR Parser using YACC
12. Intermediate code generation
13. Implementation of code generation

SEMESTER-V

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 303	Computer Networks	C	3	0	2	4

UNIT I: OVERVIEW OF THE INTERNET (PHYSICAL LAYER AND DATA LINK LAYER)

Basic Computer Network concepts, Protocol, Layering Scenario. Layer Architecture: OSI Model, TCP/IP model. Internet history standards and administration; Comparison of the OSI and TCP/IP reference model. Guided transmission media, wireless transmission media. Different LAN topologies: BUS, RING and STAR topology. Data Link layer design issues: Error detection techniques. Error Correction Techniques, Flow control. Sliding Window protocols. Go back N and selective Repeat protocols. Difference between single bit sliding window and n-bit sliding window protocols.

UNIT II: MEDIUM ACCESS CONTROL

Static and Dynamic channel Allocations. Shared channel Access: Pure ALOHA and slotted ALOHA. Persistent CSMA protocols: 1, P and Non-persistent CSMA protocols. CSMA with collision detection. Comparison of different CSMA protocols. Collision free protocols: Bit-map protocol, Token Ring and Binary Count down protocols. Limited Contention protocols: Adaptive tree walk protocol. Shared medium for wireless networks: CSMA/CA or MACA. Interconnecting LANs: HUBS, Repeaters and Switches and bridges. Spanning tree algorithm for bridges.

UNIT III: NETWORK LAYER

Overview: Connection oriented and connection less services. Comparison of packet switched, and circuit switched networks. Routing: proactive routing and reactive routing protocols, static and dynamic routing protocols. Dijkstra Algorithm, Distance vector routing and Link state routing protocols. Routing in wireless networks: AODV and DSR routing protocols. Overview of IP header and IP addressing. Classful IP addressing: Class A, B, C, D and E. Limitations of classful Addressing, Introduction to Subnet. Overview of Congestion: Warning Bit, Choke packets, Load Shedding, RED(Random Early Detection).

UNIT IV: INTERNETWORKING AND TRANSPORT LAYER

IP Encapsulation and Tunneling. IP packet fragmentation, ICMP, ARP. ICMP, DHCP, Introduction to Transport layer. Different end-to-end transport layer protocols: TCP and UDP. Brief explanation of TCP protocol. Packet formats for TCP and UDP protocol.

UNIT V: TRANSPORT AND APPLICATION PROTOCOLS

TCP Connection Management Modeling. TCP Sliding Window. TCP congestion control. Introduction to application layer paradigms. Client Server model. Introduction and overview of HTTP protocol. Overview of FTP protocol. Operation of Electronic Mail. Introduction to peer-to-peer communication models. Introduction and overview of TELNET. Importance of Security in computer Networks.

TEXBOOKS/REFERENCES

1. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.
2. Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
3. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.
4. Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.

LIST OF PRACTICAL EXPERIMENTS

1. Explain about wires hark and display how to send packets or packets from one layer to another.
2. Write a Java program to implement Error Detection Technique using CRC Algorithm.
3. Write a Java program to implement Error Correction Technique using Hamming code.
4. Write a Java program to implement TCP Client Server programming.
5. Write a Java program to implement UDP Client Server Programming.
6. Write a Java program to implement 1-bit Stop and Wait Protocol at data link layer.
7. Write a Java program to implement N-bit Sliding Window Protocol at data link layer.
8. Write a Java program to implement Dijkstra Shortest path routing protocol.
9. Write a Java program to implement Distance Vector Routing.
10. Write a Java program to implement echo command in client server socket programming.
11. Write a Java program to implement Trace-route command.
12. Write a Java program to implement Ping command.
13. Write a Java program to display the class of IP address, network mask and generate the subnet IP address based on the subnet bits entered from the keyboard.
14. Write a Java program to implement sliding window protocol at the transport layer.
15. Write a Java program to transfer file using TCP?

SEMESTER-V

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 304	Database Management Systems	C	3	0	2	4

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.

TEXTBOOKS/REFERENCES

1. Ramez Elmasri and Shamkant Navathe. 2010. Fundamentals of Database Systems (6th ed.). Addison-Wesley Publishing Company, USA.
2. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004
3. A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008.

4. Database system Implementation: Hector Garcia-Molina Jeffrey D. Ullman Jennifer Widom, Prentice Hall, 2000
5. C.J. Date. 2003. An Introduction to Database Systems (8 ed.). Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA.

LIST OF PRACTICAL EXPERIMENTS

1. Implementation of data storage and indexing methods using files.
2. DML queries on single table.
3. Queries on Joining tables and Aggregate Functions.
4. Nested queries, Queries on creation of views, indexes, sequences, and access privileges.
5. Triggers, Assertions.
6. SQL Transactions.
7. PL/SQL, Stored Procedures.
8. Design and Develop Applications.

SEMESTER-V

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 330	Industry Standard Coding Practice -2	ES	0	0	4	1

UNIT I
Problems Solving with: Structure Pointers, formation of links, Operations on Linked lists, Operations on a circular linked list, Operations on a double linked list & Industry Standard Practice Questions.

UNIT II
Problem Solving with - Stack Operations, Queue data structure Implementation, Linear / Binary Search Algorithms, Sorting Algorithms, Industry Standard Practice Questions.

UNIT III
Problem Solving with - Nonlinear data structures, trees operations, application of search property on a binary tree, tree balancing.

UNIT IV
Problem Solving with - Multiway search structures, Operations on a 2-4 tree, nonlinear structures, red, black trees & operations, Tries, String Algorithms & Industry Standard Practice Questions.

UNIT V
Problem Solving with – features of Object-oriented programming, leveraging Standard Template Libraries. Industry Standards of leveraging DBMS concepts, SQL Queries, Entity Relationship Models, Query Optimization, Transactions & Concurrency, Normalization & Industry Standard Practice Questions.

TEXTBOOKS

1. Fundamentals of Data Structures in C++ - 2e- Sahni Horowitz - Universities Press.
2. Algorithms -4e- Robert Sedgewick & Kevin Wayne - Addison-Wesley Professional.
3. C++ Standard Library A Tutorial and Reference – 2e - Nicolai M. Josuttis - Addison Wesley Longman.
4. An Introduction to Database Systems – 8e - C.J. Date – Pearson.
5. Competitive Programming – 3e – Steven Halim, Felix Halim

SEMESTER-V

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CDC 331	Employability Skills	HS	1	1	0	0

UNITI: NUMBERS

Types and Properties of Numbers and Remainders. LCM, GCD, Fractions and decimals, Surds and Progressions.

UNITII

Permutations, Combinations and Probability. Data Interpretation.

UNITIII

Geometry and Coordinate Geometry. Trigonometry and Mensuration.

UNITIV: REASONING

Syllogism and Non-Verbal Reasoning. Analytical Reasoning.

TEXTBOOKS

1. Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2. R.S Agarwal, A Modern Approach to Verbal and Non Verbal Reasoning, S.Chand Publications.
3. Arun Sharma– How to Prepare for Data Interpretation & Logical Reasoning for the CAT.

SEMESTER-VI

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
MAT 131	Differential Equations	BS	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).

UNITII: 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).

UNITIII: 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.

UNITIV: SERIES SOLUTIONS OF ODES

Introduction to power series method, Legendre's equation &polynomials, Frobenius Method, Bessel's Equations & Functions.

UNITV: 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.

TEXTBOOKS

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

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

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 305	Software Engineering	C	3	0	2	4

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, Requirement's 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.

TEXTBOOKS

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 PrivateLimited, 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.

LIST OF PRACTICAL 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

3. To perform the function-oriented diagram: DFD and Structured chart
4. To perform the user's view analysis: Use case diagram
5. To draw the structural view diagram: Class diagram, object diagram
6. To draw the behavioral view diagram: Sequence diagram, Collaboration diagram
7. To draw the behavioral view diagram: State-chart diagram, Activity diagram
8. To draw the environmental view diagram: Deployment diagram
9. To draw the implementation view diagram: Component diagram
10. To perform various testing using the testing tool unit testing, integration testing

SEMESTER-VI

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
ISES 312	Industry Specific Employability Skills-VI	HS	1	1	0	0

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& ASSESSMENTS

SEMESTER-VI

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 331	Industry Standard Coding Practice -3	ES	0	0	4	1

UNIT I
Problem solving with - Descriptive statistics, Mean/median/mode, Measures of dispersion/range variance, deviations, mean/median/mode problems, Random variables, Univariate & Bivariate random variables.

UNIT II
Problem solving with - Graphs, Handshaking Lemma, Simple Graphs, DFS/BFS, connected components, coloring, Introduction to DAGs, Spanning Trees, Articulation Points/ Connected points.

UNIT III
Problem solving with - Greedy Methods: Coin change, Fractional Knapsack, Activity Selections/ Job sequencing with Deadlines, Spanning Trees, Dynamic Programming: 0/1 Knapsack, Substructures, Longest common substring/subsequence, Longest Increasing sub sequence, Grid based Problems.

UNIT IV
Problem solving with - Divide & Conquer Strategies: Quick/Merge Sort, Min/Power functions, Backtracking, N Queens problem, Finding the path & Grid based problems, iterative/loop free approaches.

UNIT V
R Language Constructs, calculations, Operators, vectors, lists, Practice problems implementing R language, Matrices and data frame, Conditional statements and loops, Problem Solving on R language examples.

TEXTBOOKS

1. An Introduction to Statistical Learning: with Applications in R - Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani.
2. Introduction to Algorithms by Thomas H. Corman, The MIT Press, 3rd Edition.
3. Introduction to Algorithms: A Creative Approach by Udi Mander, Pearson.
4. R Cookbook - Paul Teetor, O'reilly.
5. Competitive Programming – 3e – Steven Halim, Felix Halim.

SEMESTER VI

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 340	UROP	PR	0	0	6	3

Department of Computer Science and Engineering, UROP Guidelines

1. Tentative date of commencement of Research Project is along with 6th semester each year.
2. The duration of the Project is 12 weeks or end by the 6th semester.
3. Maximum of 5 students form a team
4. Each faculty co-ordinates maximum 5teams
5. The title of the research work, scope, methodology and expected outcomes need to be approved by the Faculty mentor/guide.
6. Grading has to be completed by the concerned faculty by the end of 6th semester.
7. Number pf credits for CSE340 is 3.

General Guidelines for UROP project report and Research work.

These guidelines explain briefly the mechanics of writing a research paper in Computer Science and Engineering. These guidelines are generic and can be customized to fit most of the research works

The writing can start with the abstract, which can be approximately one page 10–20 sentences. The abstract will be refined and updated as a continuous process. The abstract can concisely (1) identify the research topic, (2) identify the benefits and advantages that result (3) and if there is novelty, describe the novelty of the presented work.

Section 1: Introduction (Motivation)

Although the title of the starting section is "Introduction" it should really be Motivation. In one or two paragraphs, the topic has to be introduced. This is followed with useful of the work, including possible applications of the work. Possible points to mention include:

1. Does the research work describe the state-of-the-art in that research domain?
2. What is the relevance of this work in filling any research gap?
3. Who will potentially benefit from the work?
4. Does the presented work provide a new technique of some sort?
5. Does this research work provide any new insight in some way?
6. Is it a review work which gives an insight to the current research in a particular domain?

Words like, contribute, benefit, advantageous, and possibly novel are used in this list. The presented work often builds on a previous system or algorithm. If so, your work may inherit benefits from the previous work. Those inherited advantages may also be listed.The introduction section then concludes with how the rest of the research paper is organized.

Section 2: Related Works: Presents review of the previous work on this topic.

The related work section demonstrates to the reader that you have done your homework (research), reviewed the previous literature, and now are ready to present your contribution based what has been

previously published. The review is confined to relevant and recent research works in the domain of the proposed research. One of the difficult aspects of the related work section is choosing the proper scope. There is some subjectivity in choosing which books or papers to refer to and also importantly, which previous literature not to refer to. This is something an advisor is able to help with.

Section 3: Presents the proposed work/experimental/simulation specifications.

Section 4: Presents any algorithms or procedures used.

Next section: Can represent an evaluation of the resultsand the

Last section: May present conclusions and future work.

Citations

Any figure, image, or equation that is taken from another source must be cited. Content and terminology from other sources must also be cited. For more information about citations and their use, see:

http://www.plagiarism.org/. Click on the "How to cite sources" link.

References should be accurate and complete, i.e., with page numbers etc. A paper without complete and correct references can leave a bad impression on the reader and detract from a paper's credibility.

Mark Distribution: (As per the Original Plan. May be reviewed)

1. Internal evaluation by Guide: 50 marks
2. External evaluation by a Committee: 50 marks
   (Project Report, Demonstration and Presentation)

SEMESTER VII /VIII

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
Semester VII						
CSE 460	Capstone Project Phase I	PR	0	0	12	6
Semester VIII						
CSE 461	Capstone Project Phase II	PR	0	0	12	6

Capstone Project Guidelines

Introduction

These guidelines are conceived as a set of procedures stating broad expectations from both students and mentors of the Capstone project which is part of the B.Tech CSE curriculum. These guidelines are intended to make the project work evaluation process easier, formal and more authentic. The Capstone Project spans 2 semesters which are the 7th and 8th semesters. The total number of credits offered for the capstone project is 12. The total credit is split into 6+6 for 7th and 8th semesters respectively. The Capstone project has to be sufficiently complex and feasible so as to be considered for 12 credits. The evaluation of the project is done by a review panel comprising department faculty members and the review process is continuous. In the first review by the constituted panel, the project may be accepted or rejected or major/minor changes can be suggested.

Project Selection

Capstone project may be an in-campus project or can be mapped with internship carried out in the industry or the research internship carried out in the other premier Universities in India/Abroad.

In campus project: The idea for student's Project may be a proposal from a faculty member or student's own, or perhaps a combination of the two. The project has to be sufficiently complex and feasible. Students are advised to choose a project that involves a combination of sound background research, a solid implementation, or piece of theoretical work, and a thorough evaluation of the Project's output. Interdisciplinary Project proposals and innovative Projects are encouraged and more appreciable.

Mapping with any Internship:

a. Any type of internships can be carried out by the students in the 7th and 8th semester after getting the due approval from the Project coordinator and the Head of the department.
b. The internship period has to be a minimum of 10 weeks of duration in each semester and the students could have carried out the practical work for at least 180 hrs during this period.
c. The internship has to involve some Software/Hardware design and implementation component and/or research component and the complexity of this work is expected to match the requirements of Capstone Project work.

Mentor allocation process: Students can form a batch of 4 (5 may be allowed in exceptional cases on the discretion of the project coordinators) and select their mentor provided the Faculty member accepts them and the faculty member has less than the specified number projects under his/her mentorship.

Project Equipment: In case of deserving projects for limited financing of equipment, the students can approach the concerned university authorities following due procedure.

Meetings with Your Supervisor:
Instructions to students: You must make sure that you arrange regular meetings with your Mentor. The meetings may be brief once your project is under way, but your Mentor needs to know that your work is progressing. You are also expected to be contactable throughout the project. You should inform the Mentor your contact details and keep these updated if these change.
Instructions to Mentors: Mentors are advised to maintain a project dairy depicting attendance of student and progress of project.

Legal and Ethical Considerations: If a student want to do some project with some company where their relatives or friends work, the details need to be disclosed to their mentor. The mentor has to report the same to the project coordinators for permission. Again, if a student doing internship with a company, the data, procedures/algorithms and softwaredeveloped may be classified and may not be allowed to submit in the report. The students need to consider that before requesting mapping.

Project Report format: Format of the report is similar to the format of standard Journal papers published. (Abstract-Literature survey-Methodology-Algorithms-Simulation-Results-explanation of results-Future work etc)

Project milestones and Assessment
Starting date of the project to be taken as the commencement date of 7th semester. A student is expected to finish first two stages in 7^{th} semester and remaining in 8^{th}. The students are expected to plan from the beginning for at least one research publication in a reputed journal.

7^{th} Semester:

Stage 1: Title, Scope of the project and Literature survey to be submitted within 4 weeks from the commencement of the project. In the first review by the constituted panel, the project may be accepted or rejected or major/minor changes can be suggested.

Stage 2: Methodology, Requirement analysis and Deliverables to be submitted within 8 weeks from the commencement of the project.

Stage 3: Algorithms, project design and implementation plan have to be submitted within 12 weeks of the commencement of the 8^{th} semester. Internal review will be conducted by the Mentor and this review has a weightage of 50%.

8^{th} Semester:

Stage 4: Project implementation to be done and demonstrate that the project meets the requirements and expectations.

Stage 5: The results need to be analyzed and if any fine tuning required is to be done.

Final evaluation for 7^{th} and 8^{th} semesters: by expert committee at the end of the 14^{th} week and this evaluation has a weightage of 50%.

SPECIALIZATION STREAMS

Artificial Intelligence and Machine Learning Stream

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 311	Introduction to Machine Learning	SE	3	0	2	4

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 Tree.

Instance based Learning: K nearest neighbor, the Curse of Dimensionality, Feature Selection: forward search, backward search, univariate, multivariate feature selection approach, Feature reduction (Principal Component Analysis), Python exercise on kNN and PCA Recommender System: Content based system; Collaborative filtering based.

UNIT III: PROBABILITY AND BAYES LEARNING

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

UNIT IV: ARTIFICIAL NEURAL NETWORKS

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

UNIT V: ENSEMBLES & CLUSTERING

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

TEXTBOOKS

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

REFERENCES

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.

LIST OF PRACTICAL EXPERIMENTS

1. Basic exercises on Python Machine Learning Packages such as Numpy, Pandas and matplotlib.
2. Given a dataset. Write a program to compute the Covariance, Correlation between a pair of attributes. Extend the program to compute the Covariance Matrix and Correlation Matrix.

3. Given a set of sample points in N dimensional feature space. Write a program to fit the points with a hyper plane using Linear Regression. Calculate sum of residual error.
4. Write a program that provides option to compute different distance measures between two points in the N dimensional feature space. Consider some sample datasets for computing distances among sample points.
5. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
6. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.
7. Write a program to implement feature reduction using Principle Component Analysis
8. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
9. Given a dataset for classification task. Write a program to implement Support Vector Machine and estimate it test performance.
10. Write a program to implement perceptron for different learning task.
11. Write programs to implement ADALINE and MADALINE for given learning task.
12. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
13. Write a program to implement K means clustering algorithm. Select your own dataset to test the program. Demonstrate the nature of output with varying value of K.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 314	Digital Image Processing	SE	3	0	2	4

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. growing, region splitting and merging.

UNIT IV

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

UNIT V

Representation: Shape features (Region-based representation and descriptors) Area, Euler's number, eccentricity. Elongatedness, rectangularity. Direction, compactness. Moments, covex 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.

TEXTBOOKS/REFERENCES

1. R.C. Gonzalez, R.E. Woods, Digital Image Processing, 3rd Edition, Pearson Education.
2. S.Sridhar, Digital Image Processing, Oxford University Press, 2011.
3. Milan Sonka, Vaclav Hlavac and Roger Boyele, Image processing, analysis, and machine vision. 3e, Cengage Learning, 2014.
4. Computer Vision A modern approach, David A. Forsyth and Jeam Ponce, Pearson Education.

LIST OF PRACTICAL EXPERIMENTS

1. Perform the following operations using library functions
    a) Read, Display and write any color image in other formats.
    b) Find RED, GREEN and BLUE plane of the color image.
    c) Convert color image into gray scale image and binary image.
    d) Resize the image by one half and one quarter.
    e) Image rotates by 45, 90 and 180 degrees.

2. Create black and white images (A) of size 1024x1024. Which consists of alternative horizontal lines of black and white? Each line is of size 128.Create black and white images (B) of size 1024x1024.Perform the following operations on Image A and Image B.
    a) Image addition of A and B
    b) Subtraction of A and B
    c) Multiplying Images of A and B
    d) Create a grayscale image of size 256x1024. Intensity of image should vary sinusoidal.
    e) Create a white image of size 256x256, with black box of size 58x58 at centre.
3. Develop programs for following intensity transformation operation on a gray scale image. Collect any gray scale image from any source. Process that image using these operations.
    a) Image negative
    b) Log transformation and inverse log transform: s = c log (1+r), c is a const, r ≥ 0. s is pixel intensity of output image, r is the pixel intensity of input image. Study the effect of constant c on the quality of output image.
    c) Power law transformation: Study the effect of different values of Gamma used in this transformation.
    d) Contrast stretching
    e) Gray level slicing
4. Develop programs for following spatial filtering operations on a gray scale image.
    a) Averaging: Implement averaging filtering operations for different window sizes and study their effect on the quality of output image. Write your observations on output image quality.
    b) Weighted averaging: Implement weighted averaging filtering operations for different window sizes and study their effect on the quality of output image. Write your observations on output image quality.
    c) Median filtering: Implement weighted averaging filtering operations for different window sizes and study their effect on the quality of output image. Write your observations on output image quality.
    d) Max filtering
    e) Min filtering
5. Take a gray scale image and add salt and pepper noise. Write programs for following operations and observe their outputs
    a) Linear smoothing or Image averaging
    b) Weighted averaging
    c) Median filtering. Compare the output quality among Image averaging and median filtering.
    d) Max filtering
    e) Min filtering
6. Write programs to perform following sharpening operations on a gray scale image
    a) Laplacian filter
    b) Filtering using composite mask
    c) Unsharp masking
    d) High boost filtering
    e) Filtering using first order derivative operators such as sobel and prewittmask
7. Write a program to improve contrast of an image using histogram equalization. The prototype of the function is as below:histogramequalisation(inputImage, noofbins);The function should

return the enhanced image. Consider two low contrast input images. Study the nature of the output image quality in each case by varying the number of bins.

8. Take a low contrast gray scale image (A) and a high contrast gray scale image (B). Write a program to improve the contrast of A with the help of image B using histogram specification or matching. The prototype of the function is as below: Histogramsp(inputImage, specifiedIage, noofbins);The function should return the enhanced image.
9. Develop programs to implement frequency domain smoothing filters (Ideal, Butterworth and Gaussian) and apply these filters on a gray scale image.
    a) Compare/comment on the output of Ideal, Butterworth and Gaussian Low pass Filters having the same radii (cutoff frequency) value.
    b) Consider a suitable gray scale image and demonstrate the ringing effect on the output of Ideal low pass frequency domain filter.
    c) Compare the output of Butterworth low pass filters (order n=2) for different cut-off frequencies (5, 15, 30, 90, 120).
    d) Compare the output of Gaussian low pass filters for different cut-off frequencies (5, 15, 30, 90, and 120)
10. Develop programs to implement frequency domain sharpening/High pass filters (Ideal, Butterworth and Gaussian) and apply these filters on a gray scale image.
    a) Compare/comment on the output of Ideal, Butterworth and Gaussian High pass Filters having the same radii (cutoff frequency) value.
    b) Consider a suitable gray scale image and demonstrate the ringing effect on the output of Ideal high pass frequency domain filter.
    c) Compare the output of Butterworth high pass filters (order n=2) for different cut-off frequencies (5, 15, 30, 90, 120).
    d) Compare the output of Gaussian high pass filters for different cut-off frequencies (5, 15, 30, 90, and 120).
11. Develop program to add different types of noise in a gray scale image and write functions to implement following filters for image restoration in presence of these noises.
    a) Remove Salt and Pepper Noise
    b) Minimize Gaussian noise
    c) Median filter and Weiner filter
12. Write and execute program for image morphological operations erosion and dilation.
13. Implement Morphological smoothing using opening and closing
14. Develop program to implement point and line detection masks. Detect points and lines using these masks for a given gray scale image.
15. Develop programs for edge detection using different edge detection mask.
16. Develop programs to achieve image segmentation using
    a) Basic Global thresholding
    b) Optimal global thresholding or Otsu's thresholding
17. Given a set of coordinates as boundary pixels in an image. Write a program to implement Hough Transform for joining the points using different lines.
18. Given a MXN image. Write a program to find the Co-occurrence matrix for a given angle and distance. Compute the Co-occurrence matrix features.
19. Given a MXN image. Write a program to find the Local Binary Pattern profile of the given image.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 412	Principles of Soft Computing	SE	3	0	2	4

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, Madeline, Multi-Layer Perceptron, Feed forward Back Propagation Network: back propagation learning, Learning Effect of Tuning 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: AlexNet, GoogleNet, VGG Net.

UNITIII: 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 cover, Inversion and deletion, Mutation operator, Bit-wise 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.

TEXTBOOKS

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

REFERENCES

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

LIST OF PRACTICAL EXPERIMENTS

1. Write a Python Program to implement a perceptron. The input is your semester marks.

2. Write a python program to extend the exercise given above to implement Feed Forward Network. The inbuilt function should not be used.
3. Write a python program to implement Hebb Network. The inbuilt function should not be used.
4. Write a python program to implement Multilayer Perceptron. The inbuilt function should not be used.
5. Write a python program to implement any ANN with back propagation learning Algorithm.
6. Write a Python Program to implement ART1 and ART 2.
7. Write a python program to implement CNN.
8. Write a python Programming to realize the working principles of popular architectures such as AlexNet, GoogleNet and VGG Net.
9. Write python Program to realize Fuzzy Sets arithmetic.
10. Write a python Program to realize fuzzy relations.
11. Write a python program to realize a fuzzy rule of any popular problem (s).
12. Write a python program to realize a defuzzification scheme for the above exercise.
13. Write a python Program to reason the fuzzy rules in exercises 12 and 13.
14. Write a python program to realize various steps of Genetic Algorithms.
15. Write a Python Program to realize GA based back propagation Networks.
16. Write a Python Program to realize Fuzzy Controlled Genetic Algorithms.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 413	Artificial Intelligence	SE	3	0	2	4

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-Game playing: Perfect decision game-based learning. Neural networks, reinforcement learning. Game playing: Perfect decision game. Imperfect decision game. Evaluation function. Minimax, alpha-beta pruning.

TEXTBOOKS/REFERENCES

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education
2. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education
3. E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education
4. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kauffman, 2002.

LIST OF PRACTICAL EXPERIMENTS

1. Week 1: Artificial Intelligence Problem identification and PEAS description.
2. Week 2: Introduction to AI programming Language PROLOG
3. Week 3: Study of facts, objects, predicates, and variables in PROLOG.
4. Week 4: Study of arithmetic operators, simple input/output, and compound goals in PROLOG.
5. Week 5: Study of string operations in PROLOG. Implement string operations like substring,string position, palindrome etc.
6. Week 6: Write a prolog program to implement all set operations (Union, intersection,complement etc.

7. Week 7: Write a program for Usage of rules in Prolog. Create a family tree program to include following rules 1. M is the mother of P *if* she is a parent of P and is female 2. F is the father of P *if* he is a parent of P and is male 3. X is a sibling of Y *if* they both have the same parent. 4. Then add rules for grand-parents, uncle-aunt, sister and brother. Based on the facts, define goals to answer questions related to

8. Week 8: Write programs for studying Usage of arithmetic operators in Prolog.
    a) Accept name of the student, rollno, his/her subject name,maximum marks and obtained marks in the subject. (Take marks of atleast 6 subjects). Compute the percentage of a student. Display his result with other information.
    b) Accept department, designation, name, age, basic salary, house rent allowance(HRA) of an employee. Compute dearness allowance (DA) which is 15% of basic salary. Determine the gross salary(basic salary+HRA+DA) of the employee. Display all information of the employee(Generate Payslip).

9. Week 9: Implement a program for recursion and list in PROLOG.

10. Week 10: WAP for studying usage of compound object and list in Prolog.
    a) Write a program to maintain inventory items using a compound object:
        i. Accept from user the details of at least 10 objects.
        ii. Display from user the details of objects entered by user
    b) Find and display odd and even numbers from a given input list.

11. Week 11: Write a prolog program to solve “Water Jug Problem”.
12. Week 12: Write a program to implement a monkey banana problem.
13. Week 13: Write a program to implement 8 Queens Problem.
14. Week 14: Write a program to solve traveling salesman problem.
15. Week 15: Write a program to solve water jug problem using LISP.

Cyber Security Stream

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 312	Introduction to Cryptography	SE	3	0	2	4

UNIT I: INTRODUCTION OF CRYPTOGRAPHY

Basic introduction Cryptography, Classical Encryption Techniques: Symmetric Cipher Model. Cryptography, Cryptanalysis and Brute-Force Attack Substitution Techniques: Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher Polyalphabetic Cipher, One TimePad. Transposition Cipher: Rail Fence Cipher, Simple Columnar or Row Transposition Data. Double Columnar or Row Transposition, Rotor Machines.

UNIT II: BLOCK CIPHERS AND THE DATA ENCRYPTION STANDARD

Introduction Traditional block Cipher structure Motiva Motivation for the feistel Cipher structure stream Ciphers and block Ciphers The data encryption Techniques Finite Fields and Advanced Encryption Standard AES encryption, AES decryption AES example, results. the avalanche effect, the strength of AES.Stream Ciphers, RC1, RC4.

UNIT III: PUBLIC-KEY CRYPTOSYSTEMS

Fermat's and Euler's Theorems, Public-Key Cryptography and RSA: Principles of public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. Diffie-hellman key exchange, The algorithm, Elliptic Curve Cryptography systems key exchange protocols man in the middle attack Elgamal Cryptographic systems.

UNIT IV: CRYPTOGRAPHIC HASH FUNCTIONS

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

UNIT V: BLOCKCHAIN

Block Chaining, Bitcoin Smart Contracts Ethereum, Hyper ledger Fabrics.

TEXTBOOKS/REFERENCES

1. Stallings, William. Cryptography and network security, 4/E. Pearson Education India, 2006.
2. D. Stinson Cryptography, Theory and Practice (Third Edition).
3. Handbook of Applied Cryptography by A. Menezes, P. Van Oorschot, S. Vanstone.
4. Blockchain blueprint for new economy, Melanie Swan.
5. Mastering Blockchain, Imran Bashir.

LIST OF PRACTICAL EXPERIMENTS

1. Write a program take text file as an input and print word, character count and ascii value of each characters as output. (Hint: Use open(), read() and split()).
2. Write a encryption program: Input: computerscienceengineeringsrmuniversity Output: gsqtyxivwgmirgiirkmriivmrkwvqyrmzivwmxc Hint: key =4 (play with ascii value).
3. Raju send an encrypted message (cipher text) "PHHW PH DIWHU WKH WRJD SDUWB" to Rani. Can you build decryption process and find out what is the message (plain text) send to Rani? Hint: try all keys.
4. Raju send encrypted message "ZICVTWQNGKZEIIGASXSTSLVVWLA" to Rani. Can you build decryption process and find out what is the message send to Rani. Hint: try all keys for each character.
5. Kohli have plain text "wewishtoreplaceplayer". Can you build encryption process and find out what is the cipher text he needs send to BCCI. Help him out by using monoalphabatic cipher. Hint: use any one-to-one mapping between alphabets.
   One to one mapping

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	N	D	R	E	W	I	C	K	S	O	H	T	B	F	G	J	L	M	P	Q	U	V	X	Y	Z

   Kohli sent encrypted message (Cipher text) "SEEMSEAOMEDSAMHL" to Anushka. Can you build decryption process and find out what is the message (plain text) send to Anushka.Hint: use above one to one mapping between alphabets.
6. Raju want to build encrypted and decryption algorithms of Playfair Cipher. Help him to build a key matrix using the key "srmapuniversity"
7. By using key matrix Raju want to send message "we are discovered save yourself" to Rani. Can you build encryption process and find out what is the cipher text message send to Rani by using palyfaircipher.

s	r	m	a	p
u	n	i/j	v	e
t	y	b	c	d
f	g	h	k	l
o	q	w	x	z

8. By using key "CBDE" Raju would like send message (plain text)"HELLO WORLD" to Rani. Can you build encryption process and find out what is the encrypted message (cipher text) to Raju by using Hill Cipher.Also Can you build decryption process and find out what is the decrypted message (plain text) of cipher text "SLHZYATGZT" by using Hill Cipher.
9. Implementation of Encryption and Decryption of Vigenère Cipher
   keyword *deceptive*
   key: deceptivedeceptivedeceptive
   plaintext: wearediscoveredsaveyourself
   ciphertext: ZICVTWQNGRZGVTWAVZHCQYGLMGJ
10. Implement the Encryption and Decryption of Row Transposition.

Key: 4 3 1 2 5 6 7
Plaintext: a t t a c k p
o s t p o n e
d u n t i l t
w o a m x y z

Ciphertext: TTNAAPTMTSUOAODWCOIXKNLYPETZ

11. Implement the Euclidean Algorithm for integers and polynomials.
12. Implement AES Key Expansion.
13. Implementation of AES encryption and decryption
14. Implementation of Simplified DES Encryption and decryption
15. Implementation of RC4
16. Implementation of RSA algorithm
17. Implementation of Diffie-Helman key exchanges
18. Implementation of elliptic-curve cryptography
19. Implementation of Hash functions
20. Implementation of SHA1, SHA2, SHA3

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 315	Network Security	SE	3	0	2	4

Unit-1: Need for Security

Need for Security: Security Attack, Security Services, Information Security, Methods of

Protection.

Network Concepts: Basic Concepts of Computer Networks

Threats in Networks: Threat Precursors, Threats in Transit, Protocol Flaws, Message Confidentiality Threats, Nonexistent and Well-Known Authentication, Spoofing, DoS, DDoS

Network Security Controls: Segmentation, Redundancy, Single Points of Failure, Encryption, Link and End-to-End Encryption, Virtual Private Networks, VPN & Firewall, PKI and Certificates, SSL and SSH Encryption, Kerberos, Onion Routing

Unit-2*:* Authentication

Message Authentication Codes (MAC): Message Authentication Requirements, Message Authentication Functions, Security of MACs, MACs Based on Hash Functions: HMAC.

Digital Signature: Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme, NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.

Overview of Authentication Systems: Password-Based Authentication, Address-Based Authentication, Cryptographic Authentication Protocols, Trusted Intermediaries, KDCs, Certification Authorities (CAs), Session Key Establishment.

Security Handshake Pitfalls: Login, Mutual Authentication, Integrity/Encryption for Data, Two-Way Public Key Based Authentication, One-Way Public Key Based Authentication, Mediated Authentication (with KDC), Needham-Schroeder, Expanded Needham-Schroeder, Otway-Rees, Nonce Types.

Strong Password Protocols: Lamport's Hash, Strong Password Protocols, Strong Password Credentials Download Protocols.

Unit-3: IPSec

IPSec: Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Comparison of Encodings.

Internet Key Exchange (IKE): Photuris, SKIP, History of IKE, IKE Phases, Phase 1 IKE - Aggressive Mode and Main Mode, Phase 2/Quick Mode, Traffic Selectors, The IKE Phase 1 Protocols, Phase-2 IKE: Setting up IPsec SAs, ISAKMP/IKE Encoding - Fixed Header, Payload Portion of ISAKMP Messages, SA Payload, SA Payload Fields.

Unit-4: Web Security

Web Security Requirements: Web Security threats, Web traffic Security Approaches.

SSL/TLS: Secure Socket Layer (SSL), Transport Layer Security (TLS), TLS Architecture, TLS record protocol, change cipher spec protocol, Alert Protocol, Handshake Protocol, Https, SSH.

***Secure Electronic Transaction (SET)*:** SET functionalities, Dual Signature, Roles & Operations, Purchase Request Generation, Purchase Request Validation, Payment Authorization and Payment Capture.

SNMP: Basic concepts of SNMP, SNMP basic components and their functionalities, Basic commands of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats.

Unit-5: **Firewall & Email Security**

Firewalls: Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configurations.

Electronic Mail Security: Pretty Good Privacy, S/MIME, DNSSEC, Domain Keys Identified Mail.

Textbooks:

1. Perlman, Radia, Charlie Kaufman, and Mike Speciner. Network security: private communication in a public world. Pearson Education India, 2016.
2. Cryptography and Network Security – Principles and Practice: William Stallings, Pearson Education, 6th Edition.

Reference Books:

1. Network Security and Cryptography, Bernard Menezes, CENGAGE Learning.
2. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
3. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition.

LIST OF PRACTICAL EXPERIMENTS

1. packet assembler/analyzer: Wireshark**.**
2. packet assembler/analyzer: hPing3.
3. Encrypted communication over socket using AES.
4. Message Authentication Code: MAC.
5. MAC Based on Hash Function: HMAC.
6. Session Key establishment using RSA.
7. Handcraft a TCP handshake.
8. Diffie-Hellman Algorithm.
9. DH Key exchange.
10. Network Mapper: Nmap Basics.
11. Penetration Testing: Metasploit Basics.
12. Keytool& OpenSSL.
13. One Way SSL to a Web App.
14. SNMP: net SNMP – MIB.
15. Firewall with UFW.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 410	Mobile and Wireless Security	SE	3	0	2	4

UNIT I – Introduction to Mobile and Wireless Networks:
IEEE wireless networks, WLAN: IEEE 802.11 (a:n), WPAN: IEEE 802.15 (Bluetooth & Zigbee), WMAN: IEEE 802.16 (WiMAX), WMAN mobile: IEEE 802.20 (MBWA), IEEE 802.21 framework (MIH), Cellular Networks, Cellular networks: VoIP, IMS, 4G Security

Unit II – How existing Wireless networks are secured:
Attacks on wireless networks, WEP, WEP Shortcomings, IEEE 802.11i, Bluetooth, Authentication in wireless networks, GSM Authentication, UTMS Authentication, SS7 Protocol Stack

UNIT III – Next Generation Wireless Networks:
Mobility & Internet, Mobility with MIPv6, Mobility with Mobile IPv4, IP mobility with HIP and NetLMM, Ad Hoc Networks: Protocols, Security in Ad Hoc Networks, Key Management in Ad Hoc Networks, Wireless Sensor Network Security, Key Management in WSN

UNIT IV – Preventing Malicious Behavior:
Naming and Addressing, Establishing Security Association: Key Establishment in Sensor Network, Establishing Security Association: Utilizing Mobility, Wormhole Attack, Privacy in RFID System, Location Privacy in Vehicular Network, Privacy Preserving Routing in Ad-hoc Networks

UNIT V – Mobile Application Security:
Brief Introduction to Android – I, Brief Introduction to Android – II, Android Security Model Permission, Package Management, User Management, Cryptographic Providers, Network Security and PKI, Credential Storage, Discovering Vulnerabilities using Static Analysis, Tools Fuzzing on Android.

Textbooks:

1. Noureddine Boudriga, Security of Mobile Communications, 2010.
2. Levente Buttyán and Jean-Pierre Hubaux, Security and Cooperation in Wireless Networks, 2008. [Available Online]

Reference Books:

1. James Kempf, Wireless Internet Security: Architectures and Protocols, 2008.
2. Android Security Internals: An In-Depth Guide to Android's Security Architecture, Author: Nikolay Elenkov, No Starch Press, First Edition, Nov. 2014

LIST OF PRACTICAL EXPERIMENTS

1. Understanding IEEE 802.11with Wireshark.
2. Medium Access Control for Wirelessly Connected Stations.
3. Wireless Security – I (Wireless Security Basics).
4. Wireless Security – II (Wireless Threats).
5. Bluetooth Security.
6. Wireless Security Pen Testing (WEP, WPA/WPA2).
7. Mobility & Load and Congestion Window Size.

8. server mobility on the network performance: Load (bits/sec) , Congestion Window Size. (bytes) , and Traffic Received (bytes).
9. Queuing Disciplines and VoIP.
10. Network Security and Virtual Private Networks.
11. Network Application Performance Analysis.
12. Connection-Oriented, Cell-Switching Technology.
13. Developing Android App.
14. Reverse Engineering using Apktool and dex2jar.
15. Analyzing Vulnerabilities using Static Analyzer and Fuzzer.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 414	Internet Protocols and Networking	SE	3	0	2	4

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

Transport layer Protocols: Transport Layer Services, UDP and TCP protocols, Flow control and Error control in Transport layer, Flow control mechanisms in Transport layer.

UNIT IV

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 V

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.

TEXTBOOKS/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.

LIST OF PRACTICAL EXPERIMENTS

1. Install and Configure Wired and Wireless NIC and transfer files between systems in LAN and Wireless LAN.
2. Study basic network command and network configuration commands.
3. Configure Host IP, Subnet Mask and Default Gateway in a System in LAN (TCP/IP Configuration).

4. Establish Peer to Peer network connection using two systems using Switch and Router in a LAN.
5. Configure a Network topology using Packet Trace.
6. Configure Internet connection and use IPCONFIG, PING / Tracer and Net stat utilities to debug the network issues.
7. Transfer files between systems in LAN using FTP Configuration, install Print server in a LAN and share the printer in a network.
8. Set up a network that utilizes TCP as its end-to-end transmission protocol and analyse the size of the congestion window with different mechanisms.
9. Implement flow control so that a fast sender will not overrun a slow receivers' buffer**.**
10. Implement RED algorithm DEC Bit scheme in TCP.
11. Implement the Drop Tail Buffer Management Policies.
12. Implement the Drop Front Buffer Management Policies**.**
13. Implement the Random Drop Buffer Management Policies.
14. Implement the Early Random Drop Buffer Management Policies.
15. Implement RED algorithm.

Data Science Stream

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 311	Introduction to Machine Learning	SE	3	0	2	4

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 Tree. Instance based Learning: K nearest neighbor, the Curse of Dimensionality, Feature Selection: forward search, backward search, univariate, multivariate feature selection approach, Feature reduction (Principal Component Analysis), Python exercise on kNN and PCA Recommender System: Content based system; Collaborative filtering based.

UNIT III: PROBABILITY AND BAYES LEARNING

Bayesian Learning, Naïve Bayes, Python exercise on Naïve Bayes

Support Vector Machine: Introduction, the Dual formulation, Maximum margin with noise, nonlinear SVM and Kernel function, solution to dual problem, python exercise on SVM.

UNIT IV: ARTIFICIAL NEURAL NETWORKS

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

UNIT V: ENSEMBLES & CLUSTERING

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

TEXTBOOKS

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

REFERENCES

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.

LIST OF PRACTICAL EXPERIMENTS

1. Basic exercises on Python Machine Learning Packages such as Numpy, Pandas and matplotlib.
2. Given a dataset. Write a program to compute the Covariance, Correlation between a pair of attributes. Extend the program to compute the Covariance Matrix and Correlation Matrix.

3. Given a set of sample points in N dimensional feature space. Write a program to fit the points with a hyper plane using Linear Regression. Calculate sum of residual error.
4. Write a program that provides option to compute different distance measures between two points in the N dimensional feature space. Consider some sample datasets for computing distances among sample points.
5. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
6. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.
7. Write a program to implement feature reduction using Principle Component Analysis.
8. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
9. Given a dataset for classification task. Write a program to implement Support Vector Machine and estimate it test performance.
10. Write a program to implement perceptron for different learning task.
11. Write programs to implement ADALINE and MADALINE for given learning task.
12. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
13. Write a program to implement K means clustering algorithm. Select your own dataset to test the program. Demonstrate the nature of output with varying value of K.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 313	Introduction to Data Science	SE	3	0	2	4

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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 - Neighborhood 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.

TEXTBOOKS/REFERENCES

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.

LIST OF PRACTICAL EXPERIMENTS

1. Write a python program to apply datafication concepts of friendship network of your facebook account.
2. Write python program to calculate the central tendency of any popular data set. The inbuilt functions in the python should not be used.
3. Write R – Programming to plot various charts and graphs. You have to consider minimum two popular data sets and draw all the statistical observations.
4. Write a python Program to apply EDA on any two popular data sets and provided your analysis and interpretations. Use matplotlib library of python along with other libraries for the analysis and interpretation.
5. Write Python program to implement Linear Regression using inbuilt python Library. Also, write your own program to implement Linear Regression without using the inbuilt function. Compare and contrast the results.
6. Write Python program to implement K-Nearest Neighbors using inbuilt python Library. Also, write your own program to implement K-Nearest Neighbors without using the inbuilt function. Compare and contrast the results.
7. Write Python program to implement K-Means using inbuilt python Library. Also, write your own program to implement K-Means without using the inbuilt function. Compare and contrast the results.
8. Write a python program to implement a Spam Filter using Linear Regression and K-NN. Use a popular dataset.
9. Write a Python Program to Scrapping the Web using suitable API. Create a usable dataset for classification and clustering purpose.
10. Write a python program to generate the features from the data set created by you for exercise 9.
11. Write a Python Program to implement Filter and Wrappers.
12. Write a Python Program to implement Decision Trees, Random Forests – The inbuilt functions should not be used for the implementation.
13. Write a python Program to implement Singular Value Decomposition and Principle Component Analysis. Use any popular data set.
14. Write a python Program to extract the friendship details of your facebook account as Social network Graph and represent in various visual forms.

15. Write a python program to extend the above exercise to discover the communities in the graph, partition the graph and extracting the neighbourhood properties of the graphs.
16. Write Python Program using Bokeh 2.1.1 realize the all the basic principles of data visualization.
17. Consider any popular dataset and present complex visualization principle using Bokeh 2.1.1

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 411	Big Data Analytics	SE	3	0	2	4

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 framework - 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.

TEXTBOOKS/REFERENCES

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

LIST OF PRACTICAL EXPERIMENTS

1. a. Hadoop Installation
   b. Hadoop Shell Commands
2. a. Writing a file from local file system to Hadoop Distributed file system (HDFS)
   b. Reading a file from HDFS to local file system.
3. a. Implementation of Word Count program using Map Reduce without combiner logic
   b. Implementation of Word Count program using Map Reduce with combiner logic
4. Implementation of Map-Reduce program using partitioner

5. a. Implementation of Maximum temperature program using Map Reduce without combiner logic
   b. Implementation of Maximum temperature program using Map Reduce with combiner logic
6. a. Create a managed table and load the data from LFS
   b. Create a managed table and load the data from HDFS
   c. Create an external table and load the data from LFS
   d. Create an external table and load the data from HDFS
   e.Drop a managed table and check the result in HDFS
   f. Drop an external table and check the data from HDFS
7. Use HiveQL to analyse the stock exchange dataset and calculate the covariance between the stocks for each month. This will help a stock-broker in recommending the stocks to his customers.
8. a.create Hive table
   b. Load data into Hive table

c. Calculate the covariance

9. Implement JOINS using HIVE
   a. Inner Join
   b. Left outer join
   c. Right outer Join
   d) Full outer join
10. Write a R program to create student record using Vector concept.
11. Write a R program to create medical patients status using data frame

i) Patient age ii) Gender iii) Symptoms iv) Patient Status

12. Write R program to visualize student marks of various subjects using Bar-chart and Scatter plot.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 419	Information Retrieval	SE	3	0	2	4

UNIT I

Introduction to information retrieval, IR problem, IR system, The Web, Search interface, Visualizing search interface, Inverted index and boolean queries, Tokenization, Stemming, Stop words, Phrases, Phrases queries, Index construction, Index compression, k-gram indexes

UNIT II

Retrieval models: Boolean, Vector space model, TF-IDF, The cosine measure, Document length normalization, Probabilistic models, Binary Independence Model, Okapi, Language modeling,
Evaluating IR system: User happiness, Precision, Recall, F-measure, E-measure, Normalized recall, Evaluation problems

UNIT III

Relevance feedback and Query expansion: Explicit relevance feedback, Explicit relevance feedback through clicks, Implicit feedback through local analysis, Implicit feedback through global analysis
Document format, Markup language, Text properties, Document processing, Document organization, Text compression, Query languages, Query properties

UNIT IV

Text/Document classification, Clustering and LSI: Introduction to classification, Naive Bayes models, Rocchio classification, k-Nearest Neighbors, Support vector machine classifiers, Decision trees, Bagging, Boosting, Choosing right classifier

Introduction to clustering, Evaluation of clustering, k-means clustering, Hierarchical agglomerative clustering, Divisive clustering; Low-rank approximations, Latent semantic indexing

UNIT V

Web IR: Hypertext, Web crawling, Indexes, Search engines, Ranking, Link analysis, Page Rank, HITS

TEXTBOOKS & REFERENCES

1. Modern Information Retrieval: The Concepts and Technology Behind Search, by Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Second Edition (Pearson Education India, 2010)
2. Introduction to Information Retrieval, by C. Manning, P. Raghavan, and H. Schütze (Cambridge University Press, 2008)
3. Mining the Web, by S. Chakrabarti (Morgan-Kaufmann, 2002)
4. Natural Language Processing And Information Retrieval, by Tanveer Siddiqui and U. S. Tiwary, First Edition (Oxford University Press, 2008)

LIST OF PRACTICAL EXPERIMENTS

1. Tokenization, Stemming, Stop words removal, Inverted index construction - Token sequence, Sort, Dictionary & Postings, Implementation of Boolean queries.
2. Ranked retrieval - Implementation of TF-IDF, Vector space model, Cosine similarity.
3. Ranked retrieval - Implementation of Binary Independence Model, Okapi BM25.
4. Implementation of Text/Document classification algorithms - Naive Bayes models, Rocchio classification, k-Nearest Neighbors, Support vector machine classifiers, Decision trees, Bagging, Boosting.

5. Implementation of Text/Document clustering algorithms - k-means clustering, Hierarchical agglomerative clustering, Divisive clustering.
6. Implementation of Low-rank approximations, Latent semantic indexing.
7. Sort-based index construction.
8. Implementation of External memory indexing - BSBI, SPIMI.
9. Implementations of Dynamic indexing - Logarithmic merge.
10. Dictionary compression - Implementation of Blocking, Posting Compression - Implementation of Gamma codes.
11. Development of a Web Crawler and a small-scale web search engine - Ranking, PageRank, HITS.

TECHNICAL ELECTIVES

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 321	Human Computer Interaction	TE	3	0	0	3

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.

TEXTBOOKS

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.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 322	Advanced Computer Architecture	TE	3	0	0	3

UNIT I: INSTRUCTION LEVEL PARALLELISM

ILP – Concepts and challenges – Hardware and software approaches – Dynamic scheduling – Speculation - Compiler techniques for exposing ILP – Branch prediction.

UNIT II: MULTIPLE ISSUE PROCESSORS

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

UNIT III: MULTIPROCESSORS AND THREAD LEVEL PARALLELISM

Symmetric and distributed shared memory architectures – Performance issues – Synchronization – Models of memory consistency – Introduction to Multithreading.

UNIT IV: MEMORY AND I/O

Cache performance – Reducing cache miss penalty and miss rate – Reducing hit time – Main memory and performance – Memory technology. Types of storage devices – Buses – RAID – Reliability, availability and dependability – I/O performance measures – Designing an I/O system.

UNIT V: MULTI-CORE ARCHITECTURES

Software and hardware multithreading – SMT and CMP architectures – Design issues – Case studies – Intel Multi-core architecture – SUN CMP architecture - heterogeneous multi-core processors – case study: IBM Cell Processor.

TEXTBOOKS

1. John L. Hennessey and David A. Patterson, “Computer architecture – A quantitative approach”, Morgan Kaufmann / Elsevier Publishers, 4th. edition, 2007.

REFERENCES

1. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture: A hardware/software approach”, Morgan Kaufmann /Elsevier Publishers, 1999.
2. Kai Hwang and Zhi.Wei Xu, “Scalable Parallel Computing”, Tata McGraw Hill, New Delhi, 200

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 323	Natural Language Processing	TE	3	0	0	3

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.

TEXTBOOKS

1. Daniel Jurafsky, James H. Martin, “Speech & language processing”, Pearson publications.
2. James Allen, Natural Language Understanding. The Benajmins/Cummings Publishing Company Inc. 1994. ISBN 0-8053-0334-0
3. Bird, Steven, Ewan Klein, and Edward Loper, Natural language processing with Python: Analyzing text with the natural language toolkit, O'Reilly Media, Inc, 2009.
4. Manning, Christopher, and Hinrich Schutze. Foundations of statistical natural language processing. MIT press, 1999.

REFERENCES

1. Pierre M. Nugues, “An Introduction to Language Processing with Perl and Prolog”, Springer.
2. Cover, T. M. and J. A. Thomas, Elements of Information Theory, Wiley, 1991. ISBN 0-471-06259-6.
3. Charniak, E.: Statistical Language Learning. The MIT Press. 1996. ISBN 0-262-53141-0.

4. Tom Mitchell, Machine Learning. McGraw Hill, 1997. ISBN 0070428077.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 324	Computer Graphics	TE	3	0	0	3

UNIT I: INTRODUCTION

Application areas of Computer Graphics, overview of graphics systems, video-display devices,raster-scan systems, random scan systems, graphics monitors, and workstations and input devices

Output primitives: Points and lines, line drawing algorithms, mid-point circle andellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill, and flood-fill algorithms.

UNIT II:2-D GEOMETRICAL TRANSFORMS

Translation, scaling, rotation, reflection and shear transformations,matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems.

2-D Viewing: The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland andCyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

UNIT III: 3-D OBJECT REPRESENTATION

Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-spline curves, Bezier and B-spline surfaces. Basic illumination models, polygon rendering methods.

3-D Geometric transformations: Translation, rotation, scaling, reflection and shear transformations, composite transformations, 3-D viewing: Viewing pipeline,viewing coordinates, view volume andgeneral projection transforms and clipping.

UNIT IV:VISIBLE SURFACE DETECTION METHODS

Classification, back-face detection,depth-buffer, scan-line,depthsorting,BSP-tree methods,area sub-divisionand octree methods.

UNIT V:COMPUTER ANIMATION

Design of animation sequence,general computer animation functions, raster animation,computer animation languages, key frame systems, motion specifications

TEXTBOOKS:

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

REFERENCES:

1. Computer Graphics Principle and Practice, J.D. Foley, A.Dam, S.K. Feiner, Addison, Wesley
2. “Procedural elements for Computer Graphics”, David F Rogers, Tata Mc Graw hill, 2nd edition.
3. “Principles of Interactive Computer Graphics”, Neuman and Sproul, TMH.
4. Principles of Computer Graphics”, Shalini, Govil-Pai, Springer.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 325	Advanced Data Structures and Algorithms	TE	3	0	0	3

UNIT I: ADVANCED DATA STRUCTURES

Strategies for choosing the appropriate data structures-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: GRAPHS & ALGORITHMS

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 III: GEOMETRIC ALGORITHMS

Point location, Convex hulls and Voronoi diagrams, Arrangements, graph connectivity, Network Flow and Matching: Flow Algorithms - Maximum Flow – Cuts - Maximum Bipartite Matching - Graph partitioning via multi-commodity flow, Karger'r Min Cut Algorithm, String matching and document processing algorithms.

UNIT IV: APPROXIMATION ALGORITHMS

Approximation algorithms for known NP hard problems - Analysis of Approximation Algorithms. Use of Linear programming and primal dual, Local search heuristics. Parallel algorithms: Basic techniques for sorting, searching, merging, list ranking in PRAMs and Interconnection.

UNIT V: RANDOMIZED ALGORITHMS

Introduction, Type of Randomized Algorithms, Min- Cut, 2-SAT, Game Theoretic Techniques, Random Walks. Online Algorithms: Introduction, Online Paging Problem, Adversary Models, k-server Problem

TEXTBOOKS

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third Edition, The MIT Press, 2009.

REFERENCES

1. Sahni, Sartaj, Data Structures, Algorithms and Applications in C++, MIT Press (2005)
2. Roger Sedgewick and Kevin Wayne, Algorithms, Addison-Wesley Professional 2011.
3. Allan Borodin and Ran El-Yaniv: Online Computation and Competitive Analysis, Cambridge University Press, 2005.
4. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, “Algorithms”, Tata McGraw-Hill, 2009.
5. RK Ahuja, TL Magnanti and JB Orlin, “Network flows: Theory, Algorithms, and Applications”, Prentice Hall Englewood Cliffs, NJ 1993.

6. Rajeev Motwani, Prabhakar Raghavan: Randomized Algorithms, Cambridge University Press, 1995.
7. Jiri Matousek and Bernd Gärtner: Understanding and Using Linear Programming, 2006.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 326	Distributed Operating Systems	TE	3	0	0	3

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.

TEXTBOOKS/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.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 420	Data and Web Mining	TE	3	0	0	3

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 PRE-PROCESSING

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 neighbour), 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.

TEXTBOOKS/REFERENCES

1. Han, J., Kamber, M., & Pei, J. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann publications.
2. Introduction to Data Mining, Vipin kumar, Michael Steinbach, Pang-Ning Tan, Person publications,2016
3. Mining the Web, Soumen Chakrabarti, 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.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 421	Complexity Theory	TE	3	0	0	3

UNIT I: COMPUTABILITY

A recap of automata theory and the Church-Turing Thesis Computational models: Lambda calculus, Turing machine Decidability Reducibility. The PCP problem & Mapping reducibility The Recursion Theorem Definition of Information.

UNIT II: TIME COMPLEXITY

Measuring Complexity, Big-O and small-o notation, Analyzing algorithms. Complexity relationships among computational models The Class-P, Examples The Class-NP, Examples The P versus NP question NP-completeness The Cook-Levin Theorem Additional NP-completeness Problems.

UNIT III: SPACE COMPLEXITY

Space complexity. Savitch's Theorem and NL. NL-completeness and log-space reductions. From P-completeness to PSPACE-completeness. The Classes L and NL NL completeness, NL equals coNL.

UNIT IV: INTERACTABILITY

Hierarchy Theorems Relativization Circuit Complexity.

UNIT V: ADVANCED TOPICS IN COMPLEXITY THEORY

Approximation Algorithms Probabilistic Algorithms Alternation Interactive Proof Systems.

TEXTBOOKS

1. Introduction to the Theory of Computation - Michael Sipser (Primary Textbook)
2. Computational Complexity - Arora Barak (Reference)

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 422	Software Project Management	TE	3	0	0	3

UNIT I: SOFTWARE MANAGEMENT & ECONOMICS

SDLC -waterfall model Conventional Software Management Performance Evolution of Software Economics – Software economics Pragmatic software cost estimation Reducing software product size Improving software processes Improving team effectiveness Improving automation through software environment.

UNIT II: THE OLD AND THE NEW WAY OF PROJECT MANAGEMENT

The principles of conventional software engineering Principles of modern software management, Transitioning to an iterative process Basics of Software estimation – Effort and Cost estimation techniques COSMIC Full function points COCOMO-I COCOMO II A Parametric Productivity Model - Staffing Pattern.

UNIT III: SOFTWARE MANAGEMENT PROCESS FRAMEWORK

Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases. Artifacts of the process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts Model based software architectures: A Management perspective. Model based software architectures: Technical perspective Work Flows of the process: Software process workflows Iteration workflows Checkpoints of the process: Major milestones, Minor Milestones, Periodic status assessment.

UNIT IV: PROJECT ORGANIZATION AND PLANNING

Work breakdown structures Planning guidelines. The cost and schedule estimating process The iteration planning process Pragmatic planning Line-of-Business organizations Project organizations, Evolution of organizations Process automation - Automation building Blocks The project environment.

UNIT V: PROJECT CONTROL AND PROCESS INSTRUMENTATION

The Seven-Core metrics: Management indicators The Seven-Core metrics: Quality indicators Life-Cycle expectations, Pragmatic software metrics, Metrics automation Modern project profiles Next generation software economics Modern process transitions.

TEXBOOKS/REFERENCES

1. Walker Royce, “Software Project Management”, 1st Edition, Pearson Education, 2006.
2. Bob huges, Mike cotterell, Rajib Mall “Software Project Management”, 6th Edition, Tata McGraw Hill, 2017.
3. SA Kelkar, Software Project Management: A Concise Study, 3rd Edition, PHI, 2013.
4. Joel Henry, Software Project Management: A Real-World Guide to Success, Pearson Education, 2009.
5. Pankaj Jalote, Software Project Management in Practice, Pearson Education, 2015.
6. https://ocw.mit.edu/courses/engineering-systems-division/esd-36-system-project-management-fall-2012/
7. https://uit.stanford.edu/pmo/pm-life-cycle

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 423	Multimedia	TE	3	0	0	3

UNITI: INTRODUCTION TO MULTIMEDIA

What is Multimedia, Multimedia and Hypermedia, Overview ofMu1timedia Software Tools Graphics and Multimedia Data Representations: Graphics Image Data Types, File Formats, and representation (image, video, and sound).

UNITII: COLOUR IN IMAGE AND VIDEO

Color Science, Color' Models in Images, Color Models in Video, Fundamental Concepts in Video, Analog Video, Digital Video Basics of Digital Audio: Digitization of Sound, MIDI: Musical Instrument Digital Interface Quantization and Transmission of Audi.

UNIT III: LOSSLESS COMPRESSION ALGORITHMS

Basics of Information Theory, Run-Length Coding, Variable-Length Coding, Dictionary-Based Coding, Arithmetic Coding, Lossless Image Compression Lossy Compression Algorithms: Distortion Measures, The Rate-Distortion Theory Quantization, Transform Coding, Wavelet-Based Coding, Embedded Zerotree of Wavelet Coefficients.

UNITIV: **IMAGE COMPL'ESSION STANDARDS**

The JPEG Standard, The JPEG2000 Standard, The JPEG-LS Standard, Bilevel Image Compression Standards.

Basic Video Compression Techniques: Introduction to Video Compression, Video Compression Based on Motion Compensation, Search for Motion Vectors, H.261, H.263.

Basic Audio Compression Techniques: ADPCM in Speech Coding, G.726 ADPCM, Vocoders.

UNIT V: MPEG Video Coding I - MPEG-1 and 2

MPEG-1, MPEG-2 MPEG Video Coding 11- MPEG-4, 7, and Beyond: Overview ofMPEG-4, Object-Based Visual Coding in MPEG-4, Synthetic Object Coding in MPEG-4, MPEG-4 Part10/H.264, MPEG-7, H.265 MPEG Audio Compression: MPEG Audio, Commercial Audio codes.

TEXTBOOKS

1. Fundamentals of Multimedia (FM), Ze-Nian Li, Mark S. Drew, in Prentice Hall, 2004 (Springer 2nd Edition, 2014 with additional author of Dr. Jiangchuan Liu).
2. Digital Multimedia by Chapman (DM), Nigel P./ Chapman, Jenny, in John Wiley & Sons Inc, 2000 (3rd Edition, 2009).

REFERENCES

1. Multimedia: Making It Work, 9 Edition by Vaughan, Tay in McGraw-Hill, 2014.
2. Multimedia: Computing, Communications and Applications by Ralf Steinmetz in Pearson Education, 2012.
3. Recent articles about multimedia (recommended at classes).

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 424	Deep Learning	TE	3	0	0	3

UNIT I: INTRODUCTION

Overview of machine learning, linear classifiers, loss functions.

Introduction to Tensor Flow: Computational Graph, Key highlights, creating a Graph, Regression example, Gradient Descent, Tensor Board, Modularity, Sharing Variables, Keras.

UNIT II: Activation Functions

Sigmoid, ReLU, Hyperbolic Fns, Softmax Perceptrons: What is a Perceptron, XOR Gate.

Artificial Neural Networks: Introduction, Perceptron Training Rule, Gradient Descent Rule, vanishing gradient problem and solution.

UNIT-III: Convolutional Neural Networks

Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, problem, and solution of under fitting and over fitting.

UNIT IV: Recurrent Neural Networks

Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, GRU, Encoder Decoder architectures.

UNITV: Deep Learning applications

Image segmentation, Self-Driving Cars, News Aggregation and Fraud News Detection Natural Language Processing, Virtual Assistants, Entertainment, Visual Recognition Fraud Detection, Healthcare.

TEXTBOOKS

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, OReilly, 2017.
3. Gulli, Antonio, and Sujit Pal. Deep learning with Keras. Packt Publishing Ltd, 2017.
4. Buduma, Nikhil, and Nicholas Locascio. Fundamentals of deep learning: Designing next-generation machine intelligence algorithms. " O'Reilly Media, Inc.", 2017.

REFERENCES

1. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G., H., and Van Loan, C. F., Matrix Computations, JHU Press,2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 425	Advanced Database Management Systems	TE	3	0	0	3

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/Redo logging Protecting media failures

TEXTBOOKS

1. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004.
2. A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008.

REFERENCES

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

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 426	Fog Computing	TE	3	0	0	3

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 CHALLENGES 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 Direction 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

Case Study 1: Introduction, Human Object Detection, Object Tracking, Lightweight Human Detection. Case Study 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.

TEXTBOOKS

1. Fog and Edge Computing, Rajkumar Buyya, Satish Narayana Srirama, Wiley Publications, 2019.
2. Fog computing in the Internet of Things: Springer publications, 2018

REFERENCES

1. Research papers from IEEE, ACM, Springer and Elsevier)

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 427	Parallel Algorithms	TE	3	0	0	3

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

Graph Algorithms - Connected Graphs, search and traversal, 8 Combinatorial Algorithms- Permutation, Combinations, Derangements.

TEXTBOOKS

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

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 428	Web Services	TE	3	0	0	3

UNIT-I

Introduction to Service Oriented Architecture-Goals of service oriented architecture- Introduction to services-The SOA Architectural Stack-Service Composition and Data Flow-Data-Flow Paradigms-Composition Techniques

UNIT-II

Introduction to web services- History of webservices-Web services: communication stack-Simple Object Access Protocol (SOAP)-Web Services Description Language (WSDL)-WSDL Main Elements-Message Communication Model in SOAP/WSDL

UNIT-III

Web Services: REST or Restful Services-REST Design Principles-Web API Design for RESTful Services-Data Services-Implementation of Data Services-XML Transformation and Query Techniques-Consuming data via direct data access to the sources

UNIT-IV

Web Service Composition: Overview-Service Orchestration vs. Service Choreography-Benefits of Web Service Composition-Web Service Composition Environment-Web Service Composition: Control Flows-BPEL (Business Process Execution Language)-BPMN (Business Process Model and Notation)-Web Service Composition: Data Flows-Data-Flow Paradigms

UNIT-V

Introduction to Service Component Architecture (SCA)-The SOA Integration Problem-Overview of SCA-High-level overview of the assembly model-Application of SCA to Use Case-SCA Runtime-Benefits of SCA

TEXTBOOKS

1. Paik, Hye-young, et al. *Web Service Implementation and Composition Techniques*. Vol. 256. Springer International Publishing, 2017.
2. Martin Kalin, Java *Web Services: Up and Running*, O'Reilly publishers, Second edition, 2013.

Course Code	Course Name	Course Category	CREDITS			
			L	T	P	C
CSE 429	Advances in Data Mining	TE	3	0	0	3

UNIT I

What is Data Mining, Compiling need of Data Mining, Business Data Mining, Data Mining Tools. Data Mining Process, CRISP-DM, Business Understanding, Data Understanding, Data Preparation, Modelling, Evaluation, Deployment. SEMMA, Steps in SEMMA Process, Comparison of CRISP & SEMMA, Handling Data.

UNIT II

Association Rules in Knowledge Discovery, Market-Basket Analysis, Mining Frequent Patterns, Associations, and Correlations, Apriori Algorithm, Pattern-Growth Approach for Mining Frequent Itemsets, Mining Frequent Itemsets using Vertical Data Format, Mining Closed and Max Patterns. Pattern Mining in Multilevel, Multidimensional Space, Constraint-Based Frequent Pattern Mining, Mining High-Dimensional Data and Colossal Patterns, Mining Compressed or Approximate Patterns.

UNIT III

Classification: Basic Concepts, Decision Tree Induction, Bayes Classification Methods: Bayes' Theorem, Na¨ıve Bayesian Classification, Rule-Based Classification. Model Evaluation and Selection, Techniques to Improve Classification Accuracy: Bagging, Boosting and AdaBoost, Random Forests, Improving Classification Accuracy of Class-Imbalanced Data. Other Classification Methods: Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches.

UNIT IV

Cluster Analysis, Partitioning Methods: k-Means: A Centroid-Based Technique, k-Medoids: A Representative Object-Based Technique. Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, BIRCH: Multiphase Hierarchical Clustering Using Clustering, Feature Trees, Chameleon: Multiphase Hierarchical Clustering Using Dynamic Modelling, Probabilistic Hierarchical Clustering. Density-Based Methods, Grid-Based Methods.

UNIT V

Outliers and Outlier Analysis, Outlier Detection Methods: Supervised, Semi-Supervised, and Unsupervised Methods, Statistical Methods, Proximity-Based Methods, and Clustering-Based Methods, Mining Contextual and Collective Outliers, Outlier Detection in High-Dimensional Data. Mining Complex Data Types, Data Mining Applications, Social Impacts of Data Mining.

TEXTBOOKS

1. Data Mining Concepts and Techniques, Third Edition, by Jiawei Han, Micheline Kamber, and Jian Pei.
2. Olson DL, Delen D. Advanced data mining techniques. Springer Science & Business Media.

REFERENCES

1. Aggarwal CC. Data mining: the textbook. Springer. William
2. Machine Learning, 2nd edition, by Ethem Alpaydin.