National Education Policy (2022)

COURSE STRUCTURE, SYLLABUS AND SCHEME OF EXAMINATION

FOR

MASTER OF COMPUTER APPLICATION

(MCA 2 YEAR COURSE)

2022-23 Onwards

Programme Outcomes (POs) – MCA

After completion of the programme, the students are able to

1. Computational Knowledge - Apply knowledge of computing, Mathematics, Management and Fundamentals of Software Engineering appropriate to the discipline.
2. Problem Analysis – Identify and analyze problems and formulate the requirements appropriate to its solution.
3. Design Development of Solutions – Design, implement and evaluate a computer based system to meet the desired needs.
4. Conduct Investigations of Complex Computing Problems – Conduct investigations and experiments to analyze and interpret data of complex applications to find valid solutions.
5. Modern Tool Usage – Select and apply current trends, techniques and modern tools that suit the computing requirements like UML diagrams.
6. Cyber Ethics - Understand cyber, ethical, security and social issues; work with appropriate societal and environmental considerations
7. Lifelong learning - Build up the passion for continuing professional development.
8. Communication Efficiency - Communicate effectively across multidisciplinary teams to accomplish a common goal.
9. Societal and Environmental concern - Develop systems that meets the desired solutions considering local societal and environmental factors.
10. Individual and Team work -Work individually and in teams for the fulfillment of the desired task.
11. Innovation and Entrepreneurship - Create a culture that focus on Innovation and Entrepreneurship. Apply the inherent skills with absolute focus to function as a successful entrepreneur.

Department of Computer Applications
VBS PURVANCHAL UNIVERSITY, JAUNPUR

STUDY & EVALUATION SCHEME

MCA (Master of Computer Applications)
Effective from session: 2022-2023

SEMESTER I

SUB CODE	SUBJECT	L	T	P	TA/CT/TS/ESE	TOTAL	Credit
MCA-101	Fundamental of Computers & Emerging Technologies	3	0	0	30/20/50/100	150	3
MCA -102	Principles of Programming using C	3	1	0	30/20/50/100	150	4
MCA -103	Principles of Management & Communication	3	0	0	30/20/50/100	150	3
MCA -104	Discrete Mathematics	3	0	0	30/20/50/100	150	3
MCA - 105	Computer Organization & Architecture	3	1	0	30/20/50/100	150	4
MCA – L11	Principles of Programming Using C **Lab**	0	0	4	50/50	100	4
MCA – L12	Internet **Lab**	0	0	2	25/50	75	2
MCA – L13	Office Automation **Lab**	0	0	2	25/50	75	2
					TOTAL	1000	25

SEMESTER II

SUB CODE	SUBJECT	L	T	P	TA/CT/TS/ESE	TOTAL	Credit
MCA-201	Theory of Automata & Formal Language	3	0	0	30/20/50/100	150	3
MCA -202	Object Oriented Programming	3	1	0	30/20/50/100	150	4
MCA -203	Operating Systems	3	0	0	30/20/50/100	150	3
MCA -204	Database Management Systems	3	0	0	30/20/50/100	150	3
MCA -205	Data Structures & Analysis of Algorithms	3	1	0	30/20/50/100	150	4
MCA -206	Cyber Security*	2	0	0	0/50	0	0
MCA-L21	Object Oriented Programming **Lab**	0	0	4	50/50	100	4
MCA-L22	DBMS **Lab**	0	0	2	25/50	75	2
MCA-L23	Data Structures & Analysis of Algorithms **Lab**	0	0	2	25/50	75	2
					TOTAL	1000	25

DEPARTMENT OF COMPUTER APPLICATIONS
VBS PURVANCHAL UNIVERSITY, JAUNPUR

STUDY & EVALUATION SCHEME

MCA (Master of Computer Applications)
Effective from session: 2022-2023

SEMESTER III

SUB CODE	SUBJECT	L	T	P	TA/CT/TS/ESE	TOTAL	Credit
MCA-301	Computer Network	3	1	0	30/20/50/100	150	4
MCA -302	Artificial Intelligence	3	0	0	30/20/50/100	150	3
MCA -303	Software Engineering	4	0	0	30/20/50/100	150	4
MCA -304	**Elective -- 1**	3	0	0	30/20/50/100	150	3
MCA -305	**Elective -- 2**	3	0	0	30/20/50/100	150	3
MCA –L31	Mini Project**	0	0	4	50/50	100	4
MCA –L32	Artificial Intelligence **Lab**	0	0	2	25/50	75	2
MCA-L33	Software Engineering **Lab**	0	0	2	25/50	75	2
					TOTAL	1000	25

SEMESTER IV

SUB CODE	SUBJECT	L	T	P	TA/CT/TS/ESE	TOTAL	Credit
MCA-401	**Elective -- 3**	3	1	0	30/20/50/100	150	4
MCA -402	**Elective -- 4**	3	1	0	30/20/50/100	150	4
MCA -403	**Elective -- 5**	3	0	0	30/20/50/100	150	3
MCA –L41	Major Project**	0	0	0	500	500	10
MCA –L42	Comprehensive Viva	0	0	0	0/50	50	4
					TOTAL	1000	25

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VBS PURVANCHAL UNIVERSITY, JAUNPUR

STUDY & EVALUATION SCHEME

MCA (Master of Computer Applications)
Effective from session: 2022-2023

		ELECTIVE SUBJECTS
Elective-1	11	Cryptography & Network Security
	12	Data Warehousing & Data Mining
	13	Quantum Computing
	14	Cloud Computing
Elective-2	21	Compiler Design
	22	Web Technology
	23	Big Data
	24	Simulation & Modeling
Elective-3	31	Digital Image Processing
	32	Soft Computing
	33	Pattern Recognition
	34	Data Analytics
Elective-4	41	Blockchain Architecture
	42	Neural Network
	43	Internet of Things
	44	Machine Learning
Elective-5	51	Distributed Database Systems
	52	Mobile Computing
	53	Computer Graphics and Animation
	54	Natural Language Processing

SEMESTER I

Fundamental of Computers & Emerging Technologies
MCA 101

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Demonstrate the knowledge of the basic structure, components, features and generations of computers.	K_1, K_2
CO 2 Describe the concept of computer languages, language translators and construct algorithms to solve problems using programming concepts.	K_2, K_3
CO 3 Compare and contrast features, functioning & types of operating system and computer networks.	K_4
CO 4 Demonstrate architecture, functioning & services of the Internet and basics of multimedia.	K_2
CO 5 Illustrate the emerging trends and technologies in the field of Information Technology.	K_1, K_2

UNIT – I Computer Fundamentals

Introduction: Introduction to computer system, uses, types. Data Representation: Number system and Coding Schemes (ASCII and UNICODE). Human Computer Interface: Relationship between Hardware and Software, Types of software, Operating system as user interface, utility programs. Role of Computers in: Business, Manufacturing, Mobile Computing, Public Sector, Media, Defense Services.

UNIT – II Basics of Computer Network

Computer Network: Definition, Goals, Structure; Broadcast and Point-To-Point Networks; Network Topology and their various Types; Types of Network: LAN, MAN, WAN; Server Based LANs & Peer-to-Peer LANs; Communications Types: Synchronous, Asynchronous; Modes of Communication: Simplex, Half Duplex, Full Duplex; Protocols and Standards.

UNIT – III Word Processing

Text Formatting using Word Processing tools: Use of Templates, Working with document: Editing text, Find and replace text, Formatting, spell check, Autocorrect, Autotext; Bullets and numbering, Tabs, Paragraph Formatting, Indent, Page Formatting, Header and footer, section break, footnotes, bibliography and references. Tables: Inserting, filling and formatting a table; Inserting Pictures and Video; Managing Mail Merge: including linking with Database; Printing documents Data Presentation using Presentation tools: Slides, Fonts, Drawing, Editing; Inserting: Tables, Images, texts, Symbols, Media; Design; Transition; Animation; and Slide-show.

UNIT – IV Overview of Emerging Technologies

Cloud Computing: Meaning, Features, & Service models – Infrastructure as a service, Advantages and disadvantages, Mobile Computing: Meaning, Business Applications of Mobile computing, Virtual reality & Augmented Reality: Meaning and applications , IOT - Internet of Things: Meaning & Application.

UNIT V Computing Trends in Internet, Education and Research:

Internet-role and importance, Web Server and Web clients like web browser or web app, IP addressing : Public Vs Private, Static Vs Dynamic, world wide web and related protocols, e-Library, Google Scholar.

Reference Books:

1. Introduction to Information Technology by ITL Education Solutions Limited, second edition.
2. ‘ O’ Level made simple “introduction to ICT resources” by Satish Jain, Shashank Jain, Shashi Singh & M. Geetha Iyer, BPB publication.
3. Computer Fundamentals fourth edition by Pradeep K. Sinha and Priti Sinha BPB Information Technology The breaking wave by Dennis Curtin Tata McGraw-hill edition
4. Computer Fundamentals by A. Goel, Pearson Education, 2010.

SEMESTER I

Principles of Programming Using C
MCA 102

Course Outcome (CO)	Bloom’s Knowledge Level (KL)
CO 1 Describe the functional components and fundamental concepts of a digital computer system including number systems. Construct flowchart and write algorithms for solving basic problems.	K_1, K_2, K_3
CO 2 Write ‘C’ programs that incorporate use of variables, operators and expressions along with data types.	K_2, K_3
CO 3 Write simple programs using the basic elements like control statements, functions, arrays and strings.	K_2, K_3
CO 4 Write advanced programs using the concepts of pointers, structures, unions and enumerated data types.	K_2, K_3
CO 5 Apply pre-processor directives and basic file handling and graphics operations in advanced programming.	K_2, K_3

UNIT – I Introduction

Algorithm, Flowcharts, Introduction of programming languages, History of C, Basic structure of C Programming, Executing C Program

Data Types: Constant, variables, Identifiers, Keywords, Tokens, Declaration of Variables, Assigning values to variables.

Operators: Arithmetic, Relational, Logical, Assignment, Increment, Decrement operators, Condition, Bit wise operators, Arithmetic expressions.

UNIT – II Branching & Looping

Decision making with if, If-else, Switch Statement, GOTO statement, While loop, Do While loop, FOR Loop, Break and Continue statements.

Array: One dimensional array, Two dimensional array, Multidimensional array, Initializing array.

UNIT – III Function

Function declaration, calling a function, the form of C function, Return values and their type, No arguments, no return value, arguments but no return, recursion, Nesting of function. Pointers: Accessing address of a variable, declaring and initializing pointers, pointer expression, pointer and array, pointer and function, pointer and structure, pointer to pointer

UNIT – IV Structure & Union

Structure definition, giving values to members, structure initialization, Array of structure, structure within structure, Size of structure, Union definition

UNIT – V File Handling

Defining and opening file, closing a file, I/O operations on file. Random access to file, Error handling in file. Dynamic memory allocation: Allocating and reallocating memory, allocating memory for structure and array

Reference Books:

1. Programming in C: Gottfried
2. Programming in ANSI C: E. Balaguruswamy
3. Let us C : Y. Kanetkar

SEMESTER I

Principles of Management & Communication
MCA 103

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Describe primary features, processes and principles of management.	K_1, K_2,
CO 2 Explain functions of management in terms of planning, decision making and organizing.	K_3, K_4
CO 3 Illustrate key factors of leadership skill in directing and controlling business resources and processes.	K_5, K_6
CO 4 Exhibit adequate verbal and non-verbal communication skills	K_1, K_3
CO 5 Demonstrate effective discussion, presentation and writing skills.	K_3, K_5

UNIT – I Management

Concept, Nature, Importance; Management : Art and Science, Management As a Profession, Management Vs. Administration, Management Skills, Levels of Management, Characteristics of Quality Managers. Evolution of Management: Early contributions, Taylor and Scientific Management, Fayol's Administrative Management, Bureaucracy, Hawthorne Experiments and Human Relations, Social System Approach, Decision Theory Approach. Business Ethics and Social Responsibility: Concept, Shift to Ethics, Tools of Ethics.

UNIT – II Introduction to Functions of Management Planning

Nature, Scope, Objectives and Significance of Planning, Types of Planning, Process of Planning, Barriers to Effective Planning, Planning Premises and Forecasting, Key to Planning, Decision Making. Organizing: Concept, Organisation Theories, Forms of Organizational Structure, Combining Jobs: Departmentation, Span of Control, Delegation of Authority, Authority & Responsibility, Organisational Design.

UNIT – III Staffing

Concept, System Approach, Manpower Planning, Job Design, Recruitment & Selection, Training & Development, Performance Appraisal Directing: Concept, Direction and Supervision Motivation: Concept, Motivation and Performance, Theories Of Motivation, Approaches for Improving Motivation, Pay and Job Performance, Quality of Work Life, Morale Building.

UNIT -IV Basics of Technical Communication

Technical Communication: features; Distinction between General and Technical communication; Language as a tool of communication; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of Communication:

Downward, Upward, Lateral or Horizontal (Peer group); Importance of technical communication; Barriers to Communication.

UNIT - V Forms of Technical Communication

Business Letters: Sales and Credit letters; Letter of Enquiry; Letter of Quotation, Order, Claim and Adjustment Letters; Job application and Resumes. Official Letters: D.O. Letters; Govt. Letters, Letters to Authorities etc. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal; Parts; Types; Writing of Proposal; Significance. Technical Paper, Project. Dissertation and Thesis Writing: Features, Methods & Writing.

Reference Books:

1. Stoner, Freeman & Gilbert Jr - Management (Prentice Hall of India, 6th Edition)
2. Koontz - Principles of Management (Tata Mc Graw Hill, Ist Edition 2008)
3. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, New Delhi .
4. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press 2007, New Delhi.

SEMESTER I

Discrete Mathematics
MCA 104

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Use mathematical and logical notation to define and formally reason about basic discrete structures such as Sets, Relations and Functions	K_1, K_2,
CO 2 Apply mathematical arguments using logical connectives and quantifiers to check the validity of an argument through truth tables and propositional and predicate logic	K_3, K_4
CO 3 Identify and prove properties of Algebraic Structures like Groups, Rings and Fields	K_5, K_6
CO 4 Formulate and solve recurrences and recursive functions	K_1, K_3
CO 5 Apply the concept of combinatorics to solve basic problems in discrete mathematics	K_3, K_5

UNIT – I Set Theory

Introduction, Combination of sets, Multi sets, ordered pairs, Set Identities.

Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Order of relations.

Functions: Definition, Classification of functions, Operations on functions, Recursively defined functions.

Natural Numbers: Introduction, Mathematical Induction, Variants of Induction, Induction with Nonzero Base cases.

UNIT – II Algebraic Structures

Definition, Groups, Subgroups and order, Cyclic Groups, Cosets, Lagrange's theorem, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphism's, Definition and elementary properties of Rings and Fields, Integers Modulo n.

UNIT – III Partial order sets

Definition, Partial order sets, Combination of partial order sets, Hasse diagram.

Lattices: Definition, Properties of lattices – Bounded, Complemented, Modular and Complete Lattice, Morphisms of lattices.

Boolean Algebra: Introduction, Axioms and Theorems of Boolean algebra, Algebraic manipulation of Boolean expressions. Simplification of Boolean Functions, Karnaugh maps, Logic gates, Digital circuits and Boolean algebra. Combinational and sequential Circuits.

UNIT – IV Propositional Logic

Proposition, well formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Theory of Inference, Natural Deduction.

Predicate Logic: First order predicate, well formed formula of predicate, quantifiers, Inference theory of predicate logic.

UNIT V Trees

Definition, Binary tree, Binary tree traversal, Binary search tree.

Graphs: Definition and terminology, Representation of graphs, Multi graphs, Bipartite graphs, Planar graphs, Isomorphism and Homeomorphism of graphs, Euler and Hamiltonian paths, Graph coloring.

Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences.

Combinatorics: Introduction, Counting Techniques, Pigeonhole Principle

Reference Books:

1. Liu and Mohapatra, "Elements of Discrete Mathematics", McGraw Hill
2. Jean Paul Trembley, R Manohar, "Discrete Mathematical Structures with Application to Computer Science", McGraw-Hill
3. YN Singh, "Discrete Mathematical Structures", Wiley India, New Delhi, First Edition, August 2010**.**

SEMESTER I

Computer Organization & Architecture
MCA 105

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Describe functional units of digital system and explain how arithmetic and logical operations are performed by computers	K_2, K_3,
CO 2 Describe the operations of control unit and write sequence of instructions for carrying out simple operation using various addressing modes.	K_2, K_4
CO 3 Design various types of memory and its organization.	K_3
CO 4 Describe the various modes in which IO devices communicate with CPU and memory.	K_2, K_3
CO 5 List the criteria for classification of parallel computer and describe various architectural schemes	K_1, K_2

UNIT – I Fundamental

Functional units of digital system and their interconnections, buses, bus architecture, types of buses and bus arbitration. Register bus and memory transfer, Processor organization, general register organization, stack organization and addressing modes,

Look ahead carry adders. Multiplication: Signed operand multiplication, Booths algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Arithmetic & logic unit design.

UNIT – II Instructions

Instruction types, formats, instruction cycles and sub cycles (fetch, execute etc), micro-operations, execution of a complete instruction, Hardwire and micro-programmed control: micro-programme sequencing, concept of horizontal and vertical microprogramming.

UNIT – III Memory

Basic concept and hierarchy, semiconductor RAM memories, 2D & 212DD memory organization. ROM memories, Cache memories: concept and design issues & performance, address mapping and replacement, Auxiliary memories: magnetic disk, magnetic tape and optical disks, Virtual memory: concept implementation.

UNIT – IV I/O Devices

Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions, Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access., I/O channels and processors, Serial Communication: Synchronous & asynchronous communication, standard communication interfaces.

UNIT V Architectural Classification

Architectural Classification Schemes, Flynn's & Feng's Classification, Performance Metrics and Measures, Speedup Performance Laws, Pipelining and Memory Hierarchy Basic and Intermediate Concepts, Linear and Nonlinear Pipeline Processors, Optimization of Cache Performance.

Reference Books:

1. Patterson, "Computer Organization and Design" Elsevier Pub. 2009
2. William Stalling, "Computer Organization", PHI
3. M. Morris Mano, "Computer System Architecture", Pearson Learning
4. Miles Murdocca, Vincent Heuring "Computer Architecture and Organisation: An Integrated Approch" 2nd Edition
5. Kai Hwang, "Advance Computer Architecture", TMH
6. Vravice, Hamacher & Zaky, "Computer Organization", TMH
7. John P Hays, "Computer Organization", McGraw Hill
8. Tannenbaum, "Structured Computer Organization", PHI
9. P Pal Chaudhry, "Computer Organization & Design" PHI
10. Dezso and Sima, "Advanced Computer Architecture", Pearson

SEMESTER II

Theory of Automata & Formal Language
MCA 201

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Define various types of automata for different classes of formal languages and explain their working.	K_1, K_2
CO 2 State and prove key properties of formal languages and automata.	K_1, K_3
CO 3 Construct appropriate formal notations (such as grammars, acceptors, transducers and regular expressions) for given formal languages.	K_3, K_4

CO 4 Convert among equivalent notations for formal languages.	K_3
CO 5 Explain the significance of the Universal Turing machine, Church-Turing thesis and concept of Undecidability.	K_2

UNIT – I Introduction

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

UNIT – II Regular Expression

Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages . Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

UNIT – III Context free grammar (CFG) and Context Free Languages (CFL)

Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs.

UNIT – IV Push Down Automata (PDA)

Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two stack PDA.

UNIT V Turing machines (TM)

Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computerof Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory.

Reference Books:

1. Hopcroft, Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. KLP Mishra and N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", PHI Learning Private Limited, Delhi India.
3. Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishing house.
4. YN Singh "Mathematical Foundation of Computer Science", New Age International.
5. Malviya, AK "Theory of Computation and Application", BPaperback Publications
6. Papadimitrou, C. and Lewis, CL, "Elements of the Theory of Computation", Pearson Publication.

Object Oriented Programming
MCA 202

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 List the significance and key features of object oriented programming and modeling using UML	K_4
CO 2 Construct basic structural, behavioral and architectural models using object oriented software engineering approach.	K_6
CO 3 Integrate object oriented modeling techniques for analysis and design of a system.	K_4, K_5
CO 4 Use the basic features of data abstraction and encapsulation in C++ programs.	K_4
CO 5 Use the advanced features such as Inheritance, polymorphism and virtual function in C++ programs.	K_3, K_4

UNIT – I Introduction to OOPs and Java Fundamentals

Object Oriented Programming – Abstraction – objects and classes – Encapsulation- Inheritance – Polymorphism- OOP in Java – Characteristics of Java – The Java Environment – Java Source File Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers – static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages – JavaDoc comments.

UNIT – II Inheritance and Interfaces

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces – Object cloning -inner classes, ArrayLists – Strings

UNIT – III Exception Handling and I/O

Exceptions – exception hierarchy – thronwig and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

UNIT – IV Multithreading and Generic Programming

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.

UNIT V Event Driven Programming

Graphics programming – Frame – Components – working with 2D shapes – Using color, fonts, and images – Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy – Introduction to Swing – layout management – Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes

Reference Books:

1. Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers‖, 3rd Edition, Pearson, 2015.
2. Steven Holzner, ―Java 2 Black book‖, Dreamtech press, 2011.
3. Timothy Budd, ―Understanding Object-oriented programming with Java‖, Updated Edition, Pearson Education, 2000.

SEMESTER II

Operating Systems
MCA 203

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Explain main components, services, types and structure of Operating Systems.	K_2
CO 2 Apply the various algorithms and techniques to handle the various concurrency control issues.	K_3
CO 3 Compare and apply various CPU scheduling algorithms for process execution.	K_2
CO 4 Identify occurrence of deadlock and describe ways to handle it.	K_3
CO 5 Explain and apply various memory, I/O and disk management techniques.	K_5

UNIT-I Operating System Concepts

OS definition and services; Types and features: batch systems, multiprogramming, multitasking, parallel systems, distributed systems, real-time systems, timesharing systems, PC systems; System Calls types, System Programs

UNIT – II Process vs. Thread

Process states, process control block; Inter process communication; Process Synchronization: Classical problems of synchronization; CPU Scheduling: Criteria; Algorithms: FCFS, SJF, Priority, Round- Critical section problem and solution criteria, Semaphores.

UNIT – III Memory Management

Paging and Segmentation approaches, virtual memory, Demand Paging and Page Replacement algorithms; Deadlocks: necessary conditions, prevention, avoidance and recovery, banker's algorithm.

UNIT – IV File Management

File system Structure, allocation methods: Contiguous allocation, Linked allocation, indexed allocation free space management: Bit vector, linked list, grouping, counting: Directory implementation: Linear List, Hash table. Device Management: Disk structure, Disk scheduling: Selecting Disk Scheduling algorithm.

UNIT V UNIX

Essential commands and utilities, Unix files, directory structure, file security, pipe, filter, Bourne shell programming features, systems calls classification and basics (reg. file manipulation, process, signal and IPC); Linux: System components, Process management, scheduling, memory management, Networking software layers, Security, various editors, I/O devices, IPC.

Reference Books:

1. Operating System Concepts by Silberschatz and Galvin; Addison Wesley
2. Ditributed Operating Systems by Andrew S. Tannenbaum; Pearson Education
3. UNIX Concepts and Applications by Sumitabha Das; Tata MC-Graw Hill

4. Ekta Walia, Khanna Publishing House, Operating System Concepts

SEMESTER II

Database Management Systems
MCA 204

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Describe the features of a database system and its application and compare various types of data models.	K_2
CO 2 Construct an ER Model for a given problem and transform it into a relation database schema.	K_5, K_6
CO 3 Formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus.	K_5, K_6
CO 4 Explain the need of normalization and normalize a given relation to the desired normal form.	K_2, K_3
CO 5 Explain different approaches of transaction processing and concurrency control.	K_2

UNIT – I Introduction

The Evolution of Database Systems- Overview of a Database Management System-Outline of Database-System Studies-The Entity- RELATIONSHIP DATA MODEL: Elements of the E/R Model-Design Principles-The Modelling of Constraints-Weak Entity Sets

UNIT – II The Relational Data Model & Algebra

Basics of the Relational Model-From E/R Diagrams to Relational Designs Converting Subclass Structures to Relations Functional Dependencies-Rules About Functional Dependencies-Design of Relational Database Schemas - Multivalued Dependencies. RELATIONAL ALGEBRA: Relational Operations-Extended Operators of Relational Algebra- Constraints on Relations

UNIT – III SQL

Simple Queries in SQL-Sub queries-Full-Relation Operations-Database Modifications-Defining a Relation Schema-View Definitions- Constraints and Triggers: Keys and Foreign Keys-Constraints on Attributes and Tuples Modification of Constraints-Schema-Level Constraints and Triggers -Java Database Connectivity- Security and User Authorization in SQL

UNIT – IV Index Structure, Query Processing

Index Structures: Indexes on Sequential Files-Secondary Indexes-B-Trees-Hash Tables-Bitmap Indexes. QUERY EXECUTION: Physical-Query-Plan Operators-One-Pass, two-pass & index based Algorithms, Buffer Management, Parallel Algorithms-Estimating the Cost of Operations-Cost-Based Plan Selection -Order for Joins-Physical- QueryPlan

UNIT V - Failure Recovery and Concurrency Control

Issues and Models for Resilient Operation -Undo/Redo Logging-Protecting against Media Failures Concurrency Control: Serial and Serializable Schedules-Conflict Serializability-Enforcing Serializability by Locks-Locking Systems with Several Lock Modes-Concurrency Control by Timestamps, validation. Transaction Management:

Serializability and Recoverability-View Serializability-Resolving Deadlocks-Distributed Databases: Commit and Lock

Reference Books:

1. Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom, "Database Systems: The Complete Book", Pearson Education, Second Edition, 2008.
2. Silberschatz, H. Korth and Sudarshan S., "Database System Concepts", 6th Edition, McGraw-Hill International, 2010.
3. Elmasri R. and Shamakant B.Navathe, "Fundamentals of Database Systems", 6th Edition, AddisionWesley , 2011.

SEMESTER II

Data Structures & Analysis of Algorithms
MCA 205

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Explain the concept of data structure, abstract data types, algorithms, analysis of algorithms and basic data organization schemes such as arrays and linked lists.	K_2
CO 2 Describe the applications of stacks and queues and implement various operations on them using arrays and linked lists.	K_3
CO 3 Describe the properties of graphs and trees and implement various operations such as searching and traversal on them.	K_3
CO 4 Compare incremental and divide-and-conquer approaches of designing algorithms for problems such as sorting and searching.	K_4
CO 5 Apply and analyze various design approaches such as Divide-and-Conquer, greedy and dynamic for problem solving .	K_4

UNIT – I: Data Structures Basics

Structure and Problem Solving, Data structures, Data structure Operations, Algorithm: complexity, Time- space tradeoff. Linked List: Introduction, Linked lists, Representation of linked lists in Memory, Traversing a linked list, Searching a linked list, Memory allocation and Garbage collection, insertion into linked list, Deletion from a linked list, Types of linked list.

UNIT – II: Stack and Queue

Introduction, Array Representation of Stack, Linked List Representation of stack, Application of stack, Queue, Array Representation of Queue, Linked List Representation of Queue. Trees: Definitions and Concepts, Operations on Binary Trees, Representation of binary tree, Conversion of General Trees to Binary Trees, Tree Traversal. Graphs: Matrix Representation of Graphs, List Structures, Other Representations of Graphs, Breadth First Search, Depth First Search, Spanning Trees. Directed Graphs Types of Directed Graphs. Applications of Graphs: Topological Sorting, Shortest-Path Algorithms – Weighted Shortest Paths – Dijkstra's Algorithm, Minimum spanning tree- Prim's Algorithm, Introduction to NP-Completeness.

UNIT – III: Searching and Sorting Techniques

Bubble sort, Merge sort, Selection sort, Heap sort, Insertion Sort. Searching Techniques: Sequential Searching, Binary Searching, Search Trees. Elementary Algorithms: Notation for Expressing Algorithms; Example of an Algorithm; Problems and Instances;

Characteristics of an Algorithm; Building Blocks of Algorithms; Procedure and Recursion – Procedure, Recursion; Outline of Algorithms; Specification Methods for Algorithms.

UNIT - IV: Mathematical Functions and Notations Functions and Notations

Modular Arithmetic / Mod Function; Mathematical Expectation in Average Case Analysis; Efficiency of an Algorithm; Well Known Asymptotic Functions and Notations; Analysis of Algorithms – Simple Examples; Well Known Sorting Algorithms – Insertion sort, Bubble sort, Selection sort, Shell sort, Heap sort.

UNIT V: Divide and Conquer Divide and Conquer Strategy

Binary Search; Max. And Min.; Merge sort; Quick sort. Greedy Method, Strategy; Optimistic Storage on Tapes; Knapsack Problem; Job Sequencing with Deadlines; Single Source Shortlist Paths, Dynamic Programming Strategy; Multistage Graphs; All Pair Shortest Paths; Travelling Salesman Problems. Backtracking Strategy, 8-Queens Problem, Sum of Subsets.

Reference Books:

1. Y. Langsam, M. Augenstin and A. Tannenbaum, Data Structures using C and C++, Pearson Education Asia, 2nd Edition, 2002.
2. Ellis Horowitz, S. Sahni, D. Mehta Fundamentals of Data Structures in C++, Galgotia Book Source, New Delhi.
3. Design and Analysis of Computer Algorithms, Aho, Pearson Education Pub.
4. Fundamentals of Computer Algorithms by Horowitz and Sahani, Galgotia

SEMESTER II

Cyber Security
MCA 206

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Identify and analyze nature & inherent difficulties in the security of the Information System.	K_3
CO 2 Analyze various threats and attacks, corresponding counter measures and various vulnerability assessment and security techniques in an organization.	K_3
CO 3 Applications of cyber based policies and use of IPR and patent law for software-based design. Define E-commerce types and threats to E-commerce.	K_1,K_2
CO 4 Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance.	K_2
CO 5 Explain concepts and theories of IPR.	K_2

UNIT – I Introduction to Information Systems

Types of information Systems, Development of Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

UNIT – II Security

Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, Access Control.

Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce- Electronic Payment System, e-Cash, Credit/Debit Cards. Digital Signature, public Key Cryptography.

UNIT – III Development of Secure Information System

Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures.

UNIT – IV Security Policies

Why Policies should be developed, WWW policies, Email Security policies, Policy Review Process-Corporate policies-Sample Security Policies, Publishing and Notification Requirement of the Policies.

UNIT V Information Security Standards

ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Patent Law.

Reference Books:

1. Charles P. Pfleeger, Shari Lawerance Pfleeger, "Analysing Computer Security", Pearson Education India.
2. V.K. Pachghare, "Cryptography and information Security", PHI Learning Private Limited, Delhi India.
3. Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen kumar Shukla ,"Introduction to Information Security and Cyber Law" Willey Dreamtech Press.
4. Schou, Shoemaker, "Information Assurance for the Enterprise", Tata McGraw Hill.
5. CHANDER, HARISH, "Cyber Laws And It Protection", PHI Learning Private Limited, Delhi, India

SEMESTER III

Computer Network
MCA 301

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Describe communication models TCP/IP, ISO-OSI model, network topologies along with communicating devices and connecting media.	K_2
CO 2 Apply knowledge of error detection, correction and learn concepts of flow control along with error control.	K_3
CO 3 Classify various IP addressing techniques, subnetting along with network routing protocols and algorithms.	K_4
CO 4 Understand various transport layer protocols and their design considerations along with congestion control to maintain Quality of Service.	K_2
CO 5 Understand applications-layer protocols and elementary standards of cryptography and network security.	K_2

UNIT – I Data Communications

Data communication Components – Data representation and Data flow – Networks – Types of Connections – Topologies – Protocols and Standards – OSI model – Transmission Media – LAN –Wired LANs, Wireless LANs, Connecting LANs, Virtual LANs.

UNIT – II Data Link Layer

Error Detection and Error Correction – Introduction–Block coding–Hamming Distance – CRC–Flow Control and Error control – Stop and Wait – Go back – N ARQ – Selective Repeat ARQ – Sliding Window – Piggybacking – Random Access – CSMA/CD, CDMA/CA.

UNIT – III Network Layer

Switching–Logical addressing – IPV4 – IPV6–Address mapping–ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT – IV Transport Layer

Process to Process Delivery – User Datagram Protocol – Transmission Control Protocol – SCTP – Congestion Control with Examples.

UNIT - V Application Layer

Domain Name Space – DDNS – TELNET – EMAIL – File transfer WWW – HTTP – SNMP – Cryptography – Basic concepts.

Reference Books:

1. Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw–Hill, Fourth Edition, 2011.
2. Larry L.Peterson, Peter S. Davie, "Computer Networks", Elsevier, Fifth Edition, 2012.
3. William Stallings, "Data and Computer Communication", Eighth Edition, Pearson Education, 2007.
4. James F. Kurose, Keith W. Ross, "Computer Networking: A Top–Down Approach Featuring the Internet", Pearson Education, 2005.

SEMESTER III

Artificial Intelligence
MCA 302

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Define the meaning of intelligence and study various intelligent agents.	K_1
CO 2 Understand, analyze and apply AI searching algorithms in different problem domains.	K_2 , K_3 , K_4
CO 3 Study and analyze various models for knowledge representation.	K_1 , K_3
CO 4 Understand the basic concepts of machine learning to analyze and implement widely used learning methods and algorithms.	K_2 , K_4 , K_6
CO 5 Understand the concept of patte rn recognition and evaluate various classification and clustering techniques	K_2 , K_5

UNIT-I Introduction

Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.

UNIT-II Introduction to Search

Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.

UNIT-III Knowledge Representation & Reasoning

Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

UNIT-IV Machine Learning

Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning,

UNIT-V Pattern Recognition

Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbour (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

Reference Books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, McGraw-Hill
3. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson Education
4. Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall of India

SEMESTER III

Software Engineering
MCA 303

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Explain various software characteris tics and analyze different software Development Models.	K1 , K2
CO 2 Demonstrate the contents of a SRS and apply basic software quality assurance practices to ensure that design, development meet or exceed applicable standards.	K1 , K2
CO 3 Compare and contrast various methods for software design.	K 2 , K3
CO 4 Formulate testing strategy for software systems, employ techniques such as unit testing, Test driven development and functional testing.	K3
CO 5 Manage software development process independently as well as in teams and make use of various software management tools for development, maintenance and analysis.	K5

UNIT – I Introduction

Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

UNIT – II Software Requirement Specifications (SRS)

Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS.

Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.

UNIT – III Software Design

Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

UNIT – IV Software Testing

Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products.

Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.

UNIT V Software Maintenance and Software Project Management

Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities,

Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

Reference Books:

1. RS Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. Pankaj Jalote, Software Engineering, Wiley
3. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
4. KK Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.

ELECTIVE - 1

E-11 - Cryptography & Network Security

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Understand various security attacks and their protection mechanism.	K_2
CO 2 Apply and analyze various encryption algorithms.	K_3 , K_4
CO 3 Understand functions and algorithms to authenticate messages and study and apply different digital signature techniques.	K_1 , K_2 , K_3
CO 4 Analyze different types of key distributions.	K_4
CO 5 Study and appraise different IP and system security mechanism.	K_1 , K_5

UNIT-I Introduction

Security attacks, services and mechanism, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers. Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation.

UNIT-II Introduction to Graph

Ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.

UNIT-III Message Authentication and Hash Function

Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA). Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

UNIT-IV Authentication Applications

Kerberos and X.509, directory authentication service, electronic mail security pretty good privacy (PGP), S/MIME.

UNIT-V IP Security

Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

Reference Books:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Pearson Education.
2. Behrouz A. Frouzan: Cryptography and Network Security, Tata McGraw Hill
3. C K Shyamala, N Harini, Dr. T.R.Padmnabhan Cryptography and Security, Wiley
4. Bruce Schiener, "Applied Cryptography". John Wiley & Sons
5. V.K. Jain, Cryptography and Network Security, Khanna Publishing House
6. Bernard Menezes," Network Security and Cryptography", Cengage Learning. 6. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill

ELECTIVE - 1

E-12 – Data Warehousing & Data Mining

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Demonstrate knowledge of Data Warehouse and its components.	K_1 , K_2
CO 2 Discuss the process of Warehouse Planning and Implementation.	K_1 , K_2
CO 3 Discuss and implement various superv ised and Non supervised learning algorithms on data.	K_6
CO 4 Explain the various process of Data Mining and decide best according to type of data.	K_2 , K_5
CO 5 Explain process of knowledge disc overy in database (KDD). Design Data Mining model.	K_2 , K_5

UNIT – I Data Warehousing

Overview, Definition, Data Warehousing Components, 8 Building a Data Warehouse, Warehouse Database, Mapping the Data Warehouse to a Multiprocessor Architecture, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting.

UNIT – II Data Warehouse Process and Technology

Warehousing Strategy, Warehouse 8 /management and Support Processes, Warehouse Planning and Implementation, Hardware and Operating Systems for Data Warehousing, Client/Server Computing Model & Data Warehousing. Parallel Processors & Cluster Systems, Distributed DBMS implementations, Warehousing Software, Warehouse Schema Design, Data Extraction, Cleanup & Transformation Tools, Warehouse Metadata

UNIT – III Data Mining

Overview, Definition & Functionalities, Data 8 Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Computer and Human inspection),Inconsistent Data, Data Integration and Transformation. Data Reduction:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Red

UNIT- IV Data Mining Techniques

Classification: Definition, Data Generalization, Analytical Characterization, 8 Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases, Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms. Clustering: Introduction, Similarity and Distance Measures, Hierarchical and Partitional Algorithms. Hierarchical Clustering- CURE and Chameleon. Density Based Methods-DBSCAN, OPTICS. Grid Based Methods- STING, CLIQUE. Model Based Method –Statistical Approach, Association rules: Introduction, Large Itemsets, Basic Algorithms, Parallel and Distributed Algorithms, Neural Network approach.

UNIT - V Data Visualization and Overall Perspective

Aggregation, Historical 8 information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse. Warehousing applications and Recent Trends: Types of Warehousing Applications, Web Mining, Spatial Mining and Temporal Mining.

Reference Books:

1. Alex Berson, Stephen J. Smith "Data Warehousing, Data-Mining & OLAP", TMH
2. Mark Humphries, Michael W. Hawkins, Michelle C. Dy, " Data Warehousing: Architecture and Implementation", Pearson
3. Margaret H. Dunham, S. Sridhar, "Data Mining: Introductory and Advanced Topics" Pearson Education
4. Arun K. Pujari, "Data Mining Techniques" Universities Press
5. Pieter Adriaans, Dolf Zantinge, "Data-Mining", Pearson Education

ELECTIVE - 1

E-13 – Quantum Computing

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Distinguish problems of different computational complexity and explain why certain problems are rendered tractable by quantum computation with reference to the relevant concepts in quantum theory.	K_1 , K_2
CO 2 Demonstrate an understanding of a quantum computing algorithm by simulating it on a classical computer, and state some of the practical challenges in building a quantum computer.	K_2 , K_3
CO 3 Contribute to a medium-scale application program as part of a co-operative team, making use of appropriate collaborative development tools (such as version control systems).	K_2 , K_3
CO 4 Produce code and documentation that is comprehensible to a group of different programmers and present the theoretical background and results of a project in written and verbal form.	K_3 , K_4
CO 5 Apply knowledge, skills, and unde rstanding in executing a defined project of research, development, or investigation and in identifying and implementing relevant outcomes.	K_3, K_6

UNIT-1 Introduction to Quantum Computation

Quantum bits, Bloch sphere representation of a qubit, multiple qubits.

UNIT-2 Background Mathematics and Physics

Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.

UNIT-3 Quantum Circuits

Single qubit gates, multiple qubit gates, design of quantum circuits.

UNIT-4 Quantum Information and Cryptography

Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.

UNIT-5 Quantum Algorithms

Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.

Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation.

Reference Books:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.2002
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms

ELECTIVE - 1

E-14 – Cloud Computing

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Understand the concepts of Cloud Computing, key technologies, strengths and limitations of cloud computing.	K_1 , K_2
CO 2 Develop the ability to understand and use the architecture to compute and storage cloud, service and models.	K_1, K_3
CO 3 Understand the application in cloud computing.	K_4, K_5
CO 4 Learn the key and enabling technologies that help in the development of cloud.	K_3, K_4
CO 5 Explain the core issues of cloud computing such as resource management and security.	K_2 , K_6

UNIT-I Introduction

Cloud-definition, benefits, usage scenarios, History of Cloud Computing - Cloud Architecture - Types of Clouds - Business models around Clouds – Major Players in Cloud Computing- issues in Clouds - Eucalyptus - Nimbus - Open Nebula, Cloud Sim.

UNIT-II Cloud Services

Types of Cloud services: Software as a Service-Platform as a Service –Infrastructure as a Service -Database as a Service - Monitoring as a Service –Communication as services. Service providers- Google, Amazon, Microsoft Azure, IBM, Sales force.

UNIT-III Collaborating Using Cloud Services

Email Communication over the Cloud - CRM Management – Project Management-Event Management - Task Management – Calendar - Schedules - Word Processing – Presentation – Spreadsheet - Databases – Desktop - Social Networks and Groupware.

UNIT-IV Virtualization for Cloud

Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System Vim, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - supervisors – Xen, KVM, VMware, Virtual Box, Hyper-V.

UNIT-V Security, Standards and Applications

Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud.

Reference Books:

1. David E.Y. Sarna Implementing and Developing Cloud Application, CRC press 2011.
2. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, Draft cloud computing synopsis and recommendation, May 2011.
3. Anthony T Velte, Toby J Velte, Robert Elsenpeter, Cloud Computing : A Practical Approach, Tata McGraw-Hill 2010.
4. Haley Beard, Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.
5. G.J.Popek, R.P. Goldberg, Formal requirements for virtualizable third generation Architectures, Communications of the ACM, No.7 Vol.17, July 1974
6. John Rittinghouse & James Ransome, Cloud Computing, Implementation, Management and Strategy, CRC Press, 2010.

ELECTIVE - 2

E-21 – Compiler Design

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Acquire knowledge of different phases and passes of the compiler and also able to use the compiler tools like LEX, YACC, etc. Students will also be able to design different types of compiler tools to meet the requirements of the realistic constraints of compilers.	K_3 , K_6
CO 2 Understand the parser and its types i.e. Top-Down and Bottom-up parsers and construction of LL, SLR, CLR, and LALR parsing table.	K_2 , K_6
CO 3 Implement the compiler using syntax-directed translation method and get knowledge about the synthesized and inherited attributes.	K_4 , K_5
CO 4 Acquire knowledge about run time data structure like symbol table organization and different techniques used in that.	K_2 , K_3
CO 5 Understand the target machine's run time environment, its instruction set for code generation and techniques used for code optimization.	K_2 , K_4

UNIT – I Compilers: Grammars & Automata

Languages – Grammars – Types of grammars – Context free grammar - regular expression - Recognizing of patterns - finite automation (deterministic & non deterministic) Conversion of NDFA to DFA - Conversion of regular expression of NDFA – Thompson's construction- minimization of NDFA –Derivation - parse tree – ambiguity

UNIT – II Lexical Analysis

Lexical analysis- handles - token specification - design of lexical analysis (LEX) - Automatic generation of lexical analyzer - input buffering - A language for specifying lexical analyzers - implementation of lexical analyzer

UNIT – III Syntax Analysis

PARSING: Definition - role of parsers - top down parsing - bottom-up parsing - Left recursion - left factoring - Handle pruning , Shift reduce parsing - operator precedence parsing – FIRST- FOLLOW- LEADING- TRAILING- Predictive parsing - recursive descent parsing. LR parsing – LR (0) items - SLR parsing – Canonical LR - LALR parsing - generation of LALR - Ambiguous grammars - error recovery

UNIT – IV Syntax Directed Translation

Intermediate Languages - prefix - postfix - Quadruple - triple - indirect triples – syntax tree- Evaluation of expression - three-address code- Synthesized attributes – Inherited attributes – Conversion of Assignment statements- Boolean expressions –Backpatching - Declaration - CASE statements.

UNIT V Code Optimization

Local optimization- Loop Optimization techniques – DAG – Dominators- Flow graphs – Storage allocations- Peephole optimization – Issues in Code Generation.

Reference Books:

1. Alfred V Aho , Jeffery D Ullman , Ravi Sethi, " Compilers , Principles techniques and tools ", Pearson Education 2011
2. Raghavan V., "Principles of Compiler Design", Tata McGraw Hill Education Pvt. Ltd., 2010.
3. David Galles, "Modern Compiler Design", Pearson Education, Reprint 2012.
4. Dasaradh Ramaiah. K., "Introduction to Automata and Compiler Design", PHI, 2011

ELECTIVE - 2

E-22 – Web Technology

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Apply the knowledge of HTML and C SS to develop web application and analyze the insights of internet programming to implement complete application over the web.	K_3 , K_6
CO 2 Understand, analyze and apply the role of JavaScript in the workings of the web and web applications.	K_2 , K_3
CO 3 Understand, analyze and build dynamic web applications using servlet and JSP.	K_2 , K_3
CO 4 Develop Spring-based Java applications using Java configuration, XML configuration, annotation-based configuration, beans and their scopes, and properties.	K_2 , K_4, K_6
CO 5 Develop web application using Spring Boot and RESTFul Web Services	K_3 , K_6

UNIT – I Introduction & Web Design

Introduction: Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, Features of Web 2.0

Web Design: Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.

UNIT – II Html & Style Sheets

HTML: Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of HTML 5

Style sheets : Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of CSS3

UNIT – III Javescript & Xml

JavaScript : Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: JavaScript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, DHTML : Combining HTML, CSS and JavaScript, Events and buttons

XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT

UNIT – IV PHP

PHP : Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP

UNIT V MYSQL

PHP and MySQL : Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs

Reference Books:

1. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India
2. Web Technologies, Black Book, Dreamtech Press
3. HTML 5, Black Book, Dreamtech Press
4. Web Design, Joel Sklar, Cengage Learning
5. Developing Web Applications in PHP and AJAX, Harwani, McGraw Hill
6. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel, Pearson

ELECTIVE - 2

E-23 – Big Data

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Demonstrate knowledge of Big Data Analytics concepts and its applications in business.	K_1 , K_2
CO 2 Demonstrate functions and components of Map Reduce Framework and HDFS.	K_1 , K_2
CO 3 Develop queries in NoSQL environment.	K_6
CO 4 Explain process of developing Map Reduce based distributed processing applications.	K_2 ,K_5
CO 5 Explain process of developing applications using HBASE, Hive, Pig etc.	K_2 ,K_5

UNIT-I Understanding Big Data

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data ,credit risk management, big data and algorithmic trading, big data and HealthCare, big data in medicine, advertising and big data, big data technologies, Introduction to Hadoop, open source technologies, cloud and big data mobile business intelligence, Crowd sourcing Analytics ,inter and trans firewall analytics

UNIT-II NoSQL Data Management

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases ,materialized views, distribution models ,sharing , masters slave replication , peer-peer replication , sharing and replication , consistency , relaxing consistency , version stamps , map reduce , partitioning and combining , composing map-reduce calculations

UNIT-III Basics of Hadoop

Data format, analyzing data with Hadoop, scaling out , Hadoop streaming , Hadoop pipes , design of Hadoop distributed file system (HDFS) , HDFS concepts , Java interface , data flow ,Hadoop I/O , data integrity , oppression ,serialization , Avro file-based data structures

UNIT-IV Map Reduce Applications

Map Reduce workflows, UNIT tests with MR UNIT, test data and local tests – anatomy of Map Reduce job run , classic Map-reduce , YARN , failures in classic Map-reduce and YARN , job scheduling , shuffle and sort , task execution , MapReduce types , input formats , output formats

UNIT-V Hadoop Related Tools

HBase, data model and implementations, Hbase clients, Hbase examples – praxis. Cassandra, cassandra data model, cassandra examples ,cassandra clients , Hadoop integration.Pig , Grunt , pig data model , Pig Latin , developing and testing PigLatin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation – HiveQL queries

Reference Books:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.

2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
4. V.K. Jain, Big Data & Hadoop, Khanna Publishing House Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
5. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
6. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.

ELECTIVE - 2

E-24 – Simulation & Modeling

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Study the concept of system, its components and types.	K_1
CO 2 Understand and anal yze nature and techniques of major simulation models.	K_2 , K_4
CO 3 Study and analyze the idea of continuous and discrete system simulation.	K_1 , K_4
CO 4 Understand the notion of system dynamics and system dynamics diagrams.	K_2
CO 5 Finding critical path computation and understanding PERT networks	K_1 , K_4

UNIT-I Introduction

System definition and components, stochastic activities, continuous and discrete systems, system modeling, types of models, static and dynamic physical models, static and dynamic mathematical models, full corporate model, types of system study.

UNIT-II Simulation

System simulation, why & when to simulate, nature and techniques of simulation, comparison of simulation and analytical methods, types of system simulation, real time simulation, hybrid simulation, simulation of pure-pursuit problem, single server queuing system and an inventory problem, Monte-Carlo simulation, Distributed Lag models, Cobweb model.

UNIT-III Simulation of Continuous Systems

Analog vs. digital Simulation, Simulation of water reservoir system, Simulation of a servo system, simulation of an autopilot, Discrete system simulation, fixed time-step vs. even to even model, generation of random numbers, test for randomness, Monte-Carlo computation vs. stochastic simulation.

UNIT-IV System Dynamics

Exponential growth models, exponential decay models, modified exponential growth models, logistic curves, generalization of growth models, system dynamic diagrams, Introduction to SIMSCRIPT: Program, system concepts, origination, and statements, defining the telephone system model.

UNIT-V Simulation of PERT Networks

Critical path computation, uncertainties in activity duration, resource allocation and consideration. Simulation languages and software, continuous and discrete simulation languages, expression-based languages, object-oriented simulation, general purpose vs. application - oriented simulation packages, CSMP-III, MODSIM-III.

Reference Books:

1. Geoftrey Gordon, “System Simulation”, PHI
2. Jerry Banks, John S. C Barry L. Nelson David M. Nicol, “Discrete Event System Simulation”, Pearson Education
3. V P Singh, “System Modeling and simulation”, New Age International.

ELECTIVE - 3

E-31 – Digital Image Processing

Course Outcome (CO)	Bloom’s Knowledge Level (KL)
CO 1 Explain the basic concepts of two- dimensional signal acquisition, sampling, quantization and color model.	K_1 , K_2
CO 2 Apply image processing techniques for image enhancement in both the spatial and frequency domains.	K_2 , K_3
CO 3 Apply and compare image restoration techniques in both spatial and frequency domain.	K_2 , K_3
CO 4 Compare edge based and region based segmentation algorithms for ROI extraction.	K_3 , K_4
CO 5 Explain compression techniques and descriptors for image processing.	K_2 , K_3

UNIT-I Introduction and Fundamentals

Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.

Image Enhancement in Frequency Domain: Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Low pass Filters; Sharpening Frequency Domain Filters – Gaussian High pass Filters; Homomorphic Filtering.

UNIT-II Image Enhancement in Spatial Domain

Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing – Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

UNIT-III Image Restoration

A Model of Restoration Process, Noise Models, Restoration in the presence of Noise Only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Band pass Filters; Minimum Mean-square Error Restoration.

UNIT-IV Morphological Image Processing

Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

UNIT-V Registration

Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth Segmentation: Introduction, Region Extraction, Pixel-Based Approach, Multi-level thareholding, Local thresholding, Region-based Approach, Edge and Line Detection:

Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by thareholding, Edge Detector Performance, Line Detection, Corner Detection.

Reference Books:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.
2. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and Sons, NY.
3. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ.

ELECTIVE - 3

E-32 – Soft Computing

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Recognize the need of soft computing and study basic concepts and techniques of soft computing.	K_1 , K_2
CO 2 Understand the basic concepts of artif icial neural network to analyze widely used neural networks.	K_2 , K_4
CO 3 Apply fuzzy logic to handle uncertainty in various real-world problems.	K_3
CO 4 Study various paradigms of evolu tionary computing and evaluate genetic algorithm in solving optimization problems.	K_1 , K_5
CO 5 Apply hybrid techniques in applications of soft computing.	K_3

UNIT-I Artificial Neural Networks

Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self organizing networks - Hopfield network.

UNIT-II Fuzzy Systems

Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition – Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.

UNIT-III Neuro - Fuzzy Modeling

Adaptive networks based Fuzzy interface systems - Classification and Regression Trees – Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls – Simulated annealing – Evolutionary computation.

UNIT-IV Genetic Algorithms

Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction – Rank method - Rank space method.

UNIT-V Application of Soft Computing

Optimization of traveling salesman problem using Genetic Algorithm, Genetic algorithm-based Internet Search Techniques, Soft computing-based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.

Reference Books:

1. Sivanandam, Deepa, " Principles of Soft Computing", Wiley
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill
3. Laurene Fausett, "Fundamentals of Neural Networks", Prentice Hall

4. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley Wang, “Fuzzy Logic”, Springer

ELECTIVE - 3

E-33 – Pattern Recognition

Course Outcome (CO)	Bloom’s Knowledge Level (KL)
CO 1 Study of basics of Pattern recognition. Understand the designing principles and Mathematical foundation used in pattern recognition.	K_1 , K_2
CO 2 Analysis the Statistical Patten Recognition.	K_3, K_4
CO 3 Understanding the different Parameter estimation methods.	K_1 , K_2
CO 4 Understanding the different Nonparametric Techniques.	K_1 , K_2,
CO 5 Understand and Make u se of unsupervised learning and Clustering in Pattern recognition.	K_2 K_3, K_4

UNIT-1 Introduction

Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.

UNIT-II Statistical Patten Recognition

Bayesian Decision Theory, Classifiers, Normal density and discriminant functions,

UNIT-III Parameter Estimation Methods

Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.

UNIT-IV Nonparametric Techniques

Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification.

UNIT-V Unsupervised Learning & Clustering

Criterion functions for clustering, Clustering Techniques: Iterative square – error partitioned clustering – K means, agglomerative hierarchical clustering, Cluster validation.

Reference Books:

1. Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification”, 2nd Edition, John Wiley, 2006.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2009.
3. S. Theodoridis and K. Koutroumbas, “Pattern Recognition”, 4th Edition, Academic Press, 2009.

ELECTIVE - 3

E-34 – Data Analytics

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Describe the life cycle phases of Data Analytics through discovery, planning and building.	K_1 , K_2
CO 2 Understand and apply Data Analysis Techniques.	K_2 , K_3
CO 3 Implement various Data streams.	K_3
CO 4 Understand item sets, Clustering, frame works & Visualizations.	K_2
CO 5 Apply R tool for developing and evaluating real time applications.	K_3 , K_5 , K_6

UNIT-I Introduction To Data Analytics

Introduction to data analytics Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.

UNIT-II Mining Data Streams

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications – Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.

UNIT-III Hadoop

History of Hadoop- the Hadoop Distributed File System – Components of Hadoop Analysing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics- Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce Features- Hadoop environment.

UNIT-IV Frameworks

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphere Insights and Streams.

UNIT-V Predictive Analytics

Simple linear regression- Multiple linear regression- Interpretation of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications.

Reference Books:

1. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley& sons, 2012.
2. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", 2nd Edition, Elsevier, Reprinted 2008.
3. Da Ruan, Guoquing Chen, Etienne E.Kerre, Geert Wets, "Intelligent Data Mining", Springer, 2007.

ELECTIVE - 4

E-41 – Blockchain Architecture

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Study and understand basic concepts of blockchain architecture	K_1 , K_2
CO 2 Analyze various requirements for consensus protocols.	K_4
CO 3 Apply and evaluate the consensus process.	K_3 , K_5
CO 4 Understand the concepts of Hyperledger fabric.	K_1
CO 5 Analyze and evaluate various use cases in financial software and supply chain.	K_4 , K_5

UNIT-I Introduction to Blockchain

Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms

UNIT-II Consensus

Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains:Design goals, Consensus protocols for Permissioned Blockchains

UNIT-III Hyperledger Fabric (A)

Decomposing the consensus process , Hyperledger fabric components, Chaincode Design and Implementation Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool

UNIT-IV Use case 1

Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance **Use case 2**: Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc

UNIT-V Use case 3

Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems Blockchain Cryptography, Privacy and Security on Blockchain

Reference Books:

1. Mstering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric

ELECTIVE - 4

E-42 – Neural Network

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Study of basic concepts of Neuro Computing, Neuroscience and ANN. Understand the different supervised and unsupervised and neural networks performance.	K_1, K_2
CO 2 Study of basic Models of neural network. Understand the Perception network and Compare neural networks and their algorithm.	K_2, K_3
CO 3 Study and Demonstrate different types of neural network. Make use of neural networks for specified problem domain.	K_2 K_3, K_4

CO 4 Understand and Identify basic design requirements of recurrent network and Self-organizing feature map.	K_1, K_2
CO 5 Able to understand the some special network. Able to understand the concept of Soft computing.	K_1, K_2 K_3

UNIT-I Neurocomputing and Neuroscience

Historical notes, human Brain, neuron Mode l, Knowledge representation, Al and NN. Learning process: Supervised and unsupervised learning, Error correction learning, competitive learning, adaptation, statistical nature of the learning process.

UNIT-II Data Processing

Scaling, normalization, Transformation (FT/FFT), principal component analysis, regression, covariance matrix, eigen values & eigen vectors. Basic Models of Artificial neurons, activation Functions, aggregation function, single neuron computation, multilayer perceptron, least mean square algorithm, gradient descent rule, nonlinearly separable problems and bench mark problems in NN.

UNIT-III Multilayered Network Architecture

Back propagation algorithm, heuristics for making BPalgorithm performs better. Accelerated learning BP (like recursive least square, quick prop, RPROP algorithm), approximation properties of RBF networks and comparison with multilayer perceptron.

UNIT-IV Recurrent Network

Temporal feed-forward network, implementation with BP, self organizing map and SOM algorithm, properties of feature map and computer simulation. Principal component and Independent component analysis, application to image and signal processing.

UNIT-V Complex Valued NN

Complex valued BP, analyticity of activation function, application in 2D information processing. Complexity analysis of network models. Soft computing. Neuro-Fuzzy-genetic algorithm Integration.

Reference Books:

1. J.A. Anderson, An Intoduction to Neural Networks, MIT
2. Hagen Demuth Beale, Neural Network Design, Cengage Learning
3. R.L. Harvey, Neural Network Principles, PHI
4. Kosko, Neural Network and Fuzzy Sets, PHI

ELECTIVE - 4

E-43 – Internet Of Things

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Demonstrate basic concepts, principles and challenges in IoT.	K_1, K_2
CO 2 Illustrate functioning of hardware devices and sensors used for IoT.	K_2
CO 3 Analyze network communication aspects and protocols used in IoT.	K_4
CO 4 Apply IoT for developing real life applications using Ardunio programming.	K_3
CO 5 To develop IoT infrastructure for popular applications	K_2, K_3

UNIT-I M2M to IoT

The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.

UNIT-II M2M to IoT – A Market Perspective

Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT-III M2M and IoT Technology Fundamentals

Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management

UNIT-IV IoT Architecture-State of the Art

Introduction, State of the art, Architecture Reference Model Introduction, Reference Model and architecture, IoT reference Model

UNIT-V IoT Reference Architecture

Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. Industrial Automation- Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation- Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.

Reference Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

ELECTIVE - 4

E-44 – Machine Learning

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 To understand the need for machine learning for various problem solving	K_1, K_2
CO 2 To understand a wide variety of learning algorithms and how to evaluate models generated from data	K_1 , K_3
CO 3 To understand the latest trends in machine learning	K_2 , K_3
CO 4 To design appropriate machine learning algorithms and apply the algorithms to a real-world problems	K_4 , K_6
CO 5 To optimize the models learned and report on the expected accuracy that can be achieved by applying the models	K_4, K_5

UNIT-I Learning

Types of machine learning - Supervised learning - The brain and the neurons, Linear Discriminants -Perceptron - Linear Separability -Linear Regression - Multilayer perceptron - Examples of using MLP - Back propagation of error.

UNIT-II Classification Algorithms

Decision trees - Constructing decision trees - Classification of regression trees - Regression example - Probability and Learning: Turning data into probabilities - Some basic statistics - Gaussian mixture models - Nearest Neighbor methods.

UNIT-III Analysis

The k-Means algorithm - Vector Quantization's - Linear Discriminant Analysis - Principal component analysis - Factor Analysis - Independent component analysis - Locally Linear embedding – Isomap - Least squares optimization - Simulated annealing.

UNIT IV Optimization Techniques

The Genetic algorithm - Genetic operators - Genetic programming - Combining sampling with genetic programming - Markov Decision Process - Markov Chain Monte Carlo methods: sampling - Monte carlo - Proposal distribution.

UNIT V Python for Machine Learning

Baysean Networks - Markov Random moFields - Hidden Markov Models -Tracking methods. Python: Installation - Python for MATLAB AND R users - Code Basics - Using NumPy and MatPolitB.

Reference Books:

1. Kevin P. Murphy, "Machine Learning – A probabilistic Perspective", MIT Pres, 2016.
2. Randal S, "Python Machine Learning, PACKT Publishing, 2016.

ELECTIVE - 5

E-51 – Distributed Database Systems

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Understand theoretical and practical aspects of distributed database systems.	K_2
CO 2 Study and identify various issues related to the development of distributed database system	K_3
CO 3 Understand the design aspects of object-oriented database system and related development	K_4
CO 4 Equip students with principles and knowledge of distributed reliability.	K_3
CO 5 Equip students with principles and know ledge of parallel and object-oriented databases.	K_5

UNIT-I Transaction and Schedules

Concurrent Execution of transaction, Conflict and View Serializability, Testing for Serializability, Concepts in Recoverable and Cascade less schedules.

UNIT–II Lock based protocols

Time stamp-based protocols, Multiple Granularity and Multi version Techniques, enforcing serializability by Locks, Locking system with multiple lock modes, architecture for Locking scheduler

UNIT-III Distributed Transactions Management

Data Distribution, Fragmentation and Replication Techniques, Distributed Commit, Distributed Locking schemes, Long duration transactions, Moss Concurrency protocol.

UNIT–IV Issues of Recovery

Atomicity in Distributed Databases, Traditional recovery techniques, Log based recovery, Recovery with Concurrent Transactions, Recovery in Message passing systems,

Checkpoints, Algorithms for recovery line, Concepts in Orphan and Inconsistent Messages.

UNIT-V Distributed Query Processing

Multiday Joins, Semi joins, Cost based query optimization for distributed database, Updating replicated data, protocols for Distributed Deadlock Detection, Eager and Lazy Replication Techniques

Reference Books:

1. Silberschatz, Korth and Sudershan, Database System Concept', Mc Graw Hill
2. Ramakrishna and Gehrke,' Database Management System, Mc Graw Hill
3. Ceei and Pelagatti,'Distributed Database', TMH
4. Distributed System, Munesh C. Trivedi, Khanna Publishing House

ELECTIVE - 5

E-52 – Mobile Computing

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Study and aware fundamentals of mobile computing.	K_1, K_2
CO 2 Study and analyze wireless networ king protocols, applications and environment.	K_1, K_4
CO 3 Understand various data management issues in mobile computing.	K_2
CO 4 Analyze different type of security issues in mobile computing environment.	K_4
CO 5 Study, analyze, and evaluate variou s routing protocols used in mobile computing.	K_1 , K_4, K_5

UNIT – I Introduction

Issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.

UNIT - II Wireless Networking

Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.

UNIT – III Data Management Issues

Data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, disconnected operations.

UNIT - IV Mobile Agents Computing

Security and fault tolerance, transaction processing in mobile computing environment.

UNIT – V Ad Hoc Networks

Localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications.

Reference Books:

1. J. Schiller, Mobile Communications, Addison Wesley.
2. A. Mehrotra , GSM System Engineering.
3. M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House.

ELECTIVE - 5

E-53 – Computer Graphics and Animation

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Understand the graphics hardware used in field of computer graphics.	K_2
CO 2 Understand the concept of graphics primitives such as lines and circle based on different algorithms.	K_2 , K_4
CO 3 Apply the 2D graphics transformations, composite transformation and Clipping concepts.	K_4
CO 4 Apply the concepts and techniques used in 3D computer graphics, including viewing transformations, projections, curve and hidden surfaces.	K_2 , K_3
CO 5 Perform the concept of multimedia and animation in real life.	K_2 , K_3

UNIT-I Introduction to Computer Graphics

What is Computer Graphics, Computer Graphics Applications, Computer Graphics Hardware and software, two-dimensional Graphics Primitives: Points and Lines, Line drawing algorithms: DDA, Bresenham's Circle drawing algorithms: Using polar coordinates, Bresenham's circle drawing, mid-point circle drawing algorithm; Filled area algorithms: Scan line: Polygon filling algorithm, boundary filled algorithm.

UNIT-II Two/Three-Dimensional Viewing

The 2-D viewing pipeline, windows, viewports, window to view port mapping; Clipping: point, clipping line (algorithms): - 4-bit code algorithm, Sutherland-Cohen algorithm, parametric line clipping algorithm (Cyrus Beck). Polygon clipping algorithm: Sutherland-Hodgeman polygon clipping algorithm. Two dimensional transformations: transformations, translation, scaling, rotation, reflection, composite transformation. Three dimensional transformations: Three-dimensional graphics concept, Matrix representation of 3 D Transformations, Composition of 3-D transformation.

UNIT-III Viewing in 3D

Projections, types of projections, mathematics of planner geometric projections, coordinate systems. Hidden surface removal: Introduction to hidden surface removal. Z-buffer algorithm, scanline algorithm, area subdivision algorithm.

UNIT-IV Representing Curves and Surfaces

Parametric representation of curves: Bezier curves, B-Spline curves. Parametric representation of surfaces; Interpolation method. Illumination, shading, image manipulation: Illumination models, shading models for polygons, shadows, transparency. What is an image? Filtering, image processing, geometric transformation of images.

UNIT- V Animation

Fundamentals of computer animation, Animation Techniques. Animation and Flash Overview, Using Layer and Creating Animation

Reference Books:

1. Procedural Elements for Computer Graphics – David F. Rogers, 2001, T.M.H Second Edition.
2. Fundamentals of 3Dimensional Computer Graphics by Alan Watt, 1999, Addision Wesley.
3. Computer Graphics: Secrets and Solutions by Corrign John, BPB
4. M.C. Trivedi, NN Jani, Computer Graphics, Jaico Publication

ELECTIVE - 5

E-54 – Natural Language Processing

Course Outcome (CO)	Bloom's Knowledge Level (KL)
CO 1 Study and understand basic concep ts, background and re presentations of natural language.	K_1 , K_2
CO 2 Analyze various real-world applications of NLP.	K_4
CO 3 Apply different parsing techniques in NLP.	K_3
CO 4 Understand grammatical concepts and apply them in NLP.	K_2 , K_3
CO 5 Apply various statistical and proba bilistic grammar methods to handle and evaluate ambiguity.	K_3 , K_5

UNIT-I Introduction

Natural Language Understanding: The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.

UNIT-II Semantics

Introduction to semantics and knowledge representation, some applications like machine translation, database interface.

UNIT-III Grammars and Parsing

Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top- Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

UNIT-IV Grammars for Natural Language

Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.

UNIT-V Ambiguity Resolution

Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

Reference Books:

1. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, NLP: A Paninian Perspective, Prentice Hall, New Delhi
2. James Allen, Natural Language Understanding, Pearson Education
3. D. Jurafsky, J. H. Martin, Speech and Language Processing, Pearson Education
4. L.M. Ivansca, S. C. Shapiro, Natural Language Processing and Language Representation
5. T. Winograd, Language as a Cognitive Process, Addison-Wesley