SOPHIA GIRLS' COLLEGE
(AUTONOMOUS)
AJMER

Scheme of Examination
And
SYLLABUS

2023-24 (Batch)
FOR
Bachelor of Computer Application

Choice Based Credit System
with
New Education Policy

Semester – I to VI

Bachelor of Computer Application

Eligibility for admission in First Year of BCA is 10+2 examination of any board with at least 50% marks. As regards admission on reserved category seats government rules will be applicable.

SCHEME OF EXAMINATION

The number of paper and the maximum marks for each paper together with the minimum marks required for a pass are shown against each subject separately. It will be necessary for a candidate to pass in the theory part as well as the practical part of a subject/paper, wherever prescribed, separately.
Classification of successful candidates shall be as follows:

First Division	60%	of the aggregate marks prescribed at Part I Examination, Part II Examination, Part III Examination, taken together
Second Division	50%	

All the rest shall be declared to have passed the examination.

- For passing a candidate shall have to secure at least 40% marks in each course (Theory and practical separately).
- No division shall be awarded at the Part -I &Part- II examination.
- Due paper(s) will be held along with the examination of the next semester. The chance of due paper(s) will be given only 4 times.
- Whenever a candidate appears at for a due paper examination she will do so according to the syllabus in force.

Program Outcome

On the successful completion of BCA the students will be able to:

- Inculcate the ability to analyze, identify, formulate and develop computer applications using modern computing tools and techniques.
- Understand and develop computer programs in the areas related to algorithm, system software, web design and networking for efficient design of computer based system
- Explore technical comprehension in varied areas of Computer Applications and experience a conducive environment in cultivating skills for thriving career and higher studies.
- Apply standard software engineering practices and strategies in software project development using open source programming environment to deliver a quality of product for business success.
- Identify opportunities, entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society.
- Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations..
- Recognize the needs for, and have the preparation and ability to engage in independent and lifelong learning.

Continuous Internal Assessment Examination Pattern
(Passed in College Academic Council)

Maximum Marks : 30

Continuous Internal Assessment (CIA)	- 20 Marks
Class Performance (CP)	- 10 Marks

Continuous Internal Assessment (CIA) Pattern
CIA will be taken from Unit – I & II only.

Section A 5 * 2 =10 marks

Contains 8 Questions of 2 marks each from which 5 questions to do.

Section B 2*3 = 6 marks

Contains 2 questions with internal choice (Two questions from each unit).
Each Question carries 3 marks.
Student has to do 2 questions and at least one question from each unit.

Section C 1 * 4 = 4 marks

Contains 1 questions with internal choice (One questions from each unit).
Question carries 4 marks.
Student has to do 1 question from the internal choice given.

Internal Practical Examination Pattern

1. A Laboratory Exercise File should be prepared by each student for each practical paper and should be submitted during practical examinations.
2. One internal examiner shall conduct two practical exams, in a day, of a batch of 60 students.
3. Duration of internal practical examination is 1 hours.
4. Internal Practical of 15 marks distribution is as under:

a. 10 marks for Viva-voce / Practical examination exercise of 2 questions.
b. 5 marks for Laboratory Exercise File.

External Examination Pattern

Maximum Marks: 70 **Duration: 2½Hrs.**

Section A 10 * 1 =10 marks

Contains 10 Questions of 1 mark each & all are compulsory to do.
Three questions from each unit (but 4 questions from one unit)
3 + 3 + 4 = 10 Questions

Section B 3*5 = 15 marks

Contains 3 questions with internal choice (Two questions from each unit).
Each Question carries 5 marks.
Student has to do 3 questions and at least one question from each unit.

Section C 3 * 15= 45 marks

Contains 3 questions with internal choice (Two questions from each unit).
Each Question carries 15 marks.
Student has to do 3 questions and at least one question from each unit.

External Practical Examination Pattern

1. A Laboratory Exercise File should be prepared by each student for each practical paper and should be submitted during practical examinations.
2. One internal and one external examiner shall conduct two practical exams, in a day, of a batch of 60 students.
3. Duration of external practical examination is 3 hours.
4. External Practical of 35 marks distribution is as under:
    a. 15 marks for practical examination exercise for 3 questions.
    b. 10 marks for Viva-voce
    c. 10 marks for Laboratory Exercise File.

Course Structure For B.C.A Semester – I

Category	Nomenclature	Credits	Contact Hours Per Week	Total Marks		Max. Marks	Min. Marks	Exam. Duration
				CIA	ESE			
MJBCA-101	Computer Fundamentals and PC Software	03	06	25	50	75	30	2½ Hrs
MJBCA-102	'C ' Programming	03	06	25	50	75	30	2½ Hrs
MJBCA-103	Multimedia	03	06	25	50	75	30	2½ Hrs
MJBCA-104	Practical: PC Software	01	02	25	-	25	10	2½ Hrs
MJBCA-105	Practical: 'C' Programming	01	02	25	-	25	10	2½ Hrs
MJBCA-106	Practical: Multimedia (Flash)	01	02	25	-	25	10	2½ Hrs

MJBCA – 101 Computer Fundamentals and PC Software

Max. Marks : 75 **Min. Marks: 30**
Credits: 03 **Duration: 2½ hrs**

Learning Outcome: On successful completion of the course, the students will be able to :–

1. Describe the computer system and identify its types.
2. Illustrate the use of different input devices.
3. Categorize different output devices on the basis on operation.
4. Summarize the different aspects of data processing.

Unit – I

Introduction to Computer: Definition, Diagram, Characteristics, Classification of Computers: Analog Computers, Digital Computers, Hybrid Computers, Classifications of computer on the basis of size and speed, different type of computers, Indian Super Computer, Applications of Computers

Input Devices: keyboard, mouse, touch pad, touch screens, data scanning devices, optical recognition systems: bar code readers, optical mark readers, Optical character reader. Digital camera

Unit – II

Output Devices: Hard copy devices: Printer (impact printers), dot matrix printer, line printer, (non-impact printers), inkjet, laser printer, 3D printer, barcode printers. Soft copy devices: (Computer Display) CRT, Flat Panel Display: LCD, plasma display panel.

Introduction to memory: classifications, volatile memory, non-volatile memory

Software: System software, application software, programming software.

MS-Word: Introduction to MS-Word, Features, Application Areas and its uses, types of views, Creating &Saving : New Document, copy, cut, paste, paste special, clipboard, undo, redo, Fonts, Paragraphs: Indentation and Spacing, Columns & Breaks, Styles, Find, Replace & Goto. Inserting Tables, Picture, ClipArt, Shapes, Smart Art and Charts, Symbols and Equations, Hyperlink, Bookmark. Header & Footer. Drop Cap, Textbox, WordArt, Date and Time. Table of contents, Footnotes and Endnotes, Page background. Mail merge, Macros, Auto correct and Auto Text. Comments, Page Setup, Size, Margins, Gutter, Orientation.

UNIT-III

MS-Excel: MS-Excel: Introduction, Features, Application Areas and its uses, views and its types, formatting and its types. **Charts**: Line, bar, column, area, pie. Pivot Tables, Data management (Sort, filters, Validation, consolidation, Text to column), auditing and tracing.

Functions and Formulas -Text: char, concatenate exact, find, left, right, mid, lower, upper, proper, search, substitute, trim. **Logical:** and, or, not **Math and trig:** abs, int, even, odd, fact, mod, pi, power, product, round, roman, sign, sqrt, trim. **Statistical:** Average, count. Protecting sheet and workbook.

MS-PowerPoint: Introduction to PowerPoint, Features, Application Areas and its uses, Creating Presentations through Blank Presentations, Templates, Slide Master, Views of PowerPoint, Formatting of Presentations: Inserting Graphics and Animations, Formatting & Customizing Presentations: Slide Transactions, Custom Animation, Inserting sounds. Set up and Custom Slide Show, Handouts.

Reference Books:

- Pradeep K. Sinha, Priti Sinha, "Computer Fundamentals". BPB Publications.
- Rajaraman, V., "Fundamental of Computers". Prentice Hall India, New Delhi.
- Fundamentals Of Information Technology, 2E , Alexis Leon & Mathews Leon, Vikas Publishing
- Microsoft Office 2007 – Joyce Cox & Joan Preppernau – PHI Publication

MJBCA – 102 'C' Programming

Max. Marks : 75 **Min. Marks: 30**
Credits: 03 **Duration: 2½ hrs**

Learning Outcome: On successful completion of the course, the students will be able to :–

1. Understand basic concepts of programming language
2. Choose the loops and decision making statements to solve the problem
3. Implement different operations on array
4. Design, implement, test and debug programs that use different data types, such as simple arrays, and structures

Unit - I

'C' Language: Character Set, Keywords, Constants, Variables, Data Types, Type Conversion.

Instruction & its types: Input Output Instructions, Operators & Expressions: Arithmetic, Relational, Logical, Conditional , Arithmetic Instructions.

Control Instructions: Decision Control (if, if-else, if else ladder, nested if, switch case),
Loop Control (while, for, do-while, Nesting Loops), Jump statements (break, continue, goto)

Unit – II

Arrays:- Concept of Arrays, One dimensional array & Two dimensional array, Storage strategy, Array Initialization, Operations on Arrays (traversing, addition, subtraction, transpose), Search – linear & binary. Sorting - bubble sort & selection sort.

Functions:- Declaration, Calling (Call by value, Call by reference) & Definition of functions, Recursion, Storage Class (auto, static, register, extern), Scope rules (Local, Global).

Unit – III

Pointers:- Pointers and addresses, Pointers as Function arguments, Pointers and Arrays, Address Arithmetic. Character Pointers, String handling and String functions (strlen, strcat, strcmp, strcmpi, strrev, strcpy).

Structure and Union: Basics, Structures and Functions, Arrays of Structures, structure pointer variables. Union definition and its use.

Reference Books:

- Let Us 'C' -Yashavant P Kanetkar, BPB Publications
- Programming in Ansi 'C' – Balaguruswami – TMH.
- 'C' Programming Language – Kernighan & Ritchie - PHI
- 'C' How to Program – Dietel & Dietel - PHI
- 'C' Programming - Dr. Neeraj Bhargava & Dr. Ritu Bhargava, Alka Publications

MJBCA – 103: Multimedia

Max. Marks : 75 **Min. Marks: 30**
Credits: 03 **Duration: 2½ hrs**

Learning Outcome: On successful completion of the course, the students will be able to:–

1. Identify terminology associated with the concepts, techniques, and processes used throughout the multimedia environment.
2. Compare different image types and compression
3. Study laws of multimedia and design environment and design basic animations and gif images using flash
4. Familiarize with graphic design principles that relates to web design and learn how to develop website.

Unit – I

Introduction to Multimedia Technology – Application areas of Multimedia, Advantages and disadvantages of Multimedia, Media Elements d(text, sound, image, video & animation), user interface and its types,

importance and features of user interface, MM hardware & software requirements(Image , Video, Audio, Sound editing software's), Images: Raster and Vector image

Unit – II

Image compression: Lossy and Lossless Compression, advantages and disadvantages of image compression, audio compression, audio synthesis, speech recognition and Speech Synthesis, Jpeg image compression, mpeg video compression(P,B, I frames).

Developing Applications using multimedia, methodology and design, Various multimedia laws: Patent law, Trademark Law, Trade secret Law, Copyright Law.

Unit – III

Flash: Introduction, Features , Advantages ,Concepts of Frame Rate and Resolution, Exploring The Flash Interface ,The Flash stage ,Timeline- Play head/Frames/Key Frames/ Blank frames ,Menus, Tools of Flash (Pen, Pencil, Paint Bucket Tool, spray brush ,Text, 3D rotation, deco tool), Custom colors and gradients ,Drawing object in flash (line, curve, oval, Rectangle , Polystar tool) , stroke and fill, Layers and its types in flash, Key frames, symbols-how to create and reuse it, Object based animation, motion tween, classic tween and shape tween, adding sound.

Reference Books

- Fundamental of multimedia ,Ritu Bhargava, Alka Publications
- Fundamental of multimedia "Drew, Feurun, 2004.
- Adobe Flash CS4: Illustrated Barbara M. Waxer

Course Structure For B.C.A Semester – II

Category	Nomenclature	Credits	Contact Hours Per Week	Total Marks		Max. Marks	Min. Marks	Exam. Duration
				CIA	ESE			
MJBCA-201	Data Structure & Algorithm	03	06	25	50	75	30	2½ Hrs
MjBCA-202	E- Commerce	03	06	25	50	75	30	2½ Hrs
MJBCA-203	Discrete Mathematics	03	06	25	50	75	30	2½ Hrs
MJBCA-204	Practical: Data Structure through 'C'	01	02	25	-	25	10	4 Hrs
MJBCA-205	Practical: HTML	01	02	25	-	25	10	4 Hrs
MJBCA-206	Practical: Discrete Mathematics	01	02	25	-	25	10	4 Hrs

MJBCA – 201 : Data Structure & Algorithm

Max. Marks : 75 **Min. Marks: 30**
Credits: 03 **Duration: 2½ hrs**

Learning Outcome: On successful completion of the course, the students will be able to:

1. Explain fundamental concepts of data structure and array operations
2. Apply appropriate searching and sorting techniques on given data structure
3. Design stack and queue data structure
4. Helps students to implement algorithms in various real-life software problems.

Unit I

Data Structures and its Types: Primitive and Composite Data Types

Arrays: - Concept of Arrays, Single dimensional array, Two dimensional array. Operations on Arrays with Algorithms (Insertion, deletion).

Searching :(Linear and Binary), Concept of sorting, Sorting algorithms (Bubble Sort, Insertion Sort, Selection Sort). **Recursion:** Factorial, Fibonacci, Tower of Hanoi.

Unit II

Linked Lists:- Introduction to linked list and double linked list, Representation of linked lists in Memory, Traversing a linked list, Searching linked list, Insertion and deletion into linked list, Doubly linked lists, Traversing a doubly linked lists.

Stacks and Queues: Representation of stacks, Implementation of stacks using Array & Link List, Uses of stacks, evaluating expression.

Introduction to queues, Implementation of queues by using array and Link lists

Unit III

Trees: Definition & Basic concepts, linked tree representation, Introduction to Binary Tree, Traversing Binary Trees (Pre order, Post order and In-order), Concept of Binary search tree, algorithm of Searching, inserting and deleting in binary search trees.

Graph: Introduction to graphs, types of graphs (complete, weak and strong, simple), Representation of Graph: adjacency Matrix, Graph Traversal: Breadth first search, Depth first search.

Reference Books:

- Data Structure Through C - Y.P. Kanetkar – BPB Publication
- Data Structure Using C - E Balagurusamy – McGraw Hill
- Data Structures And Algorithm Analysis In C – Mark Allen Weiss – Pearson Education

MJBCA–202 : E-Commerce

Max. Marks : 75 **Min. Marks: 30**
Credits: 03 **Duration: 2½ hrs**

Learning Outcome:

On successful completion of the course, the students will be able to

1. Define E-commerce and its impact in different areas.
2. Understand different Business Models
3. Handle electronic transactions in secure way
4. Understand the basic concepts and technologies used in the field of management information systems**.**

Unit – I

E-Commerce -Introduction, Advantage, Disadvantages, Traditional commerce Vs. E-Commerce, Partial Vs Pure E-commerce. Impact of E-Commerce in different areas, the anatomy of E-commerce,

EDI: Introduction, Types of EDI, EDI Security and Privacy Issues, Application of EDI in business, Electronic-Catalogs, Digital Libraries. Framework of E-commerce, Business Models based on the relationship of Transaction Parties Business-to-Business (B2B), Business-to-Consumer (B2C), Consumer-to-Consumer (C2C), Consumer-to-Business (C2B), Business-to-Government (B2G), Government-to-Business (G2B), Government - to - Citizen (G2C),Intra- Business Organizational.

Unit – II

What is E-Governance: Objectives, Benefits, Developmental stages of E-Governance, Prerequisites for E-Governance, E-Governance models.

Business Models based on the relationship of Transaction types: Brokerage model, Aggregator and Advertising model. **Electronic Payment Systems:** Introduction, Features, Types (E-Cash, E-cheque, credit card, Smart Card, Electronic Purses), Electronic Payments and Protocols E-Customer Relationship Management, Security Threats (Active, Malicious, Server Side).

Ethical, Social, and Political issues in E-commerce: Understanding ethical, social, and political issues in E-commerce, Privacy and information rights, Intellectual property rights, Governance, Public safety and welfare.

Unit – III

Introduction of HTML: introduction, markup language, editing common tags, headers, text styles, working with links: creating a hyperlink, selecting hyperlink color, linking different sections of the webpage, formatting text, horizontal rules and more line breaks, unordered lists, nested and ordered lists.

Working with images: Inserting an image, adding border to image, aligning an image, using image as hyperlink. **Working with tables:** creating table, specifying caption to a table, setting width of table and table columns, setting cell spacing and padding, spanning rows and columns, image maps.

Basic HTML forms, working with frames: creating vertical and horizontal frames, applying hyperlink targets to a frame.

Cascading style sheets: inline, internal and external style sheets.

Reference Books:-

1. The Complete E Commerce Book − Janice Reynolds − CRC Press
2. E Commerce A Beginners Guide - Daniel D'Apollonio− Google Books
3. HTML Black Book − Steven Holzner−DreamTech

MJBCA–203 : Discrete Mathematics

Max. Marks : 75 **Min. Marks: 30**
Credits: 03 **Duration: 2½ hrs**

Learning Outcome: On successful completion of the course, the students will be able to:

1. Apply set operations to solve applied problems
2. Examine the validity of argument by using Propositional Calculus
3. Understand different graphs and matrix operations.
4. Upon completion of the course, the student will be able to use logical notation.

Unit I

Basic terminology of Graph Theory –Vertices, Edges, Loop, Path, degree**, Types-** Undirected- Directed, weighted-Un-weighted, Simple-Multigraph, Labelled, Null, Di-graph, Subgraph, Connected-disconnected, Cyclic-Acyclic, Dijkstra's shortest path algorithm, Minimum Cost spanning Tree Algorithm (Prim's and Kruskal's).

Sets: Elements of a set, methods of describing a set, types of sets, Operations on sets-- union, intersection and difference of sets, Associative Laws, Distributive laws, De Morgan's laws (proofs) Venn Diagrams, Cartesian product of two sets.

Unit II

Relation: Basic definition of relation and types of relations (reflexive, irreflexive, symmetric, A-symmetric, transitive, anti symmetric, equivalence), Binary relations, domain, range, inverse and composite.

Language of Logic: Proposition, Compound Proposition, Conjunction, Disjunction, Implication, Converse, Inverse & Contra positive, Biconditional Statements, tautology, Contradiction & Contingency, Logical Equivalences, Universal and existential quantifiers .

Unit III

Matrices: Definition of a matrix, types of matrices, Basic operations(Addition, subtraction and Multiplication), Transpose, Determinant of a square Matrix, Minor and Co-factors , Adjoint of a square Matrix, Inverse of a matrix, Solution to System of Linear equations- Matrix Inverse method and Cramer's method.

Reference Books:

- Keneth H. Rosen, "Discrete Mathematics and Its Applications", TMH
- C.L. Liu, "Elements of Discrete Mathematics", TMH.
- Kolman, Busby & Ross, "Discrete Mathematical Structures", PHI.
- Narsingh Deo, "Graph Theory With Application to Engineering and Computer Science", PHI.

Course Structure For B.C.A Semester – III

Category	Nomenclature	Credits	Contact Hours Per Week	Total Marks		Max. Marks	Min. Marks	Exam. Duration
				Internal	External			
MJBCA-301	Java Programming	03	06	25	50	75	30	2½ Hrs
MJBCA-302	Database Management System	03	06	25	50	75	30	2½ Hrs
MJBCA-303	Operating System	03	06	25	50	75	30	2½ Hrs
MJBCA-304	Computer Communication & Networking	03	06	25	50	75	30	2½ Hrs
MJBCA-305	Practical: Java Programming	01	01	25	-	25	10	4 Hrs
MJBCA-306	Practical: DBMS - SQL	01	01	25	-	25	10	4 Hrs
MJBCA-307	Practical: Operating System - Linux	01	01	25	–	25	10	4 Hrs
MJBCA-308	Practical: Computer Communication & Networking (Simulation)	01	01	25	–	25	10	4 Hrs
VAC	As per College							

MJBCA-301 : Java Programming

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Describe the features of Java
2. Develop programs with basic programming constructs.
3. Experiment with branching & Looping and Arrange data in Arrays.
4. Formalize the OOP concept and validate its real world implementation
5. An integrated development environment to write, compile, run, and test simple object-oriented Java programs.

Unit – I

JAVA: Introduction to Object Orientated Programming, Abstraction, Object Oriented Programming Principles, Features of JAVA, Introduction to JAVA byte code, Program elements; Primitive data types, variables, Input Output in Java, operators: arithmetic, assignment, logical, relational , Boolean logical operators, operator precedence.

Control statements: Java's Selection Statements, if statement, switch statement, Iteration statements, while, do-while, for-each, Nested loop, Jump Statement, using break, continue, return. Arrays, One & Two Dimensional Array

Unit – II

Object and Classes: Objects, constructors, returning and passing objects as parameter. Inheritance: Definition & its Types, Extended class, usage of Super, Overloading and overriding methods, Abstract classes, using final with inheritance.

String Handling: String constructors, special string operation, character extraction, searching and comparing string, string Buffer class.

Package and Interfaces: Defining package, access modifiers, importing package, Defining and implementing interfaces.

Unit – III

Exception handling: Exception handling fundamentals, Exception types, try, catch and multiple catch statements. Usage of throw, throws and finally.

Threading: Multithreading, multiprocessing, life cycle of thread, Garbage collection.

Applet: applet Fundamentals, applet life cycle, using paint method and drawing polygon.

Reference Books:-

- Introduction to Java Programming, Y. Daniel Liang, PHI.

- Java Complete Reference, Patrick Naughton, Tata McGraw Hill.
- The Java Handbook, Patrick Naughton, Tata McGraw Hill.
- Introduction to Java Programming, E Balaguruswamy, PHI.

MJBCA-302: Database Management System

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Understand key concepts of database system
2. Apply the ER concept and ER mapping to relational Model.
3. Differentiate file organizations, relational algebra operations
4. Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS using Oracle Software.

Unit – I

Overview and History of DBMS, Basic DBMS terminology, File Processing System v/s DBMS, advantages and disadvantages of DBMS, DBA and his responsibilities, Data Abstraction, physical and logical data independence, architecture of DBMS: Client /Server architecture, 2 Tier & 3 Tier. Overview of hierarchical, network and relational models, comparison of network, hierarchical and relational models.

Entity Relationship model: Overview of Data Design Entities, Attributes and Entity Sets, degree of relationship, Weak & Strong entities

Unit – II

Enhanced ER Model: Generalization, Specialization, Aggregation.

Implementation of sequential, random & indexed sequential file organization. Types of Keys.

E.F.Codd's rules, Relational Algebra

Normalization: Functional dependencies, Fully Functional dependency, Transitive dependency, Normal forms: first, second, third normal forms, BCNF

Database integrity: entity integrity, domain integrity, referential integrity

Unit – III

Introduction to SQL: Characteristics and Components of SQL, SQL data types and literals, Types of SQL commands, SQL operators. Table Constraints: Null Constraint, Primary Key, Unique key constraint, Foreign Key constraint, domain key constraint, Check Constraints, & Not Null.

Searching, Matching & Basic Oracle Functions: String, Numeric, and Aggregate Functions.

Queries based on group by clause, order by clause, having clause, Unions, Intersection, Minus SQL, Sub queries & joins. Introduction of views and indexes.

Reference Books:

- Fundamentals of Database Systems- Elmasri And Navathe Benjamin/Cummings Publishing
- SQL Complete Reference- Leon and Leon, Tata McGraw Hill
- SQL, PL/SQL Programming Language- Ivan Bayross, BPB Publications
- Database Management System- Korth, Tata McGraw Hill

MJBCA-303: Operating System

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Understand the structure and functionalities of an OS
2. Apply scheduling algorithms
3. Apply different page replacement algorithms
4. Understand user and editors in Linux
5. Understanding the basic set of commands and utilities in Linux systems. To learn to develop software for Linux systems

Unit I

Introduction to Operating Systems, Goals of OS, Operations of OS, and Classes of OS: Batch processing, multiprogramming, multi-processing, time sharing, distributed, real time systems, system calls.

Process concept: PCB, process scheduling, fundamental of scheduling, scheduling criteria, long medium short term scheduling, CPU scheduling algorithms: FCFS, SJF, Priority, RR, Thrashing, Threads.

Unit II

Process Synchronization, mutual exclusion, semaphores, monitors, critical section.

Memory Management: Logical versus physical address, contiguous allocation, fragmentation, Compactation, swapping, segmentation, paging, page replacement algorithm, virtual memory, virtual memory with paging, demand paging.

Deadlock: Shared resources, resource allocation and scheduling, resource graph models, deadlock detection, deadlock avoidance, deadlock prevention algorithms

UNIT – III

Introduction of Open Source Software, Need of Open Source, comparison with closed source / Proprietary software.

Linux Architecture, Linux file system ,Types of File system (EX2, EX3, EXT4, NTFS)

Shell Commands: user access commands, directory commands, file manipulation commands, security and protection commands, Find, Shell metacharacters, positional parameteters.

I/O Redirection and Piping, Relation and Absolute path, hard link and soft link, Linux Directory types.

Shell Programming – Introduction to Shell, Shell Variables, Shell keywords, control statements- if-then-else, case-switch, While, Until.

References Books:

- A practical Guide to Linux, Sobell, Pearson.
- A Practical Guide to Linux Commands, Editors, and Shell Programming, Sobell, Pearson.
- A Practical Guide to Fedora and Red Hat Enterprise Linux, Sobell, 5e, Pearson.
- Redhat Linux 6.0 Administration Wiley

MJBCA-304: Computer Communication & Networking

Max. Marks: 75 **Min. Marks: 30**

Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: Study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.

1. Acquire knowledge of Transmission Media and Error checking and correction method
2. Gain core knowledge of Asynchronous transmission Mode
3. Include learning about computer network organization and implementation, obtaining theoretical understanding of data communication and computer networks.

Unit I

Networking Basics: Introduction to digital communications, Types of network: LAN, WAN, MAN,

Types of network terminal: Client (Thin, Fat, Hybrid), Server (File, Mail, Application, Communication, Database, Print), Client Server Model

Topology: Bus, Ring, Star, Tree/Snowflake, Mesh, Combined/ Hybrid

Concepts of: Amplitude, Frequency, Phase, Bit rate, Baud rate, Bandwidth.

Signal types: Analog signals, Digital signals, Periodic, Aperiodic

Unit II

Transmission Media: Guided, Unguided, Transmission Mode: Parallel, Serial

Networking Devices: Router, Hub, Switch, Bridge, Gateway

Switching: Introduction, Types (circuit, packet, message)

Multiplexing: Frequency division, Wavelength division, Time Division, Demultiplexing

Unit III

Protocol: Standards, Architecture, OSI Model, TCP/IP Model, HDLC

Asynchronous transfer mode: Introduction, Protocol architecture, ATM cells, ATM layers,

Point to Point Protocol: point-to-point layers, link control protocol, network control protocol.

Error classification: Types of errors (Single Bit Error, Burst Error).

Reference:

- Data and Computer communications, William Stallings, PHI

- Data communication and networking, Behoruz A. Forouzan
- Data communication and networking, A S Godbole, Tata McGrawhill
- Network concepts and Architecture, Hancock, BPB Publications

Course Structure For B.C.A Semester – IV

Category	Nomenclature	Credits	Contact Hours Per Week	Total Marks		Max. Marks	Min. Marks	Exam. Duration
				CIA	ESE			
MJBCA-401	Relational Database Management System	03	06	25	50	75	30	2½ Hrs
MJBCA-402	Website Development	03	06	25	50	75	30	2½ Hrs
MJBCA-403	VB.NET Programming	03	06	25	50	75	30	2½ Hrs
MJBCA-404	Software Engineering	03	06	25	50	75	30	2½ Hrs
MJBCA-405	Practical: RDBMS – PL SQL	01	02	25	-	25	10	4 Hrs
MJBCA-406	Practical: Website Development – PHP	01	02	25	-	25	10	4 Hrs
MJBCA-407	Practical: VB.NET Programming	01	02	25	–	25	10	4 Hrs
MJBCA-408	Practical: Software Engineering (Case Studies)	01	02	25	–	25	10	4 Hrs

MJBCA-401 : Relational Database Management System

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Compare and Contrast between different types of databases.
2. Optimize the operations
3. Implement basic operations of database language
4. Handle the events occurring on database and explicit error handling
5. Execute various advance SQL and Pl/SQL queries related to Transaction Processing & Locking using concept of Concurrency control.

Unit – I

Transaction Processing: ACID Properties, Transaction State, Concurrent Executions, Need of Serializability, Conflict vs. View Serializability, Testing for Serializability.

Concurrency Control: Implementation of Concurrency: Lock-based protocols, Timestamp-based protocols, Deadlock handling.

Database Failure and Recovery: Database Failures, Recovery Schemes: Shadow Paging and Log-based Recovery.

UNIT – II

Query optimization & processing: Introduction, Algorithm for external sorting, select & join operation, project & set operations.

Parallel Databases : I/O Parallelism, Interquery Parallelism, Intraquery Parallelism.

Distributed Databases: Replication and Fragmentation, Distributed Transactions, Commit protocol, Concurrency Control in Distributed Databases.

UNIT – III

Introduction to PL/SQL and its advantages over SQL, PL/SQL block structure, variables and constants, attributes, character set, data types, control structures, conditional control.

Sequential control, Introduction to Cursor (Implicit & Explicit),Error handling in PL/SQL, creating function & procedure, package functions, package procedures, Oracle transactions

Database Triggers: Introduction, Use & type of database Triggers, Triggers Vs. Declarative Integrity Constraints, BEFORE Vs. AFTER Trigger Combinations, Creating a Trigger, Dropping a Trigger.

Reference Books:-

- SQL Complete Reference, Leon and Leon, Tata McGraw Hill
- SQL, PL/SQL Programming Language, Ivan Bayross, BPB Publications

- DB2 Developer′s Guide, Mullins, BPB Publications
- Data Base Management System, Navathe, Pearson Education Asia.

MJBCA-402: Website Development

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to:

1. Impart knowledge server side programming using PHP
2. Develop the decision making statement logic under different concepts using XAMP server
3. Gain ability to develop web applications database connectivity using MYSQL Database
4. The student will discover how does web works really, what makes web sites work, how to and where to start research, planning for website & build excellent web sites

Unit – I

Client – Side Programming (Java Script)
JavaScript: Introduction, Keywords, variables, expression, data type
Operators : Arithmetic, Relational, Logical, Assignment, Increment/ Decrement, Bitwise
Control Structure: if-else, switch, Break, loop: while, do-while, for, for-in.
Function: Create, Core JavaScript (Properties and Methods of String, Math and Date Object)
Java script arrays: introduction, array-declaring and allocating arrays.
JavaScript and MS-Access: Connecting to MS-Access Database, Create, Insert, Update, Delete, Extract

Unit – II

Server – Side Programming (PHP)
PHP ─ Introduction, Common Uses, Characteristics, Syntax, Running Script from Command Prompt,
Variable: Local, Global, Static, Constants
Operator: Types, Precedence of Operators
Control Structure: if-else, switch, Break, loop: while, do-while, for, for-each.

Unit – III

Arrays: Numeric Array, Associative Arrays, Multidimensional Array
Web Concepts, GET and POST, File Inclusion
Function: Strings, Math and Date function, Conversion Functions, Function (create, calling), Cookies, Sessions, Error and Exception Handling.
PHP and MySQL: Connecting to MySQL Database, Create, Insert, Delete, Retrieving
Reference Books:-

- PHP A Beginners Guide – VikramVaswani – McGraw Hill
- Programming PHP – Kevin Tatroe, Peter Macintyre – O'Reilly
- PHP & My SQL Web Development – Laura Thompson & Luke Welling – Addison Wesley

MJBCA-403: VB. NET Programming

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Understand the .net Framework
2. Know the use of variables and operators
3. Design user interface and apply looping and decision making .
4. Connect with database
5. Understand and implement string manipulation, events, and exception handling within. NET application environment

Unit - I

Overview of .NET Framework
What is .NET framework, Origins of .NET, Architecture & Components, Common Language Runtime, Common Type System, Common Language Specification, MSIL, Framework Base Classes & Namespaces, IDE, .NET Languages.
Visual Basic Language Features:

Introduction to VB.NET, Program Structure and Code Conventions, Data Types & Variables, Constants & Enumerations, Operators, Decision making & Looping, Arrays & Strings, Date & Time, Procedures in VB.

Unit – II

Building a User Interface:
The Visual Basic Environment, Event-Driven Programming, Building Forms: The Basics & Advanced Techniques, Working with Traditional Controls: Label Control, Text Box, Creating Buttons, Option Buttons, List Box, Combo Box.

Unit – III

Using Advanced Controls: Creating Timers, Dialog Boxes, Picture Box, List View Control, Tree View Control, Menus and Toolbars.
Working with Database: Introduction to OleDB, ODBC, SQL Server, Connection String, Data Source, OleDbConnection, OleDbCommand, OleDBReader, Select, Insert, Update, Delete.
Reference Books:

- The Complete Reference Visual Basic .NET, Jeffery R Shapiro (McGraw–Hill/Osborne)
- Application of .NET Technology, Module- 4.1-R4 By Prof. Satish Jain (BPB Publications)

MJBCA-404: Software Engineering

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Understand basic concepts of software engineering.
2. Compare different software engineering process models
3. Create architectural design for a given project
4. Apply different testing techniques
5. Basic knowledge and understanding of the analysis and design of complex systems and ability to apply software engineering principles and techniques**.**

Unit – I

Software Engineering : Concept, Software Characteristics, Software myths, Software Applications, Software Engineering Definitions, System Development Life Cycle (SDLC) ,
Software Process Model: Water fall Model, Incremental Model, Prototype. Spiral model.
Software Requirements, Functional and non-functional requirements, User requirements, System requirements.

Unit – II

Software Metrics: Role of Metrics and Measurement, Process and Product Metrics, Size metric. COCOMO Model
Planning and Software Project:
Project Scheduling and its goal, Work breakdown structure, Project Scheduling and its techniques: Gantt Chart, PERT and CPM.
Design: Introduction, Objective, Modularity (Cohesion & Coupling)

Unit – III

Coding: Introduction and Clean room Approach
Testing: Introduction, Objective, Characteristics, Principles, Testability
Software Testing Strategies: Unit Testing, Integration Testing, Validation Testing (Alpha and Beta Testing), Verification, System Testing (Recovery, Security, Stress, Performance),
Black Box Testing and White Box Testing: Introduction and Comparison.
Reference Books:-

- Roger S. Pressman, “Software Engineering – A Practitioner’s Approach “, Sixth Edition, McGraw
- R.E. Fairley, “Software Engineering Concepts”, Paperback Edition, McGraw Hill.
- Jalota, “An Integrated Approach to Software Engineering”, Narosa Publishing House

Course Structure For B.C.A Semester – V

Category	Nomenclature	Credits	Contact Hours Per Week	Total Marks		Max. Marks	Min. Marks	Exam. Duration
				Internal	External			
MJBCA-501	Python Programming	03	06	25	50	75	30	2½ Hrs
MJBCA-502	Computer Graphics	03	06	25	50	75	30	2½ Hrs
MJBCA-503	Internet of Things	03	06	25	50	75	30	2½ HRs
MJBCA-504	Practical: Python Programming	01	02	25	-	25	10	4 Hrs
MJBCA-505	Practical: Computer Graphics	01	02	25	-	25	10	4 Hrs
MJBCA-506	Practical: Internet of Things	01	02	25	–	25	10	4 Hrs

MJBCA-501 : Python Programming

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome

1. Improve programming skills
2. Hands on Regular Expression
3. Ability to Text Processing scripts
4. Develop Problem solving and programming capability.

Unit- I

Python Basics: IDLE, Editors, Keywords, Identifiers, Indents, Input Output Basic Syntax, Variable, Dynamic Typing, Data Types (Mutable and Immutable), Built-in Conversion Methods.
Operator: Arithmetic, Comparison, Logical, Identity, Membership.
Control Statements: Conditional (If, If- else, Elsif, Nested if-else), Looping (While, For, Nested loops), Break, Continue, Pass.
Array: Introduction, Creation, Traverse, Insertion, Deletion, Search, Update.

Unit- II

String: Introduction, Types, Escape Sequences, Formatting, Operators, Built-in Methods (Capitalize, Upper, Lower, Title, Find, Count, Isalpha, Isdigit, Islower, Isupper), Basic Operations (Accessing, Updating, Concatenation).
List & Tuple: Introduction, Accessing, Operators, Built-in Methods (Len, Max, Min, Append, Insert, Remove, Pop, Reverse, Sort, List), Basic Operations (Updating, Delete, Concatenation, Indexing, Slicing).
Set: Introduction, Accessing, Built-in Methods (Add, Update, Clear, Copy, Discard, Remove), Operations (Union, Intersection, Difference).
Dictionary: (Single Dimensional) Introduction, Accessing, Updating, Deleting, Viewing values in dictionaries, Built-in Methods (Len, Max, Min, Pop, Clear, Items, Keys, Values, Update).

Unit- III

Function: Defining, Calling, Function Arguments (Required, Keyword, Default, Variable Length) Anonymous Functions, Global and Local Variables.
Modules: Introduction, Importing Module, Built-in Modules (Math, Statistics, Random).
Package: Creating, Installing, Importing Modules from the Package.
Errors & Exception: Error Types, Exception Handling - Introduction, Try, Except, Else, Finally.
File Input-Output: Opening and Closing files, Reading and Writing files.

Reference Books:

- Let Us Python – YashavantKanetkar, BPB Publications.
- Python The Complete Reference – Martin C. Brown, McGraw Hill
- Core Python Programming – R. NageswaraRao, Dreamtech Press

MJBCA-502: Computer Graphics

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome After learning the course the students should be able to:

1. To understand the various computer graphics hardware and display technologies.
2. 2D and 3D viewing technologies
3. Various 2D and 3D objects transformation techniques.
4. Interpret the mathematical foundation of the concepts of computer graphics.

Unit – I

Introduction: Elements of graphics workstation. Video Display Devices. Color model, Raster Scan Systems. Random Scan systems. Input devices. Graphics Software Coordinate Representations, Fundamental Problems in Geometry. **Algorithms**: Line drawing algorithms- DDA Algorithm. Bresenham's Line Algorithm. Frame buffers. Circle and Eclipse generating algorithms.
Shape fill Algorithm. Character generation. Attributes of lines, curves, filling, characters.

Unit – II

Graphics Primitives: Primitive Operations, The display file interpreter-Normalized Device Coordinates. Display- File structure. Display – file algorithm. Display control and Polygons, polygon representation. Text attributes.
Geometric Transformations: Matrices. Scaling Transformations. Sin and Cos Rotation. Homogeneous Co-ordinates and Translation. Co-ordinate Translations. Rotation about an arbitrary point. Inverse Transformations, Transformations Routines. 2-D Viewing- The viewing pipeline. Viewing co-ordinate, Reference Frame. Windows to view ports. Co-ordinate transformation.

Unit – III

Clipping Techniques: Clipping in Raster, point clipping, Line clipping, Cohen-Sutherland Line clipping Algorithm, Cyrus-Beck Line clipping Algorithm
Computer Animation: Design of Animation Sequences. General Computer Animation Functions-Raster Animations. Key Frame Systems. Morphing Simulating Accelerations. Motion Specifications. Kinematics and Dynamics.

Reference Books:

- Computer Graphics- Principles and Practice- J. Foley, A. Van Dam, S. FeinerHughes:Pearson
- Principles of Interactive Computer Graphics-Newman and Sproull, Tata McGraw Hill
- Computer Graphics, Hern& Becker, Pearson Publication
- Computer Graphics, Cornel Pokorny, BPB Publications.

MJBCA-503: Internet of Things

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Compare and contrast the deployment of smart objects and the technologies to connect them to network.
2. Appraise the role of IoT protocols for efficient network communication.
3. Elaborate the need for Data Analytics and Security in IoT.
4. Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in the Industry.

UNIT-I

Introduction to IoT: Definition, and characteristics of IoT, Genesis of IoT, IoT and Digitization, Design of IOT: Physical design of IOT, Logical Design of IOT- Functional Blocks, communication models, Communication APIs, IOT enablingTechnologies- Wireless Sensor Networks, Cloud computing, big data analytics, embedded systems. IOT Levels and deployment templates.
Architecture and Reference Model: Introduction, Reference Model and architecture, Representational State Transfer (REST), architectural style, Uniform Resource Identifiers (URIs).

UNIT-II

IoT Hardware and Software: Sensor and actuator, Types of Sensors, Types of Actuators, Arduino, Raspberry Pi, LiteOS, RIoTOS, Contiki OS, Tiny OS.

Cloud for IoT: IoT with Cloud-Challenges, Selection of Cloud Service Provider for IoT Applications, Fog Computing, Cloud Computing: Security Aspects,

Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics

Domain Specific IoTs Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT-III

IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming, IoT Physical Devices and Endpoints - IoT Physical Devices and Endpoints: Arduino Pin diagram, Arduino Architecture, Arduino Programming, Sensors and Interfacing: Types of Sensors: Integrating Sensors: HDT (Humidity and Temperature Sensor), Gas Detector, HC-05 (Bluetooth Module), Ultrasonic Sensor, Infrared Sensor, Soil Moisture Sensor.

Reference Books:

1. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for IOT" by . David Hanes, Gonzalo Salgueiro, Pearson Education.
2. "Internet of Things" by Srinivasa K G, CENGAGE Leaning India.
3. "Internet of Things (A Hands-on-Approach)" by . Vijay Madisetti and Arshdeep Bahga, VPT.

Course Structure For B.C.A Semester – VI

Category	Nomenclature	Credits	Contact Hours Per Week	Total Marks		Max. Marks	Min. Marks	Exam. Duration
				Internal	External			
MJBCA-601	Mobile App Development	03	06	25	50	75	30	2½ Hrs
MJBCA-602	Artificial Intelligence	03	06	25	50	75	30	2½ Hrs
MJBCA-603	Information Protection & Security	03	06	25	50	75	30	2½ Hrs
MJBCA-604	Practical: Mobile App Development	01	02	25	-	25	10	4 Hrs
MJBCA-605	Practical: Artificial Intelligence	01	02	25	-	25	10	4 Hrs
MJBCA-606	Practical: Information Protection & Security	01	02	25	-	25	10	4 Hrs

MJBCA-601 : Mobile App Development

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Define Android OS and its architecture.
2. Simulate the process of application life cycle.
3. Outline the Application development in Android.
4. Create a general purpose application for android OS.
5. Design and develop user Interfaces for the Android platform.

Unit I

Fundamentals of Android Development: Introduction to Android, The Android SDK, Understanding the Android Software Stack, Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator, The Android Debug Bridge (ADB), Basic Widgets Understanding the Role of Android Application Components, Event Handling, Displaying Messages Through Toast, Creating and Starting an Activity, Using the Edit ext Control

Unit II

The Android Debug Bridge (ADB), basic widgets understanding the role of Android Application Components, event handling, displaying messages through toast, creating and starting an activity,using the Edit ext Control Building Blocks for Android Application Design, Laying Out Controls in Containers, utilizing resources and media.

Unit III

Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments Advanced, Android Programming: Internet, Entertainment, and Services,
Implementing drawing and animations, displaying web pages and maps, communicating with SMS and emails, creating and using content providers: creating and consuming services, publishing android applications.

Reference Books:-

- Android Application Development, Rick Rogers, O'Reilly.
- Starting with Android, M.M. Sharma-Rashmi Aggarwal, BPB Publications.

MJBCA-602: Artificial Intelligence

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Understand basic principles and application of AI
2. Represent knowledge in various ways
3. Solve various problems by applying a suitable search method
4. Understand key concept of learning

Unit I

Definition of AI, Applications of AI, knowledge-based systems, representation of knowledge, organization and acquisition of knowledge.

State space, Production system and its components, problem characteristics, production system characteristic, Problems (8-Puzzle problem, Tower of Hanoi, Cannibals and Missionaries and Travelling Salesman Problem)

Search problems: DFS, BFS, Heuristics Search (Generate and test, Greedy or Best First search).

Unit II

Syntax, semantics of propositional logic, syntax and semantics of FOPL, conversion to clausal form. Inference rule, resolution principles.

Truth maintenance system, fuzzy logic, associative networks, frame networks.

Unit III

Concept of learning: Inductive and deductive, rote learning, Components of Learning Model, Performance Measures, Types of Learning (Supervised, Unsupervised, Active & Reinforcement).

Concept of expert system, need for an expert system, Characteristics & features of an expert system, Components of an expert system, Stages in the development of an expert system, Application areas of Expert System.

Reference Books:

1. Introduction to AI & Expert System – Patterson - PHI
2. Artificial Intelligence - Elaine Rich & Kevin Knight – MGHill
3. Artificial Intelligence - Luger – Pearson

MJBCA-603: Information Protection & Security

Max. Marks: 75 **Min. Marks: 30**
Credit: 03 **Duration: 2½ Hrs**

Learning Outcome: On successful completion of the course, the students will be able to

1. Identify and classify computer and security threats and develop a security model to prevent, detect and recover from attacks
2. Understand the concept of encryption and analyze various symmetric & asymmetric encryption algorithm
3. Familiarize with network security designs
4. Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.

Unit – I

Information security concepts, Need for security, types of attacks, virus, worms, Trojan, botnet, ransomware, backdoors. Goals for security.

Cryptographic techniques: plain text and cipher text, substitution and transposition techniques: Caesar cipher, modified Caesar cipher, mono alphabetic cipher, Vigenere cipher, hill cipher, Vernam Cipher, steganography, key range and key size.

Unit-II

Computer based symmetric key cryptographic algorithm: Introduction, Diffie Hellman Key Exxchange/ Agreement algorithm algorithm types: stream cipher and block cipher and mode: ECB, CBC, CFB, OFB. An overview of symmetric key cryptography, Fiestle Structure, concept of confusion and diffusion, basics of data encryption standard DES.

Unit- III

Computer based asymmetric cryptographic algorithm: Introduction of asymmetric key cryptography, an overview of asymmetric key cryptographic, and the RSA algorithm.

Internet security protocols: basic concepts, secure socket layer SSL, Secure hypertext transfer protocol.

User authentication mechanism: passwords, certificate based authentication, biometrics authentication, Firewalls

Reference Books:-

- Cryptography and Network Security - William Stallings – Pearson
- Behrouz A. Forouzan and D. Mukhopadhyay- Cryptography & Network Security, 2nd Edition - 1st reprint 2010, McGraw Hill, New Delhi.
- Wade Trapple, Lawrence C. Washington- Introduction to Cryptography with coding Theory, 2nd Edition pearson Education