Kurukshetra University, Kurukshetra

(Established by the State Legislature Act XII of 1956)

('A+' Grade, NAAC Accredited)

|| योगस्थ: कुरु कर्माणि ||

समबुद्धि व योग युक्त होकर कर्म करो

(Perform Actions while Stead fasting in the State of Yoga)

Scheme of Examination and Syllabus of

Master of Computer Application (MCA)(Non-CBCS) in Phased Manner

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS

Non-CBCS CURRICULUM (2020-21)

Program Name: Master of Computer Applications (MCA)(Non-CBCS)

(For the Batches Admitted From 2020-2021)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

SCHEME OF EXAMINATIONS
FOR
MASTER OF COMPUTER APPLICATIONS
(NON-CBCS)
(FOR INSTITUTES AFFILIATED TO KURUKSHETRA UNIVERSITY, KURUKSHETRA)
W. E. F. ACADEMIC SESSION 2020-21 IN PHASED MANNER

Paper Code	Nomenclature of Paper	Workload Per Week (Hrs.)	Exam Time (Hrs.)	External Marks		Internal Marks	Total Marks	Pass Marks
				Max.	Pass			
First Semester								
MCA-20-11	Programming in Java	4	3	75	30	25	100	40
MCA-20-12	Data Structures using C++	4	3	75	30	25	100	40
MCA-20-13	Operating Systems	4	3	75	30	25	100	40
MCA-20-14	Data Communication and Computer Networks	4	3	75	30	25	100	40
MCA-20-15	Object-Oriented Analysis and Design using UML	4	3	75	30	25	100	40
MCA-20-16	S/W Lab – I Based on MCA-20-11	5	3	100	40	-	100	40
MCA-20-17	S/W Lab – II Based on MCA-20-12	5	3	100	40	-	100	40
Total		**30**		**575**	**230**	**125**	**700**	**280**
Second Semester								
MCA-20-21	Web Technologies	4	3	75	30	25	100	40
MCA-20-22	Linux and Shell Programming	4	3	75	30	25	100	40
MCA-20-23	Advanced Data Base Systems	4	3	75	30	25	100	40
MCA-20-24	Elective-I	4	3	75	30	25	100	40
MCA-20-25	Elective-II	4	3	75	30	25	100	40
MCA-20-26	S/W Lab – III Based on MCA-20-21 and MCA-20-23	5	3	100	40	-	100	40
MCA-20-27	S/W Lab – IV Based on MCA-20-22	5	3	100	40	-	100	40
Total		**30**		**575**	**230**	**125**	**700**	**280**
Elective – I								
MCA-20-24 (i)	Principles of Programming Languages	4	3	75	30	25	100	40
MCA-20-24(ii)	High Performance Networks	4	3	75	30	25	100	40
MCA-20-24(iii)	Compiler Design	4	3	75	30	25	100	40
Elective – II								
MCA-20-25 (i)	Theory of Computation	4	3	75	30	25	100	40
MCA-20-25 (ii)	Design and Analysis of Algorithms	4	3	75	30	25	100	40

Paper Code	Nomenclature of Paper	Workload Per Week (Hrs.)	Exam Time (Hrs.)	External Marks		Internal Marks	Total Marks	Pass Marks
				Max.	Pass			
MCA-20-25(iii)	Security in Computing	4	3	75	30	25	100	40
Third Semester								
MCA-20-31	Computer Architecture and Parallel Processing	4	3	75	30	25	100	40
MCA-20-32	Data Mining and Integration using R	4	3	75	30	25	100	40
MCA-20-33	Artificial Intelligence	4	3	75	30	25	100	40
MCA-20-34	Elective-III	4	3	75	30	25	100	40
MCA-20-35	Elective-IV	4	3	75	30	25	100	40
MCA-20-36	S/W Lab – V Based on MCA-20-32	5	3	100	40	-	100	40
MCA-20-37	S/W Lab – VI Based on MCA-20-35	5	3	100	40	-	100	40
*MCA-20-38	Summer Training / Internship (Industry Based)	-	Viva Voce	150	60	50	200	80
Total		**30**		**725**	**290**	**175**	**900**	**360**
Elective – III								
MCA-20-34 (i)	Cloud Computing and IoT	4	3	75	30	25	100	40
MCA-20-34 (ii)	Cyber Security	4	3	75	30	25	100	40
MCA-20-34(iii)	Digital Marketing	4	3	75	30	25	100	40
Elective – IV								
MCA-20-35 (i)	Advances in Java	4	3	75	30	25	100	40
MCA-20-35 (ii)	Advanced Web Technologies	4	3	75	30	25	100	40
MCA-20-35(iii)	Programming with Kotlin	4	3	75	30	25	100	40
Fourth Semester								
MCA-20-41	Big Data and Pattern Recognition	4	3	75	30	25	100	40
MCA-20-42	Computer Graphics and Animation	4	3	75	30	25	100	40
MCA-20-43	Mobile Application Development	4	3	75	30	25	100	40
MCA-20-44	Elective-V	4	3	75	30	25	100	40
MCA-20-45	Elective-VI	4	3	75	30	25	100	40
MCA-20-46	S/W Lab–VII Based on MCA-20-41 and MCA-20-42	5	3	100	40	-	100	40
MCA-20-47	Project Based on MCA-20-43	5	3	75	30	25	100	40
Total		**30**		**550**	**220**	**150**	**700**	**280**
Grand Total		**120**		**2425**	**970**	**575**	**3000**	**1200**
Elective – V								
MCA-20-44 (i)	Soft Computing	4	3	75	30	25	100	40
MCA-20-44 (ii)	Machine Learning	4	3	75	30	25	100	40

Paper Code	Nomenclature of Paper	Workload Per Week (Hrs.)	Exam Time (Hrs.)	External Marks		Internal Marks	Total Marks	Pass Marks
				Max.	Pass			
MCA-20-44(iii)	Digital Image Processing	4	3	75	30	25	100	40
Elective – VI								
MCA-20-45 (i)	Optimization Techniques	4	3	75	30	25	100	40
MCA-20-45(ii)	Information Systems	4	3	75	30	25	100	40
MCA-20-45(iii)	Blockchain Technology	4	3	75	30	25	100	40

***Note 1:** Summer Training / Internship will be held immediately after 2nd Semester Examination and will be having a minimum duration of 45 days and maximum duration of 60 days. Students have to submit the Summer Training / Internship Report latest by 30th August. Evaluation of the Report and Viva-Voce shall be held during 3rd Semester. The Evaluation and Viva-Voce shall be held by one External and one Internal examiner.

Note 2: Evaluation procedure for internal assessment marks:

Two Mid Term Examinations should be conducted by the concerned teacher each of 10 marks. Five marks may be given by the concerned teacher on the basis of performance during the course (puzzles / assignments / interactions / attendance etc.).

Note 3: Size of groups in all practical courses should not be more than thirty students.

MCA-20-11: Programming in JAVA

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The course aims is to equip the students with JAVA programming language concepts with object-oriented programming principles. In this course student will be able to learn the basic syntax and semantics of the Java language and programming environment; build robust applications using Java's object-oriented features; implement the interface and inheritance; understand exceptional handling and multi-threading concepts along with Applets, AWT and Event Handling.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-11.1	learn the basic features of Java;
MCA-20-11.2	develop program using different concepts of OOPs;
MCA-20-11.3	develop programming using Java I/O and Applet Programming;
MCA-20-11.4	design and Implement Graphics programming using AWT and Layouts.

Unit – I

Java History: Java features, How Java differs from C++, Java Program Structure, Java Tokens, , Java virtual machine, Constants, variables and data types, operators & expressions, control structures, arrays, class & object, garbage collection, finalize() method, Inheritance, method overriding, Abstract class, Multiple inheritance, Interfaces, extending Interfaces, Accessing Interface variables.

UNIT – II

Packages, Exception Handling & Multithreading: API Packages, Creating packages, Accessing a package, Adding a class to a package, use of super and final keywords, Wrapper classes, Exception types, uncaught exceptions, multiple catch clauses, nested try statements, built-in exceptions, creating your own exceptions, Multithreading; Java thread model, thread priorities, threads synchronization, thread suspending, resuming and stopping threads.

UNIT – III

I/O Streams & Applet: Console I/O – reading console input, writing console output, Files I/O-Byte Streams, Character Streams, Collection of inbuilt Interfaces & Classes, Applet programming, Applet life Cycle, creating executable Applet, Applet Tag, Running an applet, passing parameters to applet, Graphics programming, GUI Concepts in Java, managing Input/Output in Applet.

UNIT – IV

Event Handling: AWT Classes, AWT Button, AWT Label, AWT TextField, AWT TextArea, AWT Checkbox, Event Listeners, Java ActionListener, Java MouseListener, MouseMotionListener, Adapter Classes as Helper Classes in Event Handling. Layout managers- Grid Layout, Flow Layout, Card Layout, Border Layout, Menus.

Text Books:

1. E. Balaguruswamy, Programming with JAVA- A Primer, Tata Mc-Graw Hill publication.
2. Patrick Naughton, Herbert, Schild, The Complete reference Java 2, Tata Mc-Graw Hill.

Reference Books:

1. Patrick Nieaneyer and Joshna Peck, Exploring Java, O. Reilley.
2. Hareliy Hahn, Teacher the Internets, P.H.I.
3. Barry Boone, William Stanck, Java 2 exam Guide, Tata Mc-Graw Hill.

MCA-20-12: Data Structures using C++	
Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.
Course Objectives: The objective of this paper is to make the students familiar with the commonly used data structures and understand their applications in real life problems.	
Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-12.1	understand and apply the array data structure along with various operations on it;
MCA-20-12.2	understand and apply the concepts of linked list, stacks and queue data structures;
MCA-20-12.3	understand and apply the tree data structure in various fields;
MCA-20-12.4	design and analyze the algorithms for graph, sorting, searching, and hashing.

Unit – I

Introduction to Data Structures: Classification of Data Structures, Complexity of Algorithms, Abstract Data Types, Arrays, Representation of Arrays in Memory, Operations on Array, Strings and its Representation in Memory, Operations on Strings, Pointers, Sparse Matrices.
Sorting: Bubble Sort, Selection Sort, and Insertion Sort.
Searching: Linear Searching, Binary Searching.
Implementation of Arrays, String, Sorting and Searching in C++.

Unit – II

Linked Lists: Introduction, Types and Operations (Insertion, Deletion, Traversal, Searching, Sorting), Applications, Dynamic Memory Management, Polynomial Representation and Addition, Implementation of Linked Representations in C++.
Stacks & Queues: Representation of Stacks, Stack Operations, Applications, Recursion, Queues, Operations on Queues, Circular Queues, Dequeue, Priority Queues, Applications, Implementation of Stacks and Queues in C++.

Unit – III

Trees: Definition and Basic Terminologies, Representation of Trees, Binary Trees, Types of Tree, Representation of Binary Trees, Binary Tree Traversals, Threaded Binary Trees, Binary Search Trees and Operations, AVL Trees, Heap, Heap-Sort, M-Way Search Trees, B-Trees, B^+ Trees, Applications, Implementation of trees in C++.

Unit – IV

Graphs: Definitions and Basic Terminologies, Representation of Graphs, Graph Traversals, Operations on Graphs, Shortest Path Problem (Warshall's Algorithm and Dijkstra's Algorithm), Minimum Spanning Tree (Prim's and Kruskal's Algorithm), Applications, Implementation of Graphs using C++.

Sorting and Searching: Recursive Binary Search, Types of Sorting, Implementation of Different Sorting Techniques in C++: Merge Sort, Radix Sort, Counting Sort, Bucket Sort. Hashing: Hash functions, Collision Resolution, Implementation using Linear and Quadratic Probing, Chaining using C++.
Text Books: 1. G.A.V Pai, Data Structures and Algorithms, Tata McGraw-Hill. 2. Drozdek, Data Structure and Algorithms in C++, Cengage Learning.
Reference Books: 1. Seymour Lipschutz, Data Structures, Tata McGraw-Hill, Schaum's Outlines, New Delhi. 2. Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education. 3. Goodrich, Data Structures & Algorithms in C++, Wiley India Pvt. Ltd. 4. S. Sahni, Data structures, Algorithms, and Applications in C++, University Press (India) Pvt. Ltd. 5. Walter Savitch, Problem solving with C++, Pearson education. 6. John R. Hubbard, Data Structures with C++, Tata McGraw-Hill, Schaum's Outlines, New Delhi.

MCA-20-13: Operating Systems	
Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question, there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to get the students familiar with different functions performed by operating systems.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-13.1	learn the concept of Operating Systems, processes and the CPU scheduling;
MCA-20-13.2	understand the concept of concurrent processes and deadlocks in operating systems;
MCA-20-13.3	understand the file, memory and device management in operating systems.
MCA-20-13.4	appreciate the need of protection & security along with distributed operating systems.

Unit – I

Introductory Concepts: Operating system functions, structure, types viz. Batch processing systems, multi-programming systems, Time-sharing systems, desktop systems, multi-processor systems, distributed systems, clustered systems, real-time systems, handheld systems, open-source operating systems.

Operating System Structures: System Components, Operating system services, system calls, system programs.

CPU Scheduling: Process concepts, process operations, inter-process communication, scheduling criteria, scheduling algorithms, Comparative study of scheduling algorithms, Multiple processor scheduling.

Unit – II

Concurrent Processes: Critical section problem, Semaphores, Classical process co-ordination problems and their solutions, monitors.

Deadlocks: Deadlock characterization, Deadlock handling, Deadlock prevention and avoidance, Deadlock detection and recovery.

Unit – III

Memory Management: Swapping, Paging, Segmentation, Virtual memory concepts: Demand Paging, Page replacement Algorithms, Thrashing.

Storage Management: File concepts, File access methods, Directory Structure, File-system mounting, File sharing, Protection, File system structure and implementation, Directory implementation, File allocation methods, Recovery. Disk scheduling criteria and algorithms.

Unit – IV

Protection & Security: Goals of protection, domains of protection, access matrix. Security: Security problem, threats, security tools, classification.

Distributed Systems: Types of network-based OS, Network structure and topologies, Communication structure & Protocol, design issues. Distributed File-system: Remote file access, File replication. Distributed

synchronization: Mutual exclusion, Concurrency control, deadlock handling.
Text Books: 1. Silberschatz A., Galvin P. B., Gagne G., Operating System Concepts, Wiley India Pvt. Ltd. 2. Chauhan Naresh, Principles of Operating Systems, Oxford University Press. 3. Tanenbaum A.S., Operating System- Design and Implementation, PHI Learning.
Reference Books: 1. Deitel H.M., Operating Systems, Pearson Education. 2. Stallings William, Operating System, PHI Learning. 3. Godbole A.S., Operating Systems, Tata McGraw-Hill, New Delhi.

MCA-20-14 Data Communication and Computer Networks

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Provide an in-depth coverage of various concepts, components, and technologies of Computer Networks and Data Communication. Provide the architectural overview of the Internet. Expose the students to the current trends in wired and wireless communication technologies and real-world networking scenario

Course Outcomes(COs)	At the end of this course, the student will be able to:
MCA-20-14.1	characterize various types of computer networks and standards along with an insight into the principles of networking by using protocol layering of the Internet and the TCP/IP protocol suite;
MCA-20-14.2	comprehend the notion of data communication and its related functional components and aspects;
MCA-20-14.3	understand design issues related to Local area Networks and get acquainted with the prevailing wired and wireless LAN technology standards;
MCA-20-14.4	get versed with the routing, addressing and congestion control issues in Networks and the Internet architecture.

Unit – I

Network Characterization: Goals and Applications; Categorization according to Size, Purpose, Design issues & Transmission Technologies; Network Architecture and Service Models; Design issues for the Layers; OSI and TCP/IP Reference Models; Functions of layers and protocols of TCP/IP; Comparison of OSI & TCP/IP ; Data Transmission using TCP/IP.

Networking Models & Applications: Centralized, Decentralized, and Distributed; Client-Server and Peer-to-Peer; File sharing & Web- based; Content Distribution Networks.

Introduction to Example Networks: The Internet and its Conceptual View ; Accessing The Internet; Connection-Oriented Networks: X.25, Frame Relay and ATM.

Unit – II

Data Communication Concepts & Components: Digital and Analog Data and Signals, Asynchronous and Synchronous transmission; bit rate, baud, bandwidth & Channel Capacity; Nyquist Bit Rate, Shannon Capacity; Network Performance Parameters; Transmission Impairment.

Connecting Devices & Transmission Media: Network Interface Cards, Connectors, Hubs, Transceivers & Media Connectors; Link-Layer Switches, Bridge, Routers, Gateways, Virtual LANs; Guided Transmission Media; Wireless transmission; Satellite communication.

Data Encoding & Modulation Techniques: NRZ, NRZ-I, Manchester and Differential Manchester encoding; 4B/5B ; Pulse Code Modulation & Delta Modulation; Digital to Analog encoding.

Switching and Bandwidth Utilization: Methods of Switching; Virtual Circuit & Datagram Networks;

Multiplexing; Spread Spectrum.
Wired Networks and The Local Loop: Telephone Networks; Modems and Modulation Techniques; Broadband and ADSL; Internet over Cable; ADSL Versus Cable; Hybrid Fiber-Coaxial Network; Fiber-to-the-Home Broadband.

Unit – III

Data Link Layer: Communication at the Data Link Layer; Nodes and Links; Link Layer Addressing; Examples of Data Link layer protocols.
Design Issues: Framing techniques: Byte Oriented and Bit Oriented Protocols; Error Control: Error Detection and Correction; Sliding Window Flow Control Protocols.
Media Access Control: Aloha, CSMA, CSMA/CD, CSMA/CA; Collision free protocols with Controlled Access; Limited Contention Protocols; Channelization: FDMA, TDMA, CDMA; Wavelength Division Multiple access for Fiber-Optic Data Communication.
IEEE LAN standards: Ethernet (Physical specifications, Encoding, Frame Format & MAC protocol); Binary Exponential Backoff algorithm; Token Ring and FDDI.
Introduction to Wireless Networks: IEEE 802.11 Wireless LAN; Wi-Max; Bluetooth and other wireless PAN technologies & their applications; Cellular Networks: Generations; GSM & CDMA Technologies.

Unit – IV

Transport layer: Addressing, Services and Protocols; TCP and UDP services & header formats.
Network Layer : Services, Routing Algorithms: Shortest path Routing, Flooding , Distance Vector Routing, Link State Routing, Hierarchical Routing, Multi Cast Routing, Routing for Mobile hosts.
Network layer in TCP/IP: Basic characteristics of IP protocol; addressing and header format of IPv4; IPv6: Major goals& features.
Congestion Control & Quality of Service: General Principals; Congestion control in Virtual – Circuit Subnets; Congestion Control in Datagram Subnets: Choke packets, Load Shedding; Random Early Detection, Jitter Control; Over provisioning, Buffering, Traffic Shaping, Leaky bucket, token bucket, Resource Reservation, Admission Control, Packet Scheduling.

Text Books:

1. Andrew S. Tanenbaum, Computer Networks, PHI.
2. Behrouz A Forouzan, Data Communications and Networking, Mc-Graw Hill Education.

Reference Books:

1. Michael A. Gallo, William M. Hancock, Computer Communications and Networking Technologies, CENGAGE learning.
2. William Stallings, Data and Computer Communications, PHI.

MCA-20-15: Object-Oriented Analysis and Design Using UML

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: To understand the concepts of UML and its use for class modeling, state modeling, use case modeling, interaction modeling, activity modeling etc. and to analyse & design software systems using object-oriented approach.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-15.1	understand basics of modeling and fundamentals of UML such as things, relationships, diagrams, extensibility mechanisms and views;
MCA-20-15.2	to practically apply knowledge of class modeling and state modeling using object-oriented analysis and design methods with a clear emphasis on UML;
MCA-20-15.3	to practically apply knowledge of use case modeling, interaction modeling and activity modelling using UML;
MCA-20-15.4	have a working ability and grasping attitude to analyse and design software systems based on object-oriented thinking using UML.

Unit – I

Modeling as a Design Technique: Principles of modeling, abstraction, encapsulation, modularity, hierarchy, typing, concurrency, persistence of objects, purpose of modelling;

UML: Principles of modeling, UML things–structural, behavioral, grouping, annotational relationships in UML–dependency, association, generalization, realization; Overview of UML diagrams, Mechanisms in the UML– specifications, adornments, common divisions, extensibility mechanisms - stereotypes, tagged values, constraints, UML profiles, UML views.

Unit – II

Class Modeling: Object & Class, Links & Associations, Generalization & Inheritance, Association Ends-scope, visibility, Multiplicity, Rolenames, Ordering, bags & sequences, Qualified association, Aggregation, association attributes & association classes, propagation of operations, Abstract class, Metadata, reification, Constraints, derived data, packages, elements of class diagrams, constructing class diagrams.

State Modeling: Events, States, Transitions & Conditions, Activity Effects, Do-Activities, Entry & Exit Activities, Completion Transitions, Sending Signal, Elements of State diagrams, Nested state diagrams, signal generalization, concurrency, constructing state diagrams.

Unit – III

Use Case modeling: Actors, Use Cases, relationships - between actors, between use cases and between actor and use case, elements of use case diagram, constructing use case diagrams.

Interaction Modeling: Elements of sequence diagram and communication diagram, constructing sequence diagram and communication diagram;

Activity Modeling: Elements of activity diagram, constructing activity diagram.

Unit – IV

System Analysis & design: System development stages, system conception, analysis, domain class model, domain state model, iterating the analysis.

Application interaction model, application class model, application state model, adding operations

System Design: estimating performance, make are use plan, organize the system into subsystem, identifying concurrency, allocating subsystems to processors and tasks, management of data stores, handling global resources, choosing software control strategies, handling boundary conditions, setting trade-off priorities, selecting an architect style.

Class Design: bridging gap, realize use cases with operations, designing algorithms, design optimization, adjustment of inheritance, organize classes & associations.

Text Books:

1. Grady Booch, James Rumbaugh, Ivar Jacobson, The Unified Modeling Language User Guide, Pearson education.
2. M. Blaha, J. Rumbaugh, Object-Oriented Modeling and Design with UML, Pearson Education.

Reference Books:

1. J.Rumbaugh, M.Blaha, W.Premerlani, F.Eddy, W.Lorensen, Object-Oriented Modeling and Design, Prentice Hall of India.
2. Satzinger, Jackson, Burd, Object-Oriented Analysis & Design with the Unified Process, Thomson.
3. Grady Booch, Object Oriented Analysis & Design, Pearson Education.

MCA-20-21: Web Technologies

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide fundamentals concepts of Web Services, JavaScript and lays foundations for the advanced studies in the area of web services.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-21.1	design web pages using HTML5 and CSS;
MCA-20-21.2	understand objects and data validation in JavaScript;
MCA-20-21.3	build Dynamic web site using server side PHP Programming and Database connectivity;
MCA-20-21.4	create web applications with Ajax.

Unit – I

Introduction: Web browsers and its functions, web optimizations; Static page design; designing static web pages with HTML5.0-HTML basic, multimedia, Graphics, Form tags, CSS 2.0 concept and its properties & CSS 3.0 properties i.e. borders, backgrounds, fonts, text effects, Buffering, Weblog, Web Cache Poisoning.

Unit – II

JavaScript: Document Object Model (DOM), Obtaining user inputs, memory concepts, Operators, Control Structures, Looping constructs, break, continue statements, Programmer defined functions, Scoping rules, Recursion and iteration, Array declaration and allocation, passing arrays to function, Objects: String, Date, Boolean, Window, document; using cookies, form validation in Java Script, Handling Events Using JavaScript.

Unit – III

PHP: Installing and Configuring MySQL and PHP, Basic Security Guidelines, Variables, Data Types, Operators and Expressions, Constants, Flow Control Functions; Switching Flow, Loops, Code Blocks and Browser Output, Objects, Strings Processing, Form processing, Connecting to database, cookies, Session, dynamic contents.

Unit – IV

Introduction to AJAX: Exploring different web technologies, Creating a simple AJAX application, Interacting with the Web Server Using the XMLHttpRequest Object, Create an XMLHttpRequest Object, Interact with the Web Server. Differentiating AJAX and Non-AJAX application.

Working with PHP and AJAX: Introduction, Process Client Requests, Accessing Files Using PHP,

Implementing Security and Accessibility in AJAX applications: Introduction, Secure AJAX Applications, Accessible Rich Internet Applications.

Text Books:

1. Deitel H.M., Deitel P.J., Internet & World Wide Web: How to program, Pearson Education.
2. Kogent Learning, Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML, AJAX – Black Book, Wiley

India Pvt. Ltd.
Reference Books: 1. Boronczyk, Naramore, Beginning PHP, Apache, MySQL Web Development, Wiley India Pvt.Ltd. 2. Thomas Powell, Ajax: The Complete Reference Book.

MCA-20-22: Linux and Shell Programming

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objectives of this course are to provide the in-depth coverage of various concepts of Linux. Linux administration is an essential course for the students.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-22.1	understand the concepts and commands of Linux;
MCA-20-22.2	understand the file management and process manipulation in Linux;
MCA-20-22.3	understand the C environment under Linux and do the system administration and communication in Linux;
MCA-20-22.4	develop shell programs in Linux.

Unit – I

Introduction: History, Basic features, architecture, distributions. Installing Linux, Logging in / Logging out.
File System: Introduction to files, Organization, Assessing File systems, Structure - boot block, super block, inode block, data block.
Basic and Advanced Commands: Directory oriented commands, File oriented commands, File access permissions: chmod, umask, chgrp, groups. General purpose commands.

Unit – II

File management and Compression: Computer devices, Disk related commands: dd, du, df, dfspace, fdisk, compressing and uncompressing files.
Manipulating Processes and Signals:Basics, process states and transitions, zombie and orphan processes, process oriented commands. Handling foreground and background jobs. Process scheduling using cron, crontab, at, batch. Changing priority. Signal generation and Handling.
System calls: Files related system calls for opening, creating, reading, writing, relocating file descriptors, closing, duplicating file descriptors, linking, unlinking, accessing file status information, checking permissions, changing ownership, groups and permissions of files. Process related system calls: exec, fork, wait, exit.

Unit – III

System Administration: Booting and shutting down process. Creating, mounting and unmounting file systems. Managing User accounts**:** creating, modifying & deleting user accounts and groups.
Networking Tools: Communication oriented commands. ping, nslookup, telnet, arp, netstat, route, ftp, trivial file transfer protocol, finger, rlogin.
C language compiler, the make command and makefiles, general debugging techniques, debugging with gdb.

Unit – IV

Pipes and filters: Connecting processes with pipes, redirecting input and output. Filters: sort, grep, egrep, fgrep, uniq, more, pr, cut, paste, tr.

Shell Programming: Shell meaning & types; Introduction to shell scripting, shell variables, exporting shell variables, Escape mechanisms, Shell meta characters, read command, conditional statements, looping and case statements, expr statement, command line arguments, sleep and basename commands, Bourne Shell Commands, string handling, arrays, shell functions, shell programs to automate system tasks.

Text Books:

1. Harwani B.M., Unix and Shell Programming, Oxford University Press.
2. Goerzen John, Linux Programming Bible, IDG Books, New Delhi.

Reference Books:

1. Matthew Neil, Stones Richard, Beginning Linux Programming, Wiley India Pvt. Ltd.
2. Christopher Negus, Linux Bible, Wiley India Pvt. Ltd.
3. Das Sumitabha, You UNIX – The Ultimate Guide, Tata McGraw Hill
4. Richard Peterson, Linux – The Complete Reference, Tata McGraw Hill

MCA-20-23: Advanced Data Base Systems

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The aim of this course is to provide an in-depth exposure of SQL and PL/SQL to implement database management system in an organization. The course covers the variety of databases to meet real life problem scenario.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-23.1	understand database architecture, designing of databases using ER and EER model;
MCA-20-23.2	to write complex queries in SQL and can design PL/SQL blocks for database implementation;
MCA-20-23.3	learn query optimization and concurrency control techniques;
MCA-20-23.4	gain knowledge of variety of databases to meet real life problem scenario.

UNIT – I

Database Systems Concepts and Architecture: Schema and Instances, DBMS architecture and Data Independence, Database languages and Interfaces, DBMS Functions and Component Modules. Entity Relationship Model: Entity Types, Entity Sets, Attributes & keys, Relationships Types & Instances, Roles and Structural Constraints, E-R Diagrams, Design of an E-R Database Schema.

The Enhanced Entity-Relationship (EER) Model: Subclasses, Super classes, Inheritance, Specialization and Generalization.

UNIT – II

SQL: Data Definition and Data Types, DDL, DML, and DCL, Views & Queries in SQL, Specifying Constraints & Indexes in SQL. PL/SQL: Architecture of PL/SQL, Basic Elements of PL/SQL, PL/SQL Transactions, Cursors and Triggers.

Relational Database Design: Functional Dependencies, Decomposition, Normal Forms Based on Primary Keys-(1NF, 2NF, 3NF, BCNF), Multi-valued Dependencies, 4 NF, Join dependencies, 5 NF, Domain Key Normal Form.

UNIT – III

Query Processing and Optimization, Transaction Processing: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Concurrency Control Techniques: Two-Phase Locking Techniques, Timestamp Ordering, Serializability. Database Backup and Recovery: Recovery facilities, Recovery Techniques.

UNIT – IV

Databases for Advance Applications: Architecture for Parallel Database and Distributed Database, Active Database Concept and Triggers, Temporal Databases Concepts, Spatial and Multimedia Databases, Deductive Databases, Geographical Information System, Mobile Databases, Web Databases, XML Schema, Object- Based Databases, OLTP Vs OLAP.

Text Books:

1. Elmasri & Navathe: Fundamentals of Database systems, Pearson Education.
2. Ivan Bayross: SQL, PL/SQL- The Program Language of ORACLE, BPB Publication.
3. Alexis Leon & Mathews Leon: Database Management System, Leon Vikas Publication.

Reference Books:

1. Korth&Silberschatz: Database System Concept, McGraw Hill International Edition.
2. Raghu Ramakrishnan& Johannes Gehrke: Database Management Systems, Mcgraw Hill.
3. Peter Rob, Carlos Colonel: Database system Design, Implementation, and Measurement, Cengage Learning.
4. Abbey, Abramson & Corey: Oracle 8i-A Beginner's Guide, Tata McGraw Hill.

MCA-20-24(i): Principles of Programming Languages	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this paper is to make the students familiar with different elements of programming languages such as data types/operators/statements/control constructs and their implementation with the understanding that it will help them in becoming a better programmer.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-24(i).1	understand the programming language hierarchy and basics of compilation;
MCA-20-24(i).2	understand the different types of grammar;
MCA-20-24(i).3	understand the features of object oriented language and different methods of sequence control;
MCA-20-24(i).4	understand the implementation of different type of functions.

Unit – I

Preliminaries: History, Impact of Programming Paradigms, Role of Programming Languages, Good Language, Effects of Programming Environment, Translators and virtual architectures, Binding and Binding time, Language Syntax, Analysis of Program, Synthesis of Object program, Formal translation models: BNF Grammars, General parsing, Language translation, Recursive descent parsing.

Unit – II

Formal languages and automata: The Chomsky hierarchy of formal languages, regular grammars, Regular expressions, Finite State Automata, Context-free grammars, Pushdown automata, Ambiguous grammars.

Language Semantics: Attribute grammars, Denotational semantics, Program verification and validation, Data objects, variables, constants, data types, declaration, type checking, type casting, type promotion, Enumerators, Composite data types.

Unit – III

Object Orientated concepts: Structured data types, Abstract data types, Information hiding, Subprogram concepts, Good program design, Type definitions, Type equivalence, Inheritance, Derived classes, Abstract classes, Polymorphism, Inheritance and software reuse.

Sequence control: Implicit and explicit sequence control, Sequence control within arithmetic expressions, sequence control between statements, sequencing with non-arithmetic expressions, Subprogram Sequence control.

Unit – IV

Miscellaneous topics: Parameter passing techniques, Static & Dynamic Scoping, Storage of variables, Static

storage, Heap Storage management, Distributed Processing, Exceptions and Exception handlers, Co-routines, Scheduled subprograms, Parallel programming, Processor design, Hardware and Software architectures, Network Programming, Evolution of scripting languages, Applets, XML.
Text Books: 1. Pratt T.W., Zelkowitz M.V., Gopal T.V., Programming Languages Design and Implementation, Pearson Education. 2. Sebesta W. Robert, Concepts of Programming Languages, Pearson Education.
Reference Books: 1. Appleby Doris &VandeKopple J. Julius, Programming Languages-Paradigm and practice, Tata McGraw Hill. 2. Sethi Ravi, Programming Languages: Concepts & Constructs, Pearson Education. 3. Scott M., Programming Language Pragmatics, Elsevier India.

MCA-20-24 (ii) :High Performance Networks	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Highlight and Characterize the constituent features of the Internet and other communication technologies for high speed networking and demanding applications. Apprise the students with the prevalent developments in High Performance Network technologies.

Course Outcomes: At the end of this course, the student will be able to:	
MCA-20-24(ii).1	have an insight into the modern wired and wireless technologies and architectures for high speed networks from a design and performance perspective;
MCA-20-24(ii).2	understand addressing and analyze performance issues related to the Internet;
MCA-20-24(ii).3	figure out the techniques involved to support real-time traffic and congestion control in the Internet along with an exposure to the Internet and Adhoc Network routing protocols;
MCA-20-24(ii).4	analyze the architectural issues of the application level services of the Internet and will be able to do Client-server programming for applications.

Unit – I

TCP/IP Networks: Standards and Administration; Internet Structure; ISPs and Backbone Networks; Internet Architecture; Key Requirements for Efficiency of Networks: Scalable Connectivity, Cost-Effective Resource Sharing, Support for Services, Manageability; Performance Parameters for High-Speed Networks; Application Performance Needs.

Network Technologies for High-Speed Networks: Ethernet and its High speed versions, FDDI, Frame Relay Networks; SONET; DWDM; ATM: Design goals, Architecture and Logical Connection, ATM Cells, connection establishment and release, Switching, ATM Layers.

Wireless Networks: 802.11 Wireless LANs/Wi-Fi: **A**rchitecture, MAC Protocol, Frame, Mobility in the same IP subnet; LAN Interoperability; 802.16 Wireless MAN/Wi-Max: Services, Layers; **Cellular Internet Access:** Architecture, Cellular Standards and Technologies, Managing Mobility in Cellular Networks.

Unit – II

Link Layer addressing & protocols: Types of Addresses and Address Resolution Protocol (ARP); HDLC; PPP.

Network Layer Performance and Protocols in TCP/IP : Delay, Throughput, Packet Loss, Congestion Control; Internet Protocol (IPv4); Fragmentation; Type of Service; Classful and Classless addressing; Subnetting&Supernetting; DHCP; CIDR.

Private Network Interconnection: Virtual Private Network; Network Address Translation (NAT).

Next Generation IP: IPv6; ICMP; Mobile IP; Address Mapping: Multicasting & IGMP.

Unit – III

TCP/IP Transport Layer and Congestion Control: Client/Server paradigm; Peer-to-Peer Paradigm; Port numbers; TCP connection; TCP flow and congestion control; Congestion –Avoidance Mechanisms: DECbit, Random Early Detection(RED), Source-Based Congestion Avoidance; UDP services and applications; SCTP Services & Features.

Quality of Service in IP Networks: Application Requirements; Data flow characteristics; Integrated Services (RSVP); Differentiated Services ; Multiprotocol Label Switching; Real-Time Transport Protocol.

Internet Routing Protocols: Unicast Routing Protocols (RIP; OSPF; BGP); Multicast Routing and Protocols (DVMRP, MOSPF, PIM, MBGP).

Mobile Adhoc Networks: Introduction; Table-Driven and On-Demand Routing Protocols.

Unit – IV

Standard Client-Server Protocols and Applications: WWW and HTTP; Web Services; FTP connections; Electronic-Mail architecture & Security; Remote logging using TELNET.

Domain Name System: Name Space, DNS in the Internet, Caching, Resource records, messages.

Client-server programming: Application Programming Interface; Introduction to Sockets; Socket Descriptors; Ports and Connection.

Network Management: Introduction , Management Information Base (MIB); SNMP.

Text Books:

1. William Stallings, High-Speed Networks and Internets, Performance and Quality of Service". Pearson Education.
2. Peterson, L.L. & Davie, B.S. Computer networks: a systems approach. Morgan Kaufmann.
3. Jean Walrand and Pravinvariya, High performance Communication networks, Harcourt and Morgan Kauffman

Reference Books:

1. Behrouz A. Forouzan, Data Communications and Networking, Fourth Edition, McGraw Hill.
2. B Muthukumaran, Introduction to High Performance Networks, McGraw-Hill
3. Adrian Farrel, The Internet and Its Protocols: A Comparative Approach,Elsevier Science
4. Douglas E. Comer, Internetworking with TCP/IP Volume – I, Principles, Protocols, and Architectures, Pearson Education.
5. Mahbub Hassan, Raj Jain, High Performance TCP/IP Networking, Concepts, Issues, and Solutions, Pearson Education.
6. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Pearson Education.
7. Andrew S. Tanenbaum, Computer Networks, PHI.

MCA-20-24(iii): Compiler Design	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of the course is to provide in-depth coverage of underlying concepts & techniques used in compiler design and to cover major topics in compilation Theory. This course will make students ready for job assignments involving compilers and prepare students to undertake projects on compilers Construction.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-24(iii).1	understand overall process of compilation;
MCA-20-24(iii).2	understand the process of parsing in compilers;
MCA-20-24(iii).3	analyze semantic analysis, building a symbol table, handle storage management and error-detection in the process of compiler designing;
MCA-20-24(iii).4	design a compiler and understand the concept of code generation and optimization.

Unit – I

Compilers and Translators, Need of Translators, Tools used for compilation, Structure of Compiler, Single-Pass and Multi-Pass Compilers, Bootstrapping, Compiler Construction Tools, Phases of Compilation process, Classification of grammars.

Lexical Analysis: Design, Finite Automata and Regular Expressions, Process of Lexical Analysis, Lexical Analyzer generators, Derivations and parse trees.

Unit – II

Parsing Techniques: Top down Parsing- Predictive Parsers, Left Recursion and its removal, Recursive Descent Parsers, LL Grammars.

Bottom-up parsing: Shift Reduce Parsing, Operator Precedence Parsing, LR Parsers, LR grammars, Comparison of parsing methods, Parser Generators.

Unit – III

Semantic Analysis: Syntax-Directed Translation Schemes.

Building Symbol Table, Data Structures for symbol table, representing scope information.

An overview of Run-time Storage Administration.

Error Detection and Recovery: Errors, Lexical-Phase Errors, Syntactic Phase Errors, Semantic Errors.

Unit – IV

Intermediate Source Forms: Postfix Notation, Syntax Trees, Triples & Quadruples.

Code Optimization: Potential cases of Code Optimization, Optimization of basic blocks, Local and Global optimizations, Code Improving Transformation.

Code Generator: Issues in the design of a code generator.
Text Books: 1. Alfred V Aho, Principles of Compiler Design, Narosa Publishing House. 2. Jean Paul Tremblay and Sorenson, The Theory and Practice of Compiler Writing, McGraw Hill.
Reference Books: 1. Dhamdhere D.M, System programming and operating system, McGraw Hill. 2. Beck L. Leland, System Software, Pearson Education. 3. Aho, Sethi, & Ullman, Compilers Principles, Techniques and Tools, Pearson Education. 4. Fischer, Crafting a compiler in C, Pearson Education.

MCA-20-25(i): Theory of Computation	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.
Course Objectives: The objective of this course is to provide the in-depth coverage of theoretical computer science. It provides an insight about design of all types of machines and their applications.	
Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-25(i).1	design various finite state machines for real life problems;
MCA-20-25(i).2	differentiate between the applications of different kind of machines;
MCA-20-25(i).3	solve the tractable and intractable problems using various approaches;
MCA-20-25(i).4	understand the need and importance of Turing machines and their suitability.

Unit – I

Finite State Machines: Finite Automata, Designing of DFA and NDFA, NFA with E-Transitions, Equivalence of DFA and NFA with proof, Regular Expressions and Regular languages, Laws of Regular Expressions, Kleene's Theorem 1 and 2, Properties and Limitations of FSM

FSM with Output: Moore and Mealy Machines, Arden's Theorem with proof, Closure Properties of Regular Sets, Pumping Lemma for Regular Grammers, Minimization of FA.

Unit – II

Formal Grammars: Definition, Construction of Regular & Context Free Grammar, Derivation, Parse Trees, Ambiguity, Removal of Ambiguity, Simplification of Context Free Grammar, CNF and GNF, Closure properties of CFL, Pumping Lemma for CFL.

Pushdown Automaton: Introduction, Types of PDA, Designing of PDA's, Conversion from PDA to CFG and vice-versa.

Unit – III

Linear Bounded Automata (LBA), Turing Machines (TM), General Model of Computation, TM as Language Acceptors, TM as Computing Partial Functions, Combining TM, Multi-Tape TM, Restricted and Universal TM; TM and Computers.

Recursive and recursively-enumerable languages and Properties, More General Grammars

Unit – IV

Reductions and the Halting Problem, Post's correspondence problem, Rice's theorem, Cook's Theorem, decidability of membership, emptiness and equivalence problems of languages, Decidable languages and problems, Diagonalization method.

Computable Functions: Primitive recursive functions, Godel Numbering, Tractable and Intractable problems, Computable Complexity.

Text Books:

1. John C. Martin, Introduction to Languages and the Theory of Computation, McGraw Hill.
2. Peter Linz, An introduction to formal language & automata, Jones & Bartlett publications.

Reference Books:

1. Hopcroft J. E. & Ullman J. D, Formal languages and their relation to Automata, Pearson Education.
2. Lewis, H.R. & Papadimitrious, C. H., Elements of the theory of computation. PHI Learning.
3. Michael Sipser, Introduction to the Theory of Computation, Cengage Learning.

MCA-20-25 (ii): Design and Analysis of Algorithms	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.
Course Objectives: The objective of this course is to provide the in-depth coverage of various algorithm design techniques. It focuses on various problems and their solutions using different algorithm design techniques.	
Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-25(ii).1	understand the complexity of problems and apply the solutions accordingly;
MCA-20-25(ii).2	categorize problems based on their characteristics and practical importance;
MCA-20-25(ii).3	design solutions to problems using various algorithmic techniques;
MCA-20-25(ii).4	classifying and solving problems as P, NP or NP Complete.

Unit – I

Introduction: Algorithms, Role of algorithms in computing, Analysing algorithms, Designing algorithms, Asymptotic notations.

Divide and Conquer: Solving recurrence equations: Back substitution method, Recursion tree method, Masters theorem.

Probabilistic Analysis and Randomized Algorithms: The hiring problem, Indicator random variables, Randomized algorithms, Probabilistic analysis and further uses of indicator random variables

Unit – II

Trees: Red-black trees and Splay trees.

Dynamic Programming (DP): Elements of DP, Matrix chain multiplication, Longest common subsequence, optimal binary search trees.

Greedy Techniques (GT): Elements of GT, Activity selection problem, Huffman codes, Knapsack Problem.

Unit – III

Graph Algorithms: Topological sort, Strongly connected components, Single source shortest path: Analysis of Dijkstra's Algorithm, Limitations of Dijkstra's Algorithm, Negative weight cycle, Bellman-Ford algorithm. All Pairs Shortest Path: Relation of Shortest path and matrix multiplication, Analysis of Floyd Warshall algorithm. Maximum Flow: Flow network, Ford-Fulkerson method.

Strings: Storage of strings, Naive string-matching algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm

Unit – IV

Computational Geometry: Line-segment properties, Convex hull, Closest pair of points.

Computational complexity: Notion of Polynomial time algorithms, Complexity classes: P, NP, NP-Hard and NP-Complete, Polynomial time verification, Reducibility, NP-Completeness, Examples of NP-Complete and

NP-Hard problems: Traveling Salesman Problem, Knapsack, Bin Packing, Satisfiability, Vertex Cover, Clique, Independent Set.

Text Books:

1. Cormen, Leiserson, Rivest, Introduction to Algorithms, PHI India.
2. Neapolitan R., Foundations of Algorithms, Jones and Bartlett Learning.

Reference Books:

1.. Cooper A., Computability Theory, Chapman and Hall/ CRC Press.
2. A.V.Aho, J.E.Hopcroft, and J.D.Ullman, The Design and Analysis of Computer Algorithms, Pearson Education India
3. AnanyLevitin: Introduction to the Design and Analysis of Algorithms, Pearson Education.
4. R.C.T Lee, S.S. Tseng, R.C. Chang, Y.T. Tsai, Introduction to Design and Analysis of Algorithms: A Strategic Approach, Tata McGraw Hill
5. Steven Skiena, The Algorithm Design Manual, Springer India.

MCA-20-25 (iii): Security in Computing

Type: Elective
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30(i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40(i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide the coverage of various security parameters and vulnerabilities. This course enables the students to handle various security issues in real-world.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-25 (iii).1	learn the concepts of computer security and various cryptographic techniques for securing a system;
MCA-20-25 (iii).2	understand the concepts of database security and various network security controls;
MCA-20-25 (iii).3	get familiar with various Internet security protocols;
MCA-20-25 (iii).4	understand various physical security breaches and Intellectual property rights.

Unit – I

Computer Security Concepts, Threats, Attacks and Assets, Security Functional Requirements, Security Architecture and Scope of Computer Security, Computer Security Trends and Strategies. Cryptography: Terminology and Background, Substitution Ciphers, Transpositions, Cryptanalysis,
Program Security: Secure Program, Non-malicious Program Error, Viruses and other Malicious Code, Targeted Malicious Code, Control against Program Threats.

Unit – II

Database Security: Database Management System, Relational Databases, Database Access Control, Inference, Security Requirements, Reliability and Integrity, Sensitive Data, Database Encryption.
Network Security: Threats in Network, Network Security Controls, and Firewall- Need for firewall, Characteristics, Types of firewall, Firewall Basing, Intrusion Detection System- Types, Goals of IDS, IDS strengths and Limitations.

Unit – III

Internet Security Protocols and Standards: Secure Socket Layer (SSL) and Transport Layer Security (TLS), IPv4 and IPv6 Security, Kerberos 672, X.509, Public Key Infrastructure.
Linux Security Model, File System Security, Linux Vulnerability, Linux System Hardening, Application Security. Window Security Architecture, Windows Vulnerability, Windows Security Defense, Browser Defenses.

Unit – IV

Physical Security Threats, Physical Security Prevention and Mitigation Measures, Recovery form Physical Security Breaches, Security Auditing Architecture, Security Audit Trail, Security Risk assessment, Security Controls or Safeguard, IT Security Plan, Implementation of Controls, Cybercrime and Computer Crime, Intellectual Property, Privacy, Ethical Issues.

Text Books:

1. Charles. P. Pfleeger & Shari Lawrence Pfleeger, Security in Computing, Pearson Education.

Reference Books:

1. William Stalling, Lawrie Brown, Computer Security Principles and Practice, Pearson Education.
2. Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill Education

MCA-20-31: Computer Architecture and Parallel Processing

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: To know parallel processing and new trends and developments in computer architectures. Understand design and development of ILP based processors and evaluate their performance. Understand MIMD architectures and different topologies used in these architectures. Study the cache coherence problems and their solutions.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-31.1	learn the concepts of parallel architectures and exploitation of parallelism at instruction level;
MCA-20-31.2	understand architectural features of multi-issue ILP processors;
MCA-20-31.3	learn MIMD architectures and interconnection networks used in them and evaluate their comparative performances;
MCA-20-31.4	analyze causes of cache coherence problem and learn algorithm for its solution.

Unit – I

Computational Model: Basic computational models, evolution and interpretation of computer architecture, concept of computer architecture as a multilevel hierarchical framework. Classification of parallel architectures, Relationships between programming languages and parallel architectures

Parallel Processing: Types and levels of parallelism, Instruction Level Parallel (ILP) processors, dependencies between instructions, principle and general structure of pipelines, performance measures of pipeline, pipelined processing of integer, Boolean, load and store instructions, VLIW architecture, Code Scheduling for ILP-Processors - Basic block scheduling, loop scheduling, global scheduling.

Unit – II

Superscalar Processors: Emergence of superscalar processors, Tasks of superscalar processing – parallel decoding, superscalar instruction issue, shelving, register renaming, parallel execution, preserving sequential consistency of instruction execution and exception processing, comparison of VLIW & superscalar processors Branch Handling: Branch problem, Approaches to branch handling – delayed branching, branch detection and prediction schemes, branch penalties and schemes to reduce them, multiway branches, guarded execution.

Unit – III

MIMD Architectures: Concepts of distributed and shared memory MIMD architectures, UMA, NUMA, CC-NUMA & COMA models, problems of scalable computers.

Direct Interconnection Networks: Linear array, ring, chordal rings, star, tree, 2D mesh, barrel shifter,

hypercubes.

Unit – IV

Dynamic interconnection networks: single shared buses, comparison of bandwidths of locked, pended & split transaction buses, arbiter logics, crossbar, multistage networks – omega, butterfly

Cache coherence problem, hardware based protocols – snoopy cache protocol, directory schemes, hierarchical cache coherence protocols.

Text Books:

1. Sima, Fountain, Kacsuk, Advanced Computer Architecture, Pearson Education.
2. D. A. Patterson and J. L. Hennessey, Computer Architecture – A Quantitative Approach, Elsevier India.

Reference Books:

1. Kai Hwang, Advanced Computer Architecture, McGraw Hill.
2. Nicholas Carter, Computer Architecture, McGraw Hill.
3. Harry F. Jordan, Gita Alaghband, Fundamentals of Parallel Processing, Pearson Education.

MCA-20-32: Data Mining and Integration using R

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide the in- depth coverage of data mining and integration aspects along with its implementation in R programming language.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-32.1	understand the fundamental concepts of data warehousing and data mining;
MCA-20-32.2	acquire skills to implement data mining techniques;
MCA-20-32.3	learn schema matching, mapping and integration strategies;
MCA-20-32.4	implement data mining techniques in R to meet the market job requirements.

UNIT – I

Data Warehouse: A Brief History, Characteristics, Architecture for a Data Warehouse. Data Mining: Introduction: Motivation, Importance, Knowledge Discovery Process, Data Mining Functionalities, Interesting Patterns, Classification of Data Mining Systems, Major issues, Data Preprocessing: Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization, Outliers.

UNIT – II

Data Mining Techniques: Clustering- Requirement for Cluster Analysis, Clustering Methods- Partitioning Methods, Hierarchical Methods, Decision Tree- Decision Tree Induction, Attribute Selection Measures, Tree Pruning. Association Rule Mining- Market Basket Analysis, Frequent Itemset Mining using Apriori Algorithm, Improving the Efficiency of Apriori. Concept of Nearest Neighborhood and Neural Networks.

UNIT – III

Data Integration: Architecture of Data Integration, Describing Data Sources: Overview and Desiderate, Schema Mapping Language, Access Pattern Limitations, String Matching: Similarity Measures, Scaling Up String Matching, Schema Matching and Mapping: Problem Definition, Challenges, Matching and Mapping Systems, Data Matching: Rule- Based Matching, Learning- Based Matching, Matching by Clustering.

UNIT – IV

R Programming: Advantages of R over other Programming Languages, Working with Directories and Data Types in R, Control Statements, Loops, Data Manipulation and integration in R, Exploring Data in R: Data Frames, R Functions for Data in Data Frame, Loading Data Frames, Decision Tree packages in R, Issues in Decision Tree Learning, Hierarchical and K-means Clustering functions in R, Mining Algorithm interfaces in R.

Text Books:

1. J Hanes, M. Kamber, Data Mining Concepts and Techniques, Elsevier India.
2. A.Doan, A. Halevy, Z. Ives, Principles of Data Integration, Morgan Kaufmann Publishers.
3. S. Acharya, Data Analytics Using R, McGraw Hill Education (India) Private Limited.

Reference Books:

1. G.S. Linoff, M.J.A. Berry, Data Mining Techniques, Wiley India Pvt. Ltd.
2. Berson, S.J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw-Hill.
3. J.Horbulyk, Data Integration Best Practices.
4. Jared P. Lander, R For Everyone, Pearson India Education Services Pvt. Ltd.

MCA-20-33: Artificial Intelligence	
Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.
Course Objectives: The objective of this course is to provide the in-depth coverage of Artificial Intelligence techniques and their applications. It focuses on various search techniques and expert systems along with other parts of artificial intelligence in computer science.	
Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-33.1	understand the different knowledge representation schemes specially FOPL;
MCA-20-33.2	apply various search methods to solve AI problems efficiently;
MCA-20-33.3	understand the Expert System and techniques to manage the uncertainty in Expert Systems;
MCA-20-33.4	understand the learning techniques and Genetic Algorithm.
Unit – I Introduction: Background and history, Overview of AI applications areas. The predicate calculus: Syntax and semantic for propositional logic and FOPL, Clausal form, inference rules, resolution and unification. Knowledge representation: Network representation-Associative network & conceptual graphs, Structured representation- Frames & Scripts.	
Unit – II Search strategies: Strategies for state space search-data driven and goal driven search; Search algorithms-uninformed search (depth first, breadth first, depth first with iterative deepening) and informed search (Hill climbing, best first, A* algorithm, mini-max etc.), computational complexity, Properties of search algorithms - Admissibility, Monotonicity, Optimality, Dominance.	
Unit – III Production system: Types of production system-commutative and non-commutative production systems, Decomposable and non-decomposable production systems, Control of search in production systems. Rule based expert systems: Architecture, development, managing uncertainty in expert systems - Bayesian probability theory, Stanford certainty factor algebra, Nonmonotonic logic and reasoning with beliefs, Fuzzy logic, Dempster/Shaffer and other approaches to uncertainty.	
Unit – IV Knowledge acquisition: Types of learning, learning by automata, intelligent editors, learning by induction. Genetic algorithms: Problem representation, Encoding Schemes, Operators: Selection, Crossover, Mutation, Replacement etc.	

Text Books:

1. George F. Luger, Artificial Intelligence, Pearson Education.
2. Dan W. Patterson Introduction to Artificial Intelligence and Expert system, PHI.

Reference Books:

1. Ben Coppin, Artificial Intelligence Illuminated, Narosa Publishing House.
2. Eugene Charniak, Drew McDermott Introduction to Artificial Intelligence, Pearson Education.
3. Nils J. Nilsson Principles of Artificial Intelligence, Narosa Publishing House.
4. Jackson Peter, Introduction to Expert systems, Pearson-Education.

MCA-20-34 (i): Cloud Computing and IoT

Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: To study the fundamental concepts of cloud computing, enabling technologies, cloud service models and security concerns. To learn core issues of Internet of Things, IOT communication protocols and security concerns.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-34(i).1	understand core issues of cloud computing and enabling technologies;
MCA-20-34(i).2	design services based on cloud computing platforms;
MCA-20-34(i).3	understand concepts, architecture, applications and design principles for connected devices in IoT;
MCA-20-34(i).4	explain, analyze and design IoT-oriented communication protocols and security concerns.

Unit – I

Cloud Computing: Definition, roots of cloud computing, characteristics, cloud architecture, deployment models, service models.

Virtualization: benefits & drawbacks of virtualization, server virtualization, virtualization of - operating system, platform, CPU, network, application, memory and I/O devices etc.

Unit – II

Cloud Computing Service Platforms – compute services, storage services, database services, application services, queuing services, e-mail services, notification services, media services, content delivery services, analytics services, deployment & management services, identity & access management services and their case studies.

Security in cloud computing: issues, threats, data security and information security

Unit – III

Internet of Thing (IoT): overview, conceptual framework, architecture, major components, common applications Design principles for connected devices: Modified OSI Model for IoT/M2M systems, ETSI M2M Domains and High-level capabilities, wireless communication technologies - NFC, RFID, Bluetooth BR/EDR and Bluetooth low energy, ZigBee, WiFi, RF transceiver and RF modules. Data enrichment, data consolidation & device management at gateway.

Unit – IV

Design principles for web connectivity: web communication protocols for connected devices: constrained application protocol, CoAP Client web connectivity, client authentication, lightweight M2M communication protocol. Message communication protocols for connected devices - CoAP-SMS, CoAP-MQ, MQTT, XMPP.

IoT privacy, security and vulnerabilities and their solutions.

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, Cloud Computing – A Hands-on Approach, University Press.
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing – Principles and Paradigms, Wiley India Pvt. Ltd.
3. Raj Kamal, Internet of Things - Architecture and Design Principles, McGraw Hills

Reference Books:

1. Kai Hwang, Geoffrey C.Fox, and Jack J. Dongarra, Distributed and Cloud Computing, Elsevier India Private Limited
2. Saurabh Kumar, Cloud Computing, Wiley India Pvt. Ltd.
3. Shailendra Singh, Cloud Computing, Oxford
4. Coulouris, Dollimore and Kindber, Distributed System: Concept and Design, Addison Wesley
5. Michael Miller, Cloud Computing, Dorling Kindersley India
6. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, Cloud computing: A practical Approach, McGraw Hill
7. Dimitrios Serpnos, Marilyn Wolf, Internet of Things (IoT) Systems, Architecture, Algorithms, Methodologies, Springer
8. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on Approach), VPT
9. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Apress Publications

MCA-20-34(ii): Cyber Security

Type: Elective
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30(i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40(i.e. 40%)

Instructions to paper setter for End semester examination: Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The course has been designed to give students an extensive overview of cyber security issues, tools and techniques that are critical in solving problems in cyber security domains.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-34(ii).1	learn various challenges and constraints in cyber security;
MCA-20-34(ii).2	learn IT ACT (Cyber law) to the given case/problem and analyze it;
MCA-20-34(ii).3	understand the need for Computer Cyber forensics;
MCA-20-34(ii).4	demonstrate the network defence tools to provide security of information.

Unit- I

Introduction to Cyber Security: Overview of Cyber Security, Internet Governance: Challenges and Constraints, Cyber Threats, Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, International convention on Cyberspace.

Unit – II

Introduction to Cybercrime and Laws: Origins of Cybercrime, Classifications of Cybercrimes, information Security, Cybercriminals, Criminals Plan for Attacks, Cybercafe, Botnets, Attack Vector, The Indian IT ACT 2000 and amendments.

Tools and Methods used in Cybercrime: Introduction, Proxy Server and Anonymizers, Password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, DOS and DDOS attack, SQLinjection.

Unit – III

Phishing and Identity Theft: Introduction to Phishing, Methods of Phishing, Phishing Techniques, Phishing Toolkits and Spy Phishing. Identity Theft: PII, Types of Identity Theft, Techniques of ID Theft. Digital Forensics Science, Need for Computer Cyber forensics and Digital Evidence, Digital Forensics Life Cycle.

Introduction to Intellectual Property Law – The Evolutionary Past - The IPR Tool Kit- Para -Legal Tasks in Intellectual Property Law – Ethical obligations in Para Legal Tasks in Intellectual Property Law –types of intellectual property rights.

Unit – IV

Network Defence tools: Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, Virtual Private Networks, Linux Firewall, Windows Firewall, Snort Detection System, Introduction to block chain technology and its applications.

Text Books:

1. Mike Shema, Anti-Hacker Tool Kit (Indian Edition), Publication McGraw Hill.
2. Nina Godbole and SunitBelpure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Publication Wiley.

Reference Books:

1. Marjie T. Britz, Computer Forensics and Cyber Crime: An Introduction, Pearson Education
2. Chwan-Hwa (John) Wu,J. David Irwin, Introduction to Computer Networks and Cyber security, CRC Press
3. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide to Computer Forensics and Investigations, Cengage Learning
4. Debirag E.Bouchoux, Intellectual Property, Cengage Learning.

MCA-20-34 (iii): Digital Marketing	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.
Course Objectives: The purpose of this syllabus is to make students aware about the basics of marketing. The course discusses about the important role of Digital Marketing in present age of Information Technology.	
Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-34 (iii).1	understand basics of marketing and digital marketing;
MCA-20-34 (iii).2	analyse the role of search engine in improving digital marketing and understand about the basics and importance of email marketing;
MCA-20-34 (iii).3	analyse role of social media marketing for the given problem;
MCA-20-34 (iii).4	understand about the basics and importance of web marketing and mobile marketing.

Unit – I

Introduction to Marketing, Importance and Scope of Marketing, Elements of Marketing - Needs, Wants, Demands, Consumer, Markets and Marketers; Marketing vs. Sales. Introduction to Digital Marketing, Benefits & Opportunity of Digital Marketing, Inbound and Outbound Marketing, Content Marketing, Understanding Traffic, Understanding Leads, Digital Marketing use in 'Business to Business' (B2B), 'Business to Consumer' (B2C) and 'Not-for Profit' marketing

Unit – II

Search Marketing (SEO): Introduction to Search Engine , Search Engine Optimization (SEO), importance of SEO for business websites, Search Results & Positioning, Benefits of Search Positioning, Role of Keywords in SEO, Meta Tags and Meta Description, On-page & Off-page optimization, Back Link, Internal & External Links, Ranking, SEO Site Map, Steps for B2B SEO and B2C SEO, Advantages & Disadvantages of SEO

Email Marketing: Introduction to Email Marketing, Elements of Email, Email List Generation, Email Structure, Email Delivery, Online Data Capture, Off Line data Capture, Creating an Email campaign, Campaign Measurement, Concept of A/B testing & its use in email marketing.

Unit – III

Digital Display Advertising: Concepts, Benefits, Challenges, Ad Formats, Ad Features, Ad Display Frequency. Overview of Google AdWords.

Social Media Marketing: Key Concepts, Different Social Media Channels – Facebook, YouTube, Twitter, Instagram, Business Page- Setup and Profile, Social Media Content, Impact of Social Media on SEO, Basic concepts – CPC, PPC, CPM, CTR, CR. Importance of Landing Page. How to create & test landing Pages. User Generated Content (Wikipedia etc.), Multi-media - Video (Video Streaming, YouTube etc), Multi-media - Audio & Podcasting (iTunes etc), Multimedia - Photos/Images (Flickr etc).

Unit – IV

Introduction to Mobile Marketing, Overview of the B2B and B2C Mobile Marketing, Use of Mobile Sites, Apps (Applications) and Widgets, Overview of Blogging Web Analytics: Introduction to Web Analytics, Web Analytics – Types & Levels, Introduction of Analytics Tools and it's use case (Google Analytics and others), Analytics Reporting, Traffic and Behaviour Report, Evaluate Conversions.

Text Books:

1. Stanton William J., Fundamentals of Marketing, McGraw Hill, N. Delhi.
2. VandanaAhuja, Digital Marketing, Oxford Higher Education.
3. Seema Gupta, Digital Marketing, McGrawHill

Reference Books:

1. Kotler Philip & Armstrong Graw, Principles of Marketing, Pearson Education, New Delhi.
2. Neelamegham S., Indian Cases in Marketing, Vikas Publication, New Delhi.
3. Ian Dodson, The Art of Digital Marketing, Wiley.
4. Puneet Singh Bhatia, Fundamentals of Digital Marketing, Pearson Education.

MCA-20-35(i) Advances in JAVA

Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The course develops programming ability of students to create dynamic web applications using server side technology with Java Database Connectivity. Students can learn networking and remote method invocation using Java API. Advanced Java features will increase ability of students in web application development.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-35(i).1	develop programming using AWT, Layout, Menu and Frames;
MCA-20-35(i).2	gain the knowledge of Server Side programming by implementing Servlet and write the deployment descriptor and enterprise application deployment;
MCA-20-35(i).3	design and Develop various application using JSPs;
MCA-20-35(i).4	learn to access database through Java programs, using Java Data Base Connectivity (JDBC).

UNIT-I

GUI Programming: AWT Classes, AWT Controls, AWT Button, AWT Label, AWT TextField, AWT TextArea, AWT Checkbox, AWTCheckboxGroup, AWT Choice, AWT List, AWT Scrollbar, AWT MenuItem& Menu, AWT PopupMenu, AWT Panel, MouseListener, MouseMotionListener, Java ItemListener, Java KeyListener, Java WindowListener. Adapter Classes, Layout managers; Grid Layout, Flow Layout, Card Layout, Border Layout, Menus, Java Frames.

UNIT-II

Servlet API and Overview: Servlet Introduction, Servlet Life Cycle, Types of Servlet, Servlet Configuration with Deployment Descriptor, Working with ServletContext and ServletConfig Object, Attributes in Servelt, Response and Redirection using Request Dispacher and using sendRedirect Method, Filter API, Manipulating Responses using Filter API, Session Tracking: using Cookies, HTTPSession, Hidden Form Fields and URL Rewriting,Types of Servlet Event: ContextLevel andSessionLevel.

UNIT-III

Java Server Pages: Introduction to JSP , Comparison with Servlet, JSP Architecture, JSP Life Cycle, JSP Scripting Elements, JSP Directives, JSP Action, JSP Implicit Objects, JSP Expression Language, JSP Standard Tag Libraries, JSP Custom Tag, JSP Session Management, JSP Exception Handling, MVC in JSP, Custom tags; Attributes, Iteration, Custom URI.

UNIT-IV

JDBC Programming: JDBC Architecture, Types of JDBC Drivers, Introduction to major JDBC Classes and Interface, Creating simple JDBC Application, Types of Statement (Statement Interface, Prepared Statement, Callable Statement), Exploring ResultSet Operations, Batch Updates in JDBC, Managing Database Transaction.

Text Books:-

1. Patrick Naughton, Herbert, Schild, The Complete reference Java 2, Tata Mc-Graw Hill.
2. Kathy walrath, Java server programming, J2EE, Black Book, Dream Tech Publishers.
3. Subrahmanyam Allamaraju, Cedric Buest, Professional Java Server Programming, Wiley Publication.

Reference Books:

1. Michael Morgan, Java 2 for Professionals Developers, SAMS Techmedia, New Delhi, India
2. Kito D. Mann,Java Server Faces in Action, Manning Publication
3. Maydene Fisher, Jon Ellis, Jonathan Bruce,JDBC™ API Tutorial and Reference, Addison Wesley.
4. GiulioZambon, Beginning JSP, JSF andTomcat, Apress.

MCA-20-35 (ii):Advanced Web Technologies

Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide the coverage of advanced technologies used in the design and development of web based applications such as Ajax/Node JS/Angular JS etc.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-35 (ii).1	apply various jQuerymethods in building UI projects;
MCA-20-35 (ii).2	design single-page applications using Angular JS;
MCA-20-35 (ii).3	handle the HTTP request by using Node JS;
MCA-20-35 (ii).4	manage and optimize the web applications.

Unit – I

Advanced Client side programming: Fundamentals of jQuery, Element Selector, Document ready function, Events, jQuery UI, Unobtrusive client validation, working with AJAX and jQuery.
Feature detection: Browser detection, Feature detection, Modernizer.

Unit – II

Introduction to AngularJS: Controllers, Models, Directives and Services, Single Page Applications, Angular User Interfaces: Angular Forms, Using Angular with Angular UI and Angular Bootstrap, Angular Services, Developing Custom Directives, Enhanced End-to End Testing.

Unit – III

Introduction to Node JS: Node JS process model, Advantages, Traditional web server model. Setup Install Node.js on windows, REPL, Node JS console, Node JS modules, Events: Event Emitter class, inheriting events, Node Package Manager, Creating web server: handling http requests, sending requests, File System, Debugging Node JS application, Database Connectivity.

Unit – IV

Search engines: Searching techniques used by search engines, keywords, advertisements, Search engine optimization for individual web pages: header entries, tags, selection of URL, alt tags, Search engine optimization for entire website: Hyperlinks and link structure, page rank of Google, click rate, residence time of website, frames, scripts, content management system, cookies, robots, Pitfalls in Optimization: optimization and testing, keyword density, doorway pages, duplicate contents, quick change of topics, broken links, poor readability, rigid layouts, navigation styles.

Text Books:

1. Shyam Seshadri & Brad Green, AngularJS: Up and Running, O'Relly.
2. Peter Smith, Professional Website performance, Wiley India Pvt. Ltd.

Reference Books:

1. Brad Dayley, Node.js, MongoDB, and AngularJS Web Development (Developer's Library), Addison Wesley.
2. Simon Holmes, Getting MEAN with Mongo, Express, Angular, and Node, Manning Publications.
3. Black Book, HTML5, Dreamtech Press.
4. Maro Fischer, Website Boosting: Search Engine, Optimization, Usability, Website Marketing, Firewall Media, New Delhi.

MCA-20-35(iii): Programming with Kotlin	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.
Course Objectives: The objective of this paper is to make the students familiar with the Programming Language Kotlin so that they shall be able to design the Mobile Applications.	
Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-35(iii).1	understand the different collection implementation using Kotlin;
MCA-20-35(iii).2	implement different types of functions;
MCA-20-35(iii).3	understand the concepts of classes and interfaces and implement them;
MCA-20-35(iii).4	design and develop Android using Kotlin.
Unit – I Variables and Data types, Handling of Strings, Arrays: Generic arrays, arrays of primitives, List, Map and Set. Ranges, Null safety: Nullable and Non-nullable types, Elvis operator (?:)	
Unit – II Conditional Statements: if, when; Loops in Kotlin: for, repeat, while; break and continue. Functions: Inline Function, Lambda Functions, Function Reference, Vararg parameters in Functions.	
Unit – III Class: Final class, open class, Inheritance: inheriting methods and fields from a class, Overriding properties and methods, Visibility modifiers, Abstract class, Data Class, Enum class, Sealed class, Nested class, Inner class, Interfaces, Programming asynchronous applications with Coroutines, Annotations.	
Unit – IV Exception Handling: Try, Catch, Finally block, Throw. Android development using Kotlin. Views: TextView, EditView, ScrollView, ImageView, ListView, Recycler view etc. Android UI Layouts: Linear, Relative and Constraint, Creating Activities, Intents and Fragments.	
Text Books: 1. Sommerhoff Peter, Kotlin for Android App Development, Pearson. 2. VenkatSubramaniam, Programming Kotlin, Pragmatic Bookshelf.	
Reference Books: 1. Stephen Samuel & Stefan Bocutiu, Programming Kotlin, Packt Publishing Ltd. 2. Antonio Leiva, Kotlin for Android Developers, Leanpub. 3. MarcinMoskala & Igor Wojda, Android Development with Kotlin, Packt Publishing Ltd.	

MCA-20-41: Big Data and Pattern Recognition

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The aim of this course is to develop knowledge of big data tools including MapReduce, NoSQL and Hadoop. The course provides an idea about data analysis; pattern recognition approaches and gives the practical exposure of NoSQL.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-41.1	understand Big Data strategies in Big Data Environment;
MCA-20-41.2	learn Basics of HDFS and Learn map-reduce analytics using Hadoop;
MCA-20-41.3	acquire knowledge of pattern recognition approaches and methods;
MCA-20-41.4	to develop solutions in NoSQL to meet the current job requirements.

UNIT – I

Understanding Big Data: Concepts and Terminology, Big Data Characteristics, Different Types of Data, Identifying Data Characteristics, Business Motivations and Drivers for Big Data Adoption: Business Architecture, Business Process Management, Information and Communication Technology, Big Data Analytics Lifecycle, Enterprise Technologies and Big Data Business Intelligence, Industry examples of big data.

UNIT – II

Data Governance for Big Data Analytics: Evolution of Data Governance, Big Data and Data Governance, Big Datasets, Big Data Oversight, Big Data Tools and Techniques: HDFS, Map Reduce, YARN, Zookeeper, HBase, HIVE, Pig, Mahout, Developing Big Data Applications, Stepwise Approach to Big Data Analysis, Big Data Failure: Failure is common, Failed Standards, Legalities.

UNIT – III

Data Analysis and Pattern Recognition: Quantitative and Qualitative Analysis, Pattern Recognition Systems, Fundamental Problems in Pattern Recognition, Feature Extraction and Reduction, Paradigms, Pattern Recognition Approaches, Importance and Applications. Data Domain for Pattern Recognition. Pattern Recognition using Nearest Neighbour Classifier and Modeling an AND Gate Neural Nets.

UNIT – IV

An Overview of NoSQL, Characteristics of NoSQL, NoSQL Storage Types, Introduction of NoSQL Products, NoSQL Data Management for Big Data: Schema Less Models, Key-Value Stores, Document Stores, Tabular Stores, Object Data Stores, Graph databases, NoSQL Misconceptions, NoSQL over RDBMS.

Text Books:

1. Thomas Erl, WajidKhattak and Paul Buhler, Big Data Fundamentals Concepts, Drivers & Techniques

Prentice Hall.
2. David Loshin, Big Data Analytics from Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph Morgan Kaufmann.
3. Jules J. Berman, Principles of Big Data Preparing, Sharing and Analyzing Complex Information, Morgan Kaufmann.
4. GauravVaish, Getting Started with NoSQL, Packt Publishing.
5. RajjanShinghal, Pattern Recognition Techniques and Applications, Oxford Higher Education.

Reference Books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer.
2. Jay Liebowitz, Big Data and Business Analytics, Auerbach Publications, CRC press.
3. Pete Warden, Big Data Glossary, O'Reily.
4. Michael Mineli, Michele Chambers, AmbigaDhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley Publications.

MCA-20-42:Computer Graphics and Animation

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Provide an introduction to the theory and practice of Computer Graphics and Animation. Provide an insight to applications of Graphics and the graphics hardware devices and software used. Introduce the principles needed to design a graphics system and the algorithms related with them.

Course Outcomes: At the end of this course, the student will be able to:	
MCA-20-42.1	have a knowledge of graphics applications and components and devices required to support the applications;
MCA-20-42.2	develop algorithms for scan converting geometrical primitives such as lines, circles, ellipses, and curves along with algorithms for filling polygons, required for designing real-world applications;
MCA-20-42.3	design algorithms for carrying out manipulations in pictures using geometric transformations, viewing transformations , and clipping operations;
MCA-20-42.4	model 3-dimensional objects and apply viewing, visible –surface determination, and shading techniques to the models for achieving realism. The student will also learn to design and develop animation sequences.

Unit – I

Introduction to Computer Graphics and its Components: Overview of Computer Graphics, its functions & elements; Introduction to GUI, Computer Vision, Augmented Reality and other Applications of Graphics; Popular Graphics Software; Components and Working of Interactive Graphics; Raster Scan and Random Scan systems and Display Processors; Look-up table; Loading the Frame Buffer; Coordinate Systems.

Graphics Devices: Display Technologies: Resolution, Aspect Ratio, Refresh CRT , Color CRT , Flat Panel Displays; Interactive Input Devices for Graphics , Image and Video Input Devices.

Unit – II

Scan Conversion: Drawing Geometry; Output Primitives; Lines and Pixel Graphics; AntiAliasing; Scan Converting Lines: DDA line drawing algorithms, Bresenham's line Algorithm; Scan Converting Circles: Polynomial method for circle drawing, circle drawing using polar coordinates, Bresenham's circle drawing; Algorithms for Generation of ellipse; Line Styles; Generation of Bar Charts, Pie-Charts.

Curve Representation: Parametric Curves, Parametric Representation of a Circle, Parametric representation of cubic curves, drawing Bezier curves.

Filled-Area Primitives: Basic Stack based fill algorithms: Flood fill algorithm, Boundary fill algorithm; Scan-line polygon fill algorithm and its computational structures.

Unit – III

Two-Dimensional Transformations: Coordinate and Geometric Transformations; Translation, Rotation,

Scaling; Matrix representations and Homogeneous coordinates, Composite transformations, General Pivot Point rotation, General Fixed Point Scaling, Shearing; Reflection ; Reflection about an arbitrary line.
2-D Viewing: Viewing pipeline; Window, Viewport, Window-to-Viewport transformation; Zooming, Panning; Pointing and Positioning techniques; Rubber band technique; Dragging.
Clipping operations: Point and Line clipping, Cohen-Sutherland line clipping, Mid-Point Subdivision line clipping, Liang-Barsky line clipping, Sutherland-Hodgman polygon clipping; Weiler-Atherton polygon clipping.

Unit – IV

3-D Graphics & Modeling: Visualization techniques for Realism; 3D Object Representation; Solid Model Representation Schemes; Euclidean Geometry methods: Regularized Boolean Set Operations, Primitive Instancing, Boundary Representations, Curved lines and surfaces, Sweep Representations, Spatial-Partitioning Representations - Octree representation, Constructive Solid Geometry; Procedural Methods: Fractals, Shape Grammars, Particle systems, Physically Based modeling, Visualization techniques; 3D transformations.
Three-Dimensional Viewing: Viewing Pipeline**; P**arallel Projection: Orthographic and Oblique Projection; Perspective Projection.
Visible-Surface Determination: Z-buffer, Depth-Sorting, Area Subdivision, BSP-Tree method; Ray casting.
Illumination and Shading: Modeling Light Intensities; Basic Illumination Models; Gouraud Shading; Phong Shading.
Introduction to Animation: Designing of Animation Sequences; Key-Frame Systems; Animation Techniques: Tweening, Morphing.

Text Books:

1. Donald Hearn, M. Pauline Baker, Computer Graphics, Pearson Education.
2. J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes, Computer Graphics - Principles and Practice, Pearson Education.

Reference Books:

1. Newmann & Sproull, Principles of Interactive Computer Graphics, McGraw Hill.
2. Rogers, David F., Procedural Elements of Computer Graphics, McGraw Hill.
3. Zhigang Xiang, Roy Plastock, Computer Graphics, Tata McGraw Hill.
4. Malay K. Pakhira, Computer Graphics, Multimedia and Animation, PHI
5. Steven Harrington, Computer Graphics, A Programming Approach, McGraw Hill.

MCA-20-43: Mobile Application Development

Type: Compulsory **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide the in-depth coverage of various concepts of mobile application development especially android based applications. This course will help the students in learning to develop and publish their own mobile applications.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-43.1	know the components and structure of mobile application development frameworks for Android based mobiles;
MCA-20-43.2	design and implement the user interfaces of mobile applications;
MCA-20-43.3	implement fragments and location based services in Android application;
MCA-20-43.4	understand the basics of SQLite and develop interactive graphics in mobile applications.

Unit – I

Introduction: Mobile Applications, Characteristics and Benefits, Application Models, Mobile devices Profiles. Basics of Android, Importance and scope, Android Versions, Features of Android, Android Architecture, Android Stack, Android Applications Structure, Android Emulator, Android SDK, Overview of Android Studio, Android and File Structure, Android Virtual Device Manager, DDMS, LogCat, Understanding Activities.

Android User Interface: Measurements – Device and pixel density independent measuring units. Layouts – Linear, Relative, Grid and Table Layouts.

Unit – II

User Interface (UI) Components – Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers, List View, Spinner View.

Event Handling – Handling clicks or changes of various UI components.

Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS

Services- Callbacks and Override in application, Application Signing, API keys for Google Maps, Publishing application to the Android Market.

Unit – III

Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities

Location and Mapping: location based services, Mapping, Google Maps activity, Working with MapViewand MapActivity; Playing and Recording of Audio and Video in application; Sensors and Near Field

Communication; Native libraries and headers, Building client server applications.

Unit – IV

Using Graphics: Canvas Drawing, Shadows, Gradients.
Persisting Data to files: Saving to Internal Storage, Saving to External Storage
Introduction to SQLite database: creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update).

Text Books:

1. Zigurd Mednieks, Laird Dornin, G, Blake Meike and Masumi Nakamura, Programming Android, O'Reilly Publications.
2. Wei-Meng Lee, Beginning Android Application Development, Wiley India Ltd.

Reference Books:

1. James C.S., Android Application development for Java Programmer, CENGAGE Learning.
2. Pradeep Kothari, Android Application Development: Black Book, Wiley India Ltd.
3. Gargenta M., Nakamura M., Learning Android, O'Reilly Publications.

MCA-20-44(i): Soft Computing

Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Introduce fundamental soft computing concepts with an exposure to non-traditional techniques for problem solving and optimization. Provide Soft Computing based research oriented direction for solving imprecisely defined problems. Provide a comprehensive introduction to nature-inspired metaheuristic methods for search and optimization, including the latest trends in evolutionary algorithms and other forms of natural computing.

Course Outcomes: At the end of this course, the student will be able to:	
MCA-20-44(i).1	have a knowledge of soft computing techniques along with their applications and non-traditional metaheuristic optimization and data clustering techniques & algorithms for obtaining optimized solutions to optimization, computational intelligence, and design/scheduling applications;
MCA-20-44(i).2	apply fuzzy logic theory to imprecisely defined problems;
MCA-20-44(i).3	use Neural Networks concepts to find solutions to problems where normally algorithmic methods do not exist or are costly;
MCA-20-44(i).4	design high-quality solutions using Genetic Algorithms for optimization and search problems and have exposure to MATLAB environment for implementing solutions to problems using soft computing techniques.

Unit – I

Soft Computing : Conventional AI to Computational Intelligence; Soft Computing Constituents and Applications.

Introduction to Non-traditional Metaheuristic Optimization Techniques: Random Optimization, Simulated Annealing, Tabu Search, Ant Colony Optimization, Particle Swarm Optimization, Harmony Search, Memetic Algorithms, Other Evolutionary Algorithms such as Firefly Algorithm, Bee Algorithm, Shuffled Frog Leap algorithm, Bat algorithm etc.

Data Clustering Algorithms: K-Means, Fuzzy C-Means, Mountain Clustering, Subtractive Clustering.

Unit – II

Fuzzy Set theory: Fuzzy Sets & Classical Sets; Operations on Fuzzy Sets, Fuzzy Relations, Linguistic Variables.

Membership Functions: Introduction, Features, & Fuzzification, Methods of Membership Value Assignment; Defuzzification.

Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic; Fuzzy Rule Base and Approximate Reasoning, Fuzzy Quantifiers; Fuzzy Inference Systems, Fuzzy Decision Making, Fuzzy Logic Control System; Fuzzy Expert Systems.

Unit – III

Neural Networks: Fundamental Concepts, Basic Models and Architecture; Machine Learning Using Neural Networks; Associative Memory Networks and their Applications.

Supervised Learning Neural Networks: Perceptron Networks, Radial Basis Function Networks: Back Propagation Neural Network: Architecture, Learning, Applications, & Research Directions; The Boltzman Machine.

Unsupervised Learning Networks: Competitive Learning networks; Kohonen Self-Organizing Networks; Hebbian learning; The Hopfield Network; Counter propagation Networks; Adaptive Resonance Theory: Introduction, Architecture, & Applications; Feed forward Networks; Reinforcement Learning.

Unit – IV

Genetic Algorithms: Introduction to Genetic Algorithms (GA) and their Terminology; Traditional Optimization and Search Techniques vs. Genetic Algorithm ; Operators in Genetic Algorithms; Problem Solving using Genetic Algorithm; Classification of Genetic Algorithms; Holland's Classifier Systems; Genetic Programming; Advantages and Limitations of Genetic Algorithm; Applications of Genetic Algorithm; Applications of GA in Machine Learning.

Introduction to Hybrid Systems; MATLAB Environment for Soft Computing Techniques.

Text Books:

1. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India.
2. Jyh Shing Roger Jang, Chuen Tsai Sun, Eiji Mizutani, Neuro Fuzzy and Soft Computing, Prentice Hall.

Reference Books:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, Prentice-Hall of India Pvt. Ltd.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall.
3. George J. Klir, Ute St. Clair, Bo Yuan, Fuzzy Set Theory: Foundations and Applications Prentice Hall.
4. Simon O. Haykin, Neural Networks: a comprehensive foundation, Pearson Education.
5. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall
6. Goldberg D. E., Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education.
7. Ahmad Lotfi, Jonathan Garibaldi, Applications and Science in Soft Computing, Springer.
8. Rajkumar Roy, Mario Koppen Soft Computing and Industry: Recent Applications, Springer.
9. James A. Freeman, David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India.
10. Du, Ke-Lin, Swamy, M. N. S., Search and Optimization by Metaheuristics: Techniques and Algorithms, Springer
11. Omid Bozorg-Haddad, Mohammad Solgi, Hugo A. Loaiciga, Meta-heuristic and Evolutionary Algorithms for Engineering Optimization, Wiley

MCA-20-44(ii): Machine Learning	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to enable student to perform experiments in Machine Learning using real-world data.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-44(ii).1	understand the basics of machine learning and supervised learning;
MCA-20-44(ii).2	analyse and implement the concepts of Naïve-Bayes and Regression;
MCA-20-44(ii).3	understand the unsupervised learning using clustering algorithms;
MCA-20-44(ii).4	perform dimensionality reduction and understand the basics of reinforcement learning.

Unit – I

Machine Learning: Introduction to Machine Learning, Overview of Machine Learning, Key Terminology and task of ML, Applications of ML;

Supervised Learning: Classification, Decision Tree Representation- Appropriate problem for Decision Learning, Decision Tree Algorithm, Hyperspace Search in Decision Tree;

Unit – II

Naive Bayes- Bayes Theorem, Classifying with Bayes Decision Theory , Conditional Probability, Bayesian Belief Network;

Regression: Linear Regression- Predicting numerical value, Finding best fit line with linear regression, Regression Tree- Using CART for regression.

Unit – III

Logistic Regression - Classification with Logistic Regression and the Sigmoid Function;

Clustering: Learning from unclassified data –Introduction to clustering, K-Mean Clustering, Expectation-Maximization Algorithm(EM algorithm), Hierarchical Clustering, Supervised Learning after clustering.

Unit – IV

Dimensionality reduction- Dimensionality reduction techniques, Principal component analysis, Anomaly Detection, Recommender Systems;

SVM, Reinforcement Learning.

Text Books:

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited.
2. EthemAlpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press.

Reference Books:

1. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press.
2. Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press.
3. Peter Harrington, Machine Learning in Action, Manning
4. Shai Shalev-Shwartz and Shai Ben David, Understanding Machine Learning From Theory to Algorithms, Cambridge University Press

MCA-20-44 (iii): Digital Image Processing	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Provide an introduction to the basic concepts and methodologies for digital image processing. To develop a foundation that can be used as a basis for further studies and research. Introduce the students to the fundamental techniques and algorithms used for acquiring, processing and extracting useful information from digital images.

Course Outcomes: At the end of this course, the student will be able to:	
MCA-20-44(iii).1	get acquainted with digital image fundamentals and its applications and get acquainted with the image representation and description methods;
MCA-20-44(iii).2	Learn and perform image pre-processing and enhancement to improve the image for further processing;
MCA-20-44(iii).3	reconstruct photometric properties degraded by the imaging process and partition a digital image into multiple segments;
MCA-20-44(iii).4	represent and analyse images at different resolutions , process images according to their shapes, and apply compression techniques to reduce the storage space of images.

Unit – I

Digital Image Fundamentals: Introduction to Digital Image Processing and its applications; Components of an Image Processing System.

Image Representation and Description: Image Representation ; Digital Image Properties; Boundary descriptors; Regional descriptors; Steps in Digital Image Processing; Elements of Visual perception; Image Sensing and Acquisition; Image Sampling and Quantization; Relationship between Pixels; Color Representation.

Data Structures for Image Analysis: Levels of Image Data Representation; Traditional Image Data Structures: Matrices, Chains, Topological Data Structures, Relational Structures; Hierarchical Data Structures: Pyramids, Quadtrees, Other Pyramidal Structures.

Unit – II

Image Pre-Processing: Pixel Brightness Transformations: Position-Dependent Brightness Correction, Gray-Scale Transformation; Geometric Transformations: Pixel Co-ordinate Transformations, Brightness Interpolation; Local Pre-Processing.

Image Enhancement: Spatial Domain: Gray level transformations; Histogram processing; enhancement using arithmetic and logic operators; Basics of Spatial Filtering; Smoothing and Sharpening Spatial Filtering.

Frequency Domain: Introduction to Fourier Transform; Filtering in the Frequency Domain; Smoothing and

Sharpening frequency domain filters; Homomorphic Filtering.

Unit – III

Image Restoration and Segmentation: Noise models; Mean Filters; Order Statistics; Adaptive filters; Noise Reduction by Frequency Domain Filtering; Inverse and Wiener filtering; Constrained Least Squares Filtering.
Segmentation: Point, line, and Edge Detection; Edge Linking and Boundary detection; Thresholding; Region based segmentation; Edge based Segmentation; Segmentation by Morphological Watersheds; Matching.
Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing.

Unit – IV

Wavelets and Multiresolution Processing: Background: Image Pyramids; Subband coding; Multiresolution expansions.
Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.
Compression – Fundamentals ; Image Compression models; Error-Free Compression; Variable Length Coding, LZW coding, Bit-Plane Coding, Lossless Predictive Coding; Lossy Compression: Lossy Predictive Coding, Transform Coding, wavelet Coding; Image Compression Standards.

Text Books:

1. Rafael C. Gonzales, Richard E. Woods, Digital Image Processing, Pearson Education.

Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, Third Edition ,Tata McGraw Hill .
2. Anil Jain K., Fundamentals of Digital Image Processing, PHI Learning.
3. Willliam K Pratt, Digital Image Processing, John Willey.
4. Malay K. Pakhira, Digital Image Processing and Pattern Recognition, First Edition, PHI Learning.
5. S. Jayaraman, S. Esakkirajan and T. Veerakumar, Digital Image Processing, McGraw Hill
6. B. Chanda ,D.DuttaMajumder, Digital Image Processing and Analysis, Prentice Hall of India.

MCA-20-45 (i): Optimization Techniques	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide the in-depth coverage of various linear programming problems and their solution techniques. It focuses on various optimization techniques and their applications in problem solving.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-45 (i).1	understand the role and principles of optimization techniques in business world;
MCA-20-45 (i).2	understand the techniques to solve and use LPP and IPP;
MCA-20-45 (i).3	analyse the optimization techniques in strategic planning for optimal gain;
MCA-20-45 (i).4	understand the techniques to solve networking and inventory issues;

Unit – I

Introduction: The Historical development, Nature, Meaning and Management Application of Operations research. Modelling, Its Principal and Approximation of O.R. Models, Main characteristic and phases, General Methods of solving models, Scientific Methods, Scope, Role on Decision Making and Development of Operation Research in India.

Linear Programming: Formulation, Graphical solution, standard and matrix form of linear programming problems, Simplex method and its flow chart, Two-phase Simplex method, Degeneracy.

Unit – II

Duality in LPP: Definition of Dual Problem, General Rules for converting any Primal into its Dual, Dual Simplex method and its flow chart.

Integer Programming: Importance, Applications and Classification, Gomory's all integer programming problem technique and its flow chart, Branch and Bound Method.

Unit – III

Transportation Models: Formulation of problem, Obtaining Initial Basic feasible solution, Optimality tests, Progressing towards optimal solution, Unbalanced Transportation Problems.

Assignment Models: Formulation of problem, Hungarian Method for Assignment Problems, Unbalanced Assignment Problems.

Unit – IV

Inventory theory Costs involved in inventory problems - single item deterministic models-economic lot size models without shortages and with shortages having production rate infinite and finite.

PERT and CPM: Basic steps in PERT/CPM, Techniques, Network Diagram Representation, Forward and Backward Pass-computation, Representation in Tabular form, Determination of Critical path, Critical activity,

Floats and Slack Times, Implementation in any programming language.
Text Books: 1. Sharma, S.D., Operations Research, KedarNath and Ram Nath, Meerut. 2. Gupta P.K., Hira and D.S., Operation Research, Sultan Chand & Sons, New Delhi.
Reference Books: 1. KantiSwarup, Gupta P.K. & Man Mohan, Operation Research, Sultan Chand & sons, New Delhi. 2. Rao S.S., Optimization Theory and Applications, Wiley Eastern Ltd. New Delhi. 3. Taha, H.A., Operation Research – An Introduction, McMillan Publishing Co, New York. 4. Gillet, B.E., Introduction to Operations Research: A Computer Oriented Algorithmic Approach, Tata McGraw Hill, New York.

MCA-20-45(ii): Information Systems

Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30(i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40(i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide an in-depth exploration of how businesses successfully manage information and provide insight into how today's businesses leverage information technologies and systems to achieve corporate objectives.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-45(ii).1	gain skills sought after in today's workplace;
MCA-20-45(ii).2	gain knowledge about IT Infrastructure & Emerging Technologies and their impact on business models and managerial decision-making;
MCA-20-45(ii).3	learn the security issues in information systems and various Enterprise Applications;
MCA-20-45(ii).4	understand, participate in, and eventually lead management discussions and drivedecisions about the firm's information systems.

Unit – I

Fundamental of Management Information systems: The Fundamental Roles of Information System in business, Trends in Information Systems, Types of Information Systems, Managerial Challenges of Information Technology.

The Components of Information Systems: System Concept, Components of an Information System, Information System Resources, Information System Activities, Recognizing Information Systems.

Unit – II

IT Infrastructure and Emerging Technologies: IT Infrastructure, Infrastructure Components, Software/Hardware Platform Trends and Emerging Technologies, Management Issues.

Foundation of Business Intelligence: Databases and Information Management: Organizing Data in a Traditional File Environment, The Database Approach to Data Management, Using Database to Improve Business Performance and Decision Making, Managing Data Resources.

Unit – III

Securing Information Systems: System Vulnerability and Abuse, Business Value of Security and Control, Establishing a Framework for Security and Control, Technologies and Tools for Security.

Key System Applications for the Digital Age.

Enterprise Applications: Enterprise Systems, Supply Chain Management Systems, Customer Relationship Management Systems, Enterprise Applications: New Opportunities and Challenges.

Unit – IV

Managing Knowledge: The Knowledge Management Landscape, Enterprises-Wide Knowledge Management Systems, Knowledge Work Systems, Intelligent Techniques.

Enhancing Decision Making: Decision Making and Information Systems, Systems for Decision Support, Executive Support Systems (ESS), Group Decision-Support Systems (GDSS).

Text Books:

1. Kenneth C.Laudon, Jane P.Laudon, Management Information Systems: Managing the Digital Firm, Pearson Education.
2. James A O'Brien, George M Marakas, Management Information Systems, Tata McGraw-Hill.

Reference Books:

1. Laudon & Laudon, Essentials of Management Information Systems, Pearson Education.
2. McLeod & Schell, Management Information Systems, Pearson Education.
3. Jawadekar, W.S., Management Information Systems, Tata McGraw-Hill.
4. Robert G.Mudrick, CoelE.Ross, James R.Claggett,Information Systems for Modern Management.

MCA-20-45 (iii): Blockchain Technology	
Type: Elective **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to introduce the concept of Blockchain. This course introduces the concept of Bitcoin and makes students familiar with Bitcoin network, payments, clients and APIs.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MCA-20-45 (iii).1	understand the concept of Blockchain and Decentralization;
MCA-20-45 (iii).2	understand the usage of Block chain and Bitcoin implementation;
MCA-20-45 (iii).3	understand and analyse the Bitcoin network and payments;
MCA-20-45 (iii).4	analyze the various platforms used for Blockchain.

Unit – I

Discover Blockchain Technology: Blockchain, Growth of blockchain technology, Distributed systems, History of blockchain and Bitcoin, Types of blockchain.

Decentralization: Methods of decentralization, Routes of decentralization, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized organizations and platforms for decentralization.

Unit – II

Blockchain: Architecture, Versions, Variants, Use cases, Life use cases of blockchain, Blockchain vs shared Database, Introduction to cryptocurrencies, Types, Applications.

Bitcoins: Introducing Bitcoin, Bitcoin digital keys and addresses, Transactions, Blockchain mining. Alternative Coins. Limitations of Bitcoin

Unit – III

Concept of Double Spending, Hashing, Proof of work.

Bitcoin Network and payments, Bitcoin network, Wallets, Bitcoin payments, Innovation in Bitcoin, Bitcoin Clients and APIs.

Unit – IV

Introduction to Blockchain Platforms: Ethereum, Hyperledger, IOTA, EOS, Multichain, Bigchain, etc., Advantages and Disadvantages, EthereumvsBitcoin, Design a new blockchain, Potential for disruption, Design a distributed application, Blockchain applications.

Text Books:

1. Imran Bashir, Mastering Blockchain, PACKT Publication.
2. Arshdeep Bikramaditya Singal, Gautam Dhameja, Priyansu Sekhar Panda., Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions, APress.
3. Bahga, Vijay Madisetti, Blockchain Applications: A Hands-On Approach.

4. Melanie Swan, Blockchain, OReilly

Reference Books:

1. Aravind Narayan. Joseph Bonneau, Bitcoin and Cryptocurrency Technologies, Princton
2. Arthu.T Books, Bitcoin and Blockchain Basics: A non-technical introduction for beginners.