MASTER OF COMPUTER APPLICATIONS (M.C.A)

COURSE STRUCTURE AND SCHEME OF VALUATION W.E.F. 2016-17

I SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 1.1	Information Technology & Applications	4	--	70	30	100	4
MCA 1.2	Data Structures and Algorithms	4	--	70	30	100	4
MCA 1.3	Discrete Mathematical Structures	4	--	70	30	100	4
MCA 1.4	Computer Organization	4	--	70	30	100	4
MCA 1.5	Information Systems & Organizational Behavior	4	--	70	30	100	4
MCA 1.6	Data Structures & Programming Lab	--	3	50	50	100	2
MCA 1.7	Computer Organization Lab	--	3	50	50	100	2
Total		20	6	450	250	700	24

MCA 1.1	INFORMATION TECHNOLOGY AND APPLICATIONS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Objectives:

The main objectives of the course are

- Gain fundamental knowledge regarding technical concepts and practices in information technology (IT).
- Identify and evaluate current and emerging technologies and assess their applicability.
- Gain a broad background across fundamental areas of information technology along with a depth of understanding in a particular area of interest within the domain of information systems.

Outcomes

- An ability to use and apply current technical concepts and practices in the core information technologies.
- An understanding of best practices and standards and their application.
- An understanding of best practices and standards and their application.

1. **The Internet and the World Wide Web**: Internet, world wide web, home page, websites, getting connected to web, browsing web, locating information on web, web multimedia.
2. **Information Technology - An Overview:** Information technology, hardware and software, information processing cycle, IT in education and training, IT in entertainment and arts, IT in science, engineering and mathematics, GPS.
3. **The computer system and central processing unit**: Types of computers, The anatomy of computer, The foundations of IT, CPU, Memory, Communications with peripherals.
4. **Input and Output, Secondary Storage, Software:** I/O devices, Storage media, backing up data, Software application programs, Types of OS, File management.
5. **Database applications:** Introduction to Databases, Database applications, queries, internet connectivity.

6. **Communications:** Network applications- FAX and Mail, LAN, WAN, Links between Networks, Modems.
7. **Multimedia, Social and Ethical Issues :** Introduction , Tools of multimedia, Multimedia on the web, viruses , IPR, Cryptography.
8. **Programming and System Development**: Programming Languages, programming methods , programming development, programming techniques.

Text Books:

1. Information Technology The Breaking Wave, Denis P Curtin, Kim Foley, Kunal Sen, Cathleen Morin, TMG
2. Computer Fundamentals, Anita Goel, Pearson Education India

MCA 1.2	DATA STRUCTURES AND ALGORITHMS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives:

1. Assess how the choice of data structures and algorithm design methods impacts the performance of programs.
2. Choose the appropriate data structure and algorithm design method for a specified application.
3. Solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, heaps, tournament trees, binary search trees, and graphs and writing programs for these solutions.
4. Solve problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking, and branch and bound and writing programs for these solutions.

Course Outcomes:

1. Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithm.
2. Demonstrate different methods for traversing trees.
3. Compare alternative implementations of data structures with respect to performance.
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing.

Syllabus:

1. **Introduction to Data Structures and Algorithms**: Review of C Programming, , Abstract Data Types, Meaning and Definition of Data Structures, Efficiency of Algorithms, Asymptotic Notations, Time complexity estimation using O notation, Average, Best case and Worst case complexities, Analysis of recursive algorithms, Arrays Operations, single and Multi-dimensional array Representation in memory

2. **Stacks**: Stack as an Abstract Data Type, Primitive Operations, Implementing Stack Operations using Arrays, Infix, Postfix and Prefix: Definitions, Evaluation and Conversions. **Queues**: Queue as an Abstract Data Type, Operations, Implementation using Arrays, Types of Queues, circular Queue, applications.

3. **Linked List**: singly linked list, Circular Lists: Insertion, Deletion and Concatenation Operations, Doubly Linked Lists, Multiply linked lists, applications, Implementation of Stacks, Queues and priority Queues using Linked Lists, Dynamic Memory Management, applications .

4. **Trees and Binary Trees** - Definitions and Terminology, representation of Trees, Binary Tree Terminology, Representation and Traversal, Threaded Binary Trees and their Traversal, Trees and their Applications; Tree Searching: Insertion and Deletion of a node from a Binary Search Tree, AVL Tree operations, Applications

5. **Searching and Hashing**: Basic Searching, Sequential Searching and its Efficiency, Transpose Sequential search, Binary Search, Interpolation Search, Hash Table structure, Hash Functions, Linear open addressing, chaining, applications

6. **Sorting**: General Background: Efficiency of Sorting, Bubble Sort, Selection Sorting, Insertion sort, Shell Sort and Quick Sort, Heap Sort, Merge Radix Sorts and their Efficiency

7. **Graphs and Their Application**: Definition of Graphs, Representation of Graphs, Transitive closure, Linked Representation of Graphs, Graph Traversal and Spanning Forests, Topological sorting of nodes, Undirected Graphs and their Traversals, Applications of Graphs, Minimal Spanning Trees.

Textbooks:

1. **Data Sructures and Algorithms – Concepts, Techniques and Algorithms** by G.A.V.Pai , Tata McGraw Hill Publishing

2. **Data Structures Using C** by Yaddish Langsam, Moshe J. Augenstein and Aaron M.Tanenbaum, Prentice Hall Of India (Low priced Edition)

Reference Books:

1. **Data Structures using C** by E. Balagurusamy, McGraw Hill Education India Pvt Limited

2. **Data Structures, Algorithms and Applications with C++,** Sahani Mc-Graw Hill.

MCA 1.3	DISCRETE MATHEMATICAL STRUCTURES	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Sets, relations and functions:** Operations on sets, relations and functions, binary relations, partial ordering relations, equivalence relations, principles of mathematical induction.

2. Permutations and combinations**;** recurrence relation and generating functions.

3. **Algebraic structures and morphisms:** Algebraic structures with one binary operation - semigroups, monoids and groups, congruence relation and quotient structures. Free and cyclic monoids and groups, permutation groups, substructures, normal subgroups.

4. Algebraic structures with two binary operations, Lattices, Principle of Duality, Distributive and Complemented Lattices, Boolean Lattices and Boolean Algebras, Uniqueness of Finite Boolean Algebras, Boolean Functions and Boolean Expressions, Propositional Calculus.

5. **Mathematical logic:** Syntax, semantics of Propositional and predicate calculus, valid, satisfiable and unsatisfiable formulas, encoding and examining the validity of some logical arguments.

6. **Proof techniques:** forward proof, proof by contradiction, contra positive proofs, proof of necessity and sufficiency.

7. **Graph Theory:** Graphs and digraphs, trees, Eulerian cycle and Hamiltonian cycle, adjacency and incidence matrices, vertex coloring, planarity.

Text Books:

Discrete Mathematical Structures with Applications to Computer Science by J. P. Tremblay and R. P. Manohar, Tata McGraw-Hill, 2001.

Reference Books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill.

2 C. L. Liu, **Elements of Discrete Mathematics**, 2nd Edition, Tata McGraw-Hill, 2000.

MCA 1.4	COMPUTER ORGANIZATION	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. Introduction to Computer Organization, CPU Organization, Memory subsystem Organization, and Interfacing, I/O Subsystem Organization and Interfacing, a relative Simple Computer, An8085 Based Computer

2. Computer arithmetic & Digital Logic Fundamentals: Unsigned, Notation, Signed Notation, Binary Code Decimal, Specialized Arithmetic Hardware, Floating Point Numbers, The IEEE 754 Floating Point Standard; Boolean Algebra, Basic functions, Mapping Boolean Functions, Combinatorial Logic, Combinational Circuits, Sequential circuits.

3. Register Transfer Languages: Micro Operations and Register Transfer Language, RTL Specification, Digital systems, More Complex Digital Systems, VHDL-VHSIC Hardware Description Language

4. Instruction Set architecture: Levels of Programming Languages,< Assembly Language Instructions, Instruction Set Architecture Design, A Relatively Sample Instruction Set Architecture, 8085 Microprocessor Instruction Set Architecture.

5. CPU Design: Specifying a CPU, Design & Implementation of a Very Simple CPU, Short comings of the simple CPUs, Internal Architecture of the 8085 microprocessor.

6. Microprocessor Control Unit Design: Basic Micro-sequencer Design, Design and Implementation of very simple Micro-sequencer, Reducing the number of Micro Instructions, Micro-prgrammed controls Hardware Control, A(Mostly) Micro-coded CPU, The Pentium Microprocessor.

7. Memory & I/O Organization: Hierarchical Memory systems, Cache Memory Systems, Virtual Memory., Memory Management in a Pentium/Windows Personal computer, Input/output Organization, Organization of Asynchronous Data Transfers, Programmed I/O, Interrupts, Directory Memory Acess,I/OProcessors, Serial Communications, Serial Communication Standards.

Text Book:

1. Computer Systems Organization & Architecture, John D. Carpinelli, Addison Wesley Longman, Inc ./ Pearson Education , 1993

Reference Book:

1. Computer System Architecture, M. Morris Mano, Third Edition, Pearson Education, 2007
2. Computer Architecture and organization: Design Principles and Applications, B. Govindarajalu, TMH Publishing Company Ltd., 2004
3. Fundamentals of Computer organization and Design, Sivarama P. Dandamudi Springer International Edition, 2004

MCA 1.5	INFORMATION SYSTEMS & ORGANIZATIONAL BEHAVIOUR	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. Organization Structure: Features of Good Organization Structures, Designing of Organization Structure, Types of Organization Structures- Functional, Product, Geographic and Matrix Organization Structures

2. Motivation : Nature and importance of motivation, Theories of motivation – Maslow's, Herzberg's and Mc Gregor's X and Y Theories of Motivation.

3. Leadership: Meaning and definition, Importance of Leadership, Leadership styles, Communication: Process of Communication, Importance, Forms of Communication and Barriers in Communication.

4. Group Dynamics : Types of Groups, Stages of Group Development, Group Behavior and Group Performance Factors.

5. Organizational Conflicts: Reasons for Conflicts, Consequences of Conflicts in Organizations, Types of Conflict, Strategies for Managing Conflicts, Organizational Climate and Culture.

6. Management Information System : Nature and Scope, Characteristics and Functions. Classification of MIS - Transaction Processing System, Management Information System, Decision Support System, Executive Support System, Office Automation System and Business Expert System.

7. Functional Information Systems: Production, Marketing, Finance and Human Resources Information Systems; Objectives and Functions of Information Resource Management.

Text Books:

1. Elements of Organizational Behavior, Robbins, 7th Edition, Pearson Education
2. Management Information Systems – D.P.Goyal, Macmillan Publishers India Ltd.

Reference Books:

1. Organizational Behaviour – L.M.Prasad, Sultan Chand and sons
2. Management Information Systems - L.M.Prasad, Usha Prasad , Sultan Chand and sons
3. Management Information Systems – Kanter Jerma , PHI

MCA 1.6	DATA STRUCTURES AND PROGRAMMING LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

Course Objectives:

1. To implement stacks and queues using arrays and linked lists.
2. To develop programs for searching and sorting algorithms.
3. To write programs using concepts of various trees.
4. To implement programs using graphs.

Course Outcomes:

1. Student will be able to write programs to implement stacks and queues.
2. Ability to implement various searching and sorting techniques.
3. Ability to implement programs using trees and graphs.

List of Programs:

1. Write a program for sorting a list using Bubble sort and then apply binary search.
2. Write a program to implement the operations on stacks.
3. Write a program to implement the operations on circular queues.
4. Write a program for evaluating a given postfix expression using stack.
5. Write a program for converting a given infix expression to postfix form using stack.
6. Write a program for implementing the operations of a priority queue using dynamic allocation.
7. Write a program for the representation of polynomials using circular linked list and for the addition of two such polynomials
8. Write a program for quick sort
9. Write a program for Merge sort.
10. Write a program for Heap sort
11. Write a program to create a binary search tree and for implementing the in order, preorder, post order traversal using recursion
12. a)Write a program for finding the transitive closure of a digraph
    b)Write a program for finding the shortest path from a given source to any vertex in a digraph using Dijkstra's algorithm

MCA 1.7	COMPUTER ORGANIZATION LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

I – CYCLE : Digital Logic Design Experiments :

1. TTL Characteristics and TTL IC Gates
2. Multiplexers & Decoders
3. Flip-Flops
4. Counters
5. Shift Registers
6. Binary Adders & Subtractors
7. A L U

II – CYCLE: 8085 Assembly Language Programming :

1. 8085 Assembly Language Programming according to theory course microprocessors-I using the following trainers :

   Keyboard Monitor of 8085µP Trainer.
   Serial Monitor of 8085µP Trainer with Terminal
   8085 Line Assembler of 8085µP Trainer with PC as Terminal
   8085 Cross Assembler using In-Circuit Emulator (ICE) with 8085µP Trainer and PC as Terminal

   Graded Problems are to be used according to the syllabus of COMPUTER ORGANIZATION

2. PENTIUM CLASS PC ARCHITECTURE FAMILIARIZATION HARDWARE & SOFTWARE PARTS DEMONSTRATION

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II SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 2.1	Probability, Statistics & Queuing Theory	4	--	70	30	100	4
MCA 2.2	Data Base Management Systems	4	--	70	30	100	4
MCA 2.3	Object Oriented Programming With JAVA	4	--	70	30	100	4
MCA 2.4	Elective-I	4	--	70	30	100	4
MCA 2.5	Management Accountancy	4	--	70	30	100	4
MCA 2.6	Object Oriented Programming Lab	--	3	50	50	100	2
MCA 2.7	Data Base Management Systems Lab	--	3	50	50	100	2
Total		20	6	450	250	700	24

Elective-I: Formal Languages & Automata Theory/ File structures/ Computer Graphics

MCA 2.1	PROBABILITY, STATISTICS & QUEUING THEORY	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Probability:** Definitions of probability, Addition theorem, Conditional probability, Multiplication theorem, Bayes' Theorem of Probability and Geometric Probability.

2. **Random variables and their properties:** Discrete Random Variable, Continuous Random Variable, Probability Distribution, Joint Probability Distributions their Properties, Transformation Variables, Mathematical Expectations, Probability Generating Functions.

3. **Probability Distributions:** Discrete Distributions : Binomial, Poisson Negative Binominal Distributions And Their Properties; Continuous Distributions : Uniform, Normal, Exponential Distributions And Their Properties.

4. **Multivariate Analysis** : Correlation, Correlation Coefficient, Rank Correlation, Regression Analysis, Multiple Regression, Attributes, Coefficient Of Association, χ^2 – Test For Goodness Of Fit, Test For Independence.

5. **Estimation**: Sample, Populations, Statistic, Parameter, Sampling Distribution, Standard Error, Un-biasedness, Efficiency, Maximum Likelihood Estimator, Notion & Interval Estimation.

6. **Testing of Hypothesis**: Formulation of Null hypothesis, critic al region, level of significance, power of the test;

7. **Sample Tests:** Small Sample Tests : Testing equality of .means, testing equality of variances, test of correlation coefficient, test for Regression Coefficient; Large Sample tests: Tests based on normal distribution

8. **Queuing Theory** : Queue description, characteristics of a queuing model, study state solutions of M/M/1: □ Model, M/M/1 ; N Model, M/M/C: Model, M/M/C: N Model , Case studies

Text Books:

1. Probability & Statistics for Engineers and Scientists,Walpole, Myers, Myers, Ye. Pearson Education.
2. Probability, Statistics and Random Processes T.Veerarajan Tata McGraw – Hill

Reference Book:

1. Probability & Statistics with Reliability, Queuing and Computer Applications, Kishor S. Trivedi, Prentice Hall of India ,1999

MCA 2.2	DATA BASE MANAGEMENT SYSTEMS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Database Systems**: Introduction to the Database Systems, Concepts of Relational Models and Relational Algebra. SQL: Introduction to SQL Queries, Integrity Constraints, Joins, Views, Intermediate and Advanced SQL features and Triggers.

2. **Database Design**: Overview of the Design process, E-R Models, Functional dependencies and other kinds of dependencies, Normal forms, Normalization and Schema Refinement.

3. **Database Application Design and Development**: User Interfaces and Tools, Embedded SQL, Dynamic SQL, Cursors and Stored procedures, JDBC, Security and Authorization in SQL, Internet Applications.

4. **Query Evaluation:** Overview, Query processing, Query optimization, Performance Tuning.

5. **Database System Architectures**: Centralized and Client-Server Architecture, Server system Architecture, Parallel and Distributed database, Object based databases and XML. Advanced data types in databases. Cloud based data storage systems.

6. **Transaction Management**: Overview of Transaction Management, Transactions, Concurrency control, Recovery systems, Advanced Transaction Processing.

7. **Case Studies**: Postgre SQL, Oracle, IBM DB2 Universal Database, Microsoft SQL Server.

Text Books:

1. Database System Concepts, Avi Silberschatz , Henry F. Korth , S. Sudarshan McGraw-Hill, Sixth Edition, ISBN 0-07-352332-1.

References:

1. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke,McGraw-Hill.

MCA 2.3	OBJECT ORIENTED PROGRAMMING WITH JAVA	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives:

1. To understand Object Oriented Programming concepts, class hierarchy, characteristics of Java, inheritance and polymorphism and become familiar with the relationship between classes and objects in a Java program.
2. Learn programming based on JAVA 7 and above.
3. To write efficient and effective applications in Java, Java's event handling model, graphical user interface (GUI), swing component set, understand the relationship between the AWT and Swing.
4. Have a better understanding of Java's event model and design, build simple Graphical User Interfaces (GUI)s, Networking, Java Database Connectivity with JDBC™, Servlets, JavaServer Pages (JSP).

Course outcomes:

1. The course aims to make the students learn programming in Java. Java language elements and characteristics, including data types, operators, and control structures are discussed in order to make the students develop Java applications.
2. The course also intended for students who would like to learn how to develop internet based applications, graphical user interface (GUI), and graphics in both AWT and SWING.
3. Advanced Java topics discussed helps students writing programs for Java database connectivity with JDBC; Manipulating databases with JDBC; Programming for Internet, JavaServer pages.

Syllabus:

1. Introduction to Computers, Programming, and Java; Elementary Programming; Selections; Mathematical Functions, Characters, and Strings; Loops;

2. Methods; Single-Dimensional Arrays; Multidimensional Arrays; Objects and Classes; Object-Oriented Thinking;

3. Inheritances and Polymorphism; Exception Handling and Text I/O; Abstract Classes and Interfaces.

4. JavaFX Basics; Event-Driven Programming and Animations;

5. JavaFX UI Controls and Multimedia; Multithreading and Parallel Programming;

6. Networking; Java Database Programming ;

7. Servlets; JavaServer Pages.

Text Book:

1) INTRODUCTION TO JAVA PROGRAMMING Comprehensive version, Y. Daniel Liang, Tenth Edition, Pearson Education, Inc.

Reference Books:

1) Object Oriented Programming Through Java, P. Radha Krishna, CRC Press.

2) Java And Object Oriented Programming Paradigm, Debasish Jana, PHI Learning Pvt. Ltd

MCA 2.4	Elective - I FORMAL LANGUAGES & AUTOMATA THEORY	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Finite Automata and Regular Expressions**: Basic Concepts of Finite State Systems, Deterministic and Non-Deterministic Finite Automata, Finite Automata with ϵ-moves, Regular Expressions, Mealy and Moore Machines, Two-Way Finite Automate, Applications of FSM.

2. **Regular sets & Regular Grammars: B**asic Definitions of Formal Languages and Grammars, Regular Sets and Regular Grammars, Closure Properties of Regular Sets, Pumping Lemma for Regular Sets, Decision Algorithm for Regular Sets, Myhill-Nerode Theorem, Minimization of Finite Automata.

3. **Context Free Grammars and Languages: C**ontext Free Grammars and Languages, Derivation Trees, Simplification of Context Free Grammars, Normal Forms, Pumping Lemma for CFL, Closure properties of CFL's, Decision Algorithm for CFL.

4. **Push down Automata:** Informal Description, Definitions, Push-Down Automata and Context free Languages, Parsing and Push-Down Automata.

5. **Turing Machines:** The Definition of Turing Machine, Design and Techniques for Construction of Turing Machines, Combining Turing Machines.

6. **Universal Turing Machines and Undecidability :** Universal Turing Machines. The Halting Problem, Variants of Turing Machines, Restricted Turing Machines , Decidable & Undecidable Problems - Post Correspondence Problem.

7. **Chomsky Hierarchy of Languages:** Regular Grammars, Unrestricted Grammars, Context Sensitive languages, Relationship between Classes of Languages.

Text books:

1. Introduction to Automata Theory, Languages and Computations – J.E. Hopcroft, & J.D. Ullman , Pearson Education Asia.

Reference books:

1. Introduction to languages and theory of computation – John C. Martin (MGH)
2. Theory of Computation, KLP Mishra and N. Chandra Sekhar, IV th Edition, PHI
3. Introduction to Theory of Computation – Michael Sipser (Thomson Nrools/Cole)

MCA 2.4	Elective - I	FILE STRUCTURES
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **File Processing Operations:** Physical and logical files, opening, reading & writing and closing files in C, seeking and special characters in files, physical devices and logical files, file-related header files in C
2. **Secondary Storage:** Disks – organization, tracks, sectors, blocks, capacity, non-data overhead, cost of a disk access,Magnetic Tape – types, performance, organization estimation of tape length and data transmission times
3. **Journey and buffer Management :**File manager, I/O buffer, I/O processing, buffer strategies and bottlenecks
4. **File Structure Concepts:** A stream file, field structures, reading a stream of fields, record structures and that uses a length indicator, Mixing numbers and characters – use of a hex dump, reading the variable length records from the files
5. **Managing records in C files:** Retrieving records by keys, sequential search, direct access, choosing a record structure and record length, header records, file access and file organization
6. **Organizing files for performance:** Data compression, reclaiming space – record deletion and storage compaction, deleting fixed-length records for reclaiming space dynamically, deleting variable-length records, space fragmentation, replacement strategies.
7. **Indexing:** Index, A simple index with an entry sequenced file, basic operations on an indexed, entry sequenced file, indexes that are too large to hold in memory, indexing to provide access by multiple keys, retrieval using combination of secondary keys, improving the secondary index structure – inverted lists
8. **Indexed sequential file access and prefix B^+ Trees:** Indexed sequential access, maintaining a sequence set, adding a simple index to the sequence set, the content of the index: separators instead of keys, the simple prefix B^+ tree, simple prefix B^+ tree maintenance, index set block size, internal set block size, internal structure of index set blocks: a variable order B-tree, loading a simple prefix B^+ tree
9. **Hashing:** Collisions in hashing, a simple hashing algorithms, hashing functions and record distributions, memory requirements, collision resolution by progressive overflow, buckets, deletions

Textbooks:

1. File Structures – An Object Oriented Approach with C^{++} by Michael J. Folk, Bill Zoellick and Greg Riccardi, Pearson.

MCA 2.4	Elective - I COMPUTER GRAPHICS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives:

1. Provides a comprehensive introduction to computer graphics with a foundation in Graphics Applications.
2. A thorough introduction to computer graphics techniques.
3. To give the basics of Geometric Transformations and projections.
4. To introduce three dimensional concepts and object representations with color models and basics of computer animation.

Course Outcomes:

1. The students will understand graphics principles and graphics hardware.
2. The students can demonstrate geometrical transformations.
3. The students can create interactive graphics applications and demonstrate computer graphics animation.

Syllabus :

1. **Introduction:** Computer Graphics and their applications: Computer Aided Design, Computer Art, Entertainment, Education and Training, Graphical User Interfaces; Overview of Graphics systems: Video Display Devices, Raster Scan Systems, Random Scan Systems, Graphics Monitors And Workstations, Input Devices, Hard Copy Devices, Interactive Input Methods, Windows and Icons, Virtual Reality Environments, Graphics Software.

2. **Output primitives:** Points and Lines, **,** Line and Curve Attributes, Color and Gray scale levels, Antialiasing, Loading the Frame buffer, Line function, Line Drawing Algorithms, Circle Generating Algorithms, Ellipse Generating Algorithms, Pixel Addressing, Area Fill Attributes, Filled Area Primitives, Filled Area Functions, Cell Array, Character Generation, Character Attributes, Bundled Attributes, Curve Functions, Parallel Curve Algorithms.

3. **Two Dimensional Transformations:** Basic 2D Transformations, Matrix Representations, Homogeneous Coordinates, Composite Transformations, Other Transformations, Transformations between Coordinate Systems, Affine Transformations.

4. **Three Dimensional Transformations & Projections:** Translation, Rotation, Scaling, Other Transformations, Composite Transformations, 3D Transformation Functions, Modeling and Coordinate Transformations, Need for projections, Parallel & Perspective projections, General Projection Transformations.

5. **Viewing Pipeline and Clipping operations :** Viewing Pipeline ,Viewing Coordinates & Reference frames, Window-to-Viewport Coordinate Transformation, Two Dimensional Viewing Functions, , Three Dimensional Viewing, View Volumes, Clipping and its Operations, Types of clipping operations- Point Clipping, Line Clipping, Polygon Clipping,, Curve Clipping,, Text and Exterior Clipping.

6. **Three Dimensional Concepts and Object representations:** 3D display methods, 3D Graphics, Polygon Surfaces, Curved Lines and Surfaces, Quadratic Surfaces, Super Quadrics, Blobby Objects, SplineRepresentations, Cubic Spline methods, Bézier Curves and Surfaces, B-Spline Curves and Surfaces,
7. **Color Models and Basics of Computer Animation:** Intuitive color concepts, Basics of RGB Color model, YIQ Color Model, CMY & HSV Color models. Design of animation Sequences, Raster Animations, Key Frame systems: Morphing, A Simple program on Animation.

Text Book:

1. Computer Graphics, Donald Hearn & M. Pauline Baker, Pearson Education, New Delhi.

Reference Books:

1. Procedural Elements for Computer Graphics, David F.Rogers, Tata Mc Graw Hill Book Company, NewDelhi, 2003.
2. Computer Graphics: Principles & PracticeinC, J.D.Foley, S.KFeiner, AVanDam F.H John Pearson Education, 2004.
3. Computer Graphics using Open GL, Franscis S Hill Jr, Pearson Education, 2004.
4. Computer Vision and Image Processing: A Practical Approach using CVIP tools, S. E. Umbaugh, Prentice Hall, 1998.

MCA 2.5	MANAGEMENT ACCOUNTANCY	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Principles Of Accounting** : Nature And Scope Of Accounting, Double Entry System Of Accounting, Introduction To Basic Books Of Accounts Of Sole Proprietary Concern, Closing Of Books Of Accounts And Preparation Of Trial Balance.

2. **Final Accounts** : Trading, Profit And Loss Accounts And Balance Sheet Of Sole Proprietary Concern With Normal Closing Entries. (With numerical problems)

3. **Ratio Analysis**: Meaning, Advantages, Limitations, Types of Ratio and Their Usefulness. (Theory only) Fund Flow Statement: Meaning Of The Term Fund, Flow Of Fund, Working Capital Cycle, Preparation and Inter-preparation Of Statement.

4. **Costing**: Nature, Importance And Basic Principles. Budget and Budgetary Control: Nature And Scope, Importance Method Of Finalization And Master Budget, Functional Budgets.

5. **Marginal Costing** : Nature, Scope, Importance, Construction Of Break Even Chart, Limitations And Uses Of Break Even Chart, Practical Applications Of Marginal Costing.(with numerical problems)

6. **Introduction To Computerized Accounting System**: Coding Logic And Codes Required, Master Files, Transaction Files, Introduction To Documents Used For Data Collection, Processing Of Different Files And Outputs Obtained.

Text Books:

1. Introduction to Accountancy. T.S.Grewal.
2. Management Accountancy, S .P.Jain.

Reference Book:

1. Introduction To Accounting, G.Agarwal.

MCA 2.6	OBJECT ORIENTED PROGRAMMING LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

Course Objectives:

1. To develop programs using basic OOPS concepts such as classes and objects.
2. To implement programs using Inheritance concepts.
3. To implement programs using Exception handling.
4. To develop programs using operator overloading concepts.

Course Outcomes:

1. Student will be able to use OOPs concepts.
2. Ability to apply Inheritance concepts to several problems.
3. Ability to use Exception Handling concepts.

List of Programs:

1. Write a Program in JAVA that implements stack operations using classes and objects.
2. Write a Program in JAVA performing complex number addition using friend functions.
3. Write a Program in JAVA for complex number addition using operator overloading.
4. Write a Program in JAVA to perform string operations by overloading operators.
5. Write a Program in JAVA on hierarchical inheritance showing public,

   private and protected inheritances.
6. Write a Program in JAVA for computation of student's result using hybrid inheritance.
7. Write a Program in JAVA implementing bubble-sort using templates.
8. Write a Program in JAVA on virtual functions.
9. Write a Program in JAVA for handling PushOnFull and PopOnEmpty Exceptions for a Stack.
10. Write a Program in JAVA for copying one file to another file using streams.
11. Write a Program in JAVA for writing and reading a class object to a file.

    a) Write program in JAVA to implement One catch block and all Exceptions

    b) using Multiple Catch blocks.

MCA 2.7	DATABASE MANAGEMENT SYSTEMS LAB	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

Course Objectives:

1. To introduce to a commercial DBMS such as ORACLE.
2. To learn and practice SQL commands for schema creation, data manipulation.
3. To learn conceptual and physical database design based on a case study.
4. To apply database design stages by studying a case study.

Course Outcomes:

1. The student is exposed to a commercial RDBMS environment such as ORACLE.
2. The student will learn SQL commands for data definition and manipulation.
3. The student understands conceptual through physical data base design.
4. The student takes up a case study and applies the design steps.

Features of a commercial RDBMS package such as ORACLE/DB2, MS Access, MYSQL & Structured Query Language (SQL) used with the RDBMS.

I. Laboratory Exercises Should Include

a. Defining Schemas for Applications,
b. Creation of Database,
c. Writing SQL Queries,
d. Retrieve Information from Database,
e. Creating Views
f. Creating Triggers
g. Normalization up to Third Normal Form
h. Use of Host Languages,
i. Interface with Embedded SQL,
j. Use of Forms
k. Report Writing

II. Some sample applications are given below:

1. Accounting Package for Shops,
2. Database Manager for Magazine Agency or Newspaper Agency,
3. Ticket Booking for Performances,
4. Preparing Greeting Cards & Birthday Cards
5. Personal Accounts - Insurance, Loans, Mortgage Payments, Etc.,
6. Doctor's Diary & Billing System
7. Personal Bank Account
8. Class Marks Management
9. Hostel Accounting
10. Video Tape Library,
11. History of Cricket Scores,
12. Cable TV Transmission Program Manager,
13. Personal Library.
14. Sailors Database
15. Suppliers and Parts Database

MASTER OF COMPUTER APPLICATIONS (M.C.A)

COURSE STRUCTURE AND SCHEME OF VALUATION W.E.F. 2016-17

III SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 3.1	Operating Systems	4	--	70	30	100	4
MCA 3.2	Computer Networks	4	--	70	30	100	4
MCA 3.3	Web Technologies	4	--	70	30	100	4
MCA 3.4	Operations Research	4	--	70	30	100	4
MCA 3.5	Elective-II	4	--	70	30	100	4
MCA 3.6	Web Technologies Lab	--	3	50	50	100	2
MCA 3.7	Operating Systems Lab	--	3	50	50	100	2
Total		20	6	450	250	700	24

Elective-II : Artificial Intelligence/ Compiler Design/ Image Processing/ Microprocessors/ Embedded Systems

MCA 3.1	OPERATING SYSTEMS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Introduction to Operating Systems**: Over view of Operating Systems, Types Of Operating Systems, Operating System Structures, Operating-System Services, System Calls, Virtual Machines, Operating System Design and Implementation.
2. **Process Management**: Process Concepts, Operations On Processes, Cooperating Processes, Threads, Inter Process Communication, Process Scheduling, Scheduling Algorithms, Multiple - Processor Scheduling. Thread Scheduling.
3. **Process Synchronization:** The Critical Section Problem, Semaphores, And Classical Problems Of Synchronization, Critical Regions, Monitors, Synchronization examples
4. **Deadlocks**: principles of Deadlocks,-System Model, Deadlocks Characterization, Methods For Handling Deadlocks, Deadlock- Prevention, Avoidance, Detection,& Recovery from Deadlocks
5. **Memory Management:** Logical Versus Physical Address, Swapping, contiguous memory allocation, paging, structure of the page table , segmentation, , Virtual Memory, Demand Paging, Page Replacement Algorithms, Thrashing
6. **File System Implementation:** Concept of a file, Access Methods, Directory Structure, Protection, File System Structure, Allocation Methods, Free Space Management, Directory Management, Device Drivers
7. **Mass-storage structure:** overview of Mass-storage structure, Disk structure, disk attachment, disk scheduling, swap-space management.

Text Books:

1. Operating Systems, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Wiley John Publ., Seventh Edition.

References:

1. Operating Systems, William Stallings 5th Edition - PHI
2. Operating Systems: A Design-Oriented Approach', Charles Crowley, 'Tata Hill Co.,1998 edition.
3. Modern Operating Systems, Andrew S.Tanenbaum, , 2nd edition, 1995, PHI.
4. Operating Systems - A concept based approach, Dhamdhere, 2nd Edition, TMH, 2006.
5. Understanding the Linux Kernel, Daniel P Bovet and Marco Cesati, 3rd Edition,' Reilly, 2005.

MCA 3.2	COMPUTER NETWORKS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Introduction to Computer Networks:** Introduction, Network Hardware, Network Software, Reference Models, Data Communication Services & Network Examples, Internet Based Applications.

2. **Data Communications:** Transmission Media, Wireless Transmission, Multiplexing, Switching, Transmission in ISDN, **Broad** Band ISDN , ATM Networks,

3. Data Link Control, Error Detection & Correction, Sliding Window Protocols, LANs & MANs: IEEE Standards for LANs & MANs-IEEE Standards 802.2, 802.3, 802.4, 802.5, 802.6, High Speed LANs.

4. **Design Issues in Networks:** Routing Algorithms, Congestion Control Algorithms, Net work Layer in the Internet, IP Protocol, IP Address, Subnets, and Internetworking.

5. **Internet Transport Protocols:** TRANSPORT Service, Elements of Transport Protocols, TCP and UDP Protocols, Quality of Service Model, Best Effort Model, Network Performance Issues.

6. Over View of DNS, SNMP, Electronic Mail, FTP, TFTP, BOOTP, HTTP Protocols, World Wide Web, Firewalls.

7. **Network Devices:** Over View of Repeaters, Bridges, Routers, Gateways, Multiprotocol Routers, Brouters, Hubs, Switches, Modems, Channel Service Unit CSU, Data Service Units DSU, NIC, Wireless Access Points, Transceivers, Firewalls, Proxies.

8. Overview of Cellular Networks, Ad-hoc Networks, Mobile Ad-hoc Networks, Sensor Networks

Text Book:

1. Computer Networks, Andrews S Tanenbaum,, Edition 5, PHI, ISBN:-81-203-1165-5

References:

1. Data Communications and Networking , Behrouz A Forouzan , Tata McGraw-Hill Co Ltd , Second Edition, ISBN: 0-07-049935-7
2. Computer networks, Mayank Dave, CENGAGE.
3. Computer networks, A system Approach, 5th ed, Larry L Peterson and Bruce S Davie, Elsevier.
4. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education.
5. Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson.

MCA 3.3	WEB TECHNOLOGIES	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. Introduction to HTML , Core Elements , Links and Addressing, Images , Text , Colors and Background, Lists, Tables and Layouts , Frames, Forms , Cascading Style Sheets.

2. Introduction to Java Scripts, Elements of Objects in Java Script, Dynamic HTML with Java Script

3. Document type definition, XML Syntax, XML Schemas, Document Object model, Presenting XML, Using XML Processors

4. JDBC OBJECTS- JDBC Driver Types, JDBC Packages, Database Connection, Statement Objects, Result Set.

5. JDBC and Embedded SQL - Tables, Inserting Data into Tables , Selecting Data from a Table, Meta Data ,Updating Table , Deleting data from Table , Joining Table , Calculating Data, Grouping and Ordering Data , Sub quires ,View.

6. Introduction to Servlet, Servlet Life Cycles, Servlet Basics, Tomcat Web Server, Configuring Apache Tomcat, Handling Client Request and Response, Handling Cookies, Session Tracking

7. Introduction to JSP, Benefits of JSP, Basic Syntax, Invoking Java code with JSP Scripting Elements, JSP Page Directive, Including Files in JSP Pages,

8. Introduction to Java Beans, Using JAVA Bean Components in JSP Documents, MVC Architecture.

Text Books:

1. Web Programming, building internet applications, 2nd Ed., Chris Bates, Wiley Dreamtech
2. The complete Reference HTML and DHTML, Thomas A. Powey
3. The complete Reference J2ME, James Keogh
4. Core Servlets and Java Server Pages, Marty Hall Larry Brown, Second Edition

Reference Books:

1. Internet , World Wide Web , How to program, Dietel , Nieto, PHI/PEA
2. Web Tehnologies, Godbole, Kahate, 2nd Ed., TMH

MCA 3.4	OPERATIONS RESEARCH	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. Overview of Operations Research, Types of OR Models , Phases of Operations Research– OR Techniques, Introduction to Linear Programming, Formulation of Linear Programming Problem, Graphical Solution; Graphical Sensitivity Analysis,

2. Standard Form of LPP, Basic Feasible Solutions , Unrestricted Variables, Simplex Algorithm , Artificial Variables, Big M Method, Two Phase Simplex Method, Degeneracy, Alternative Optimal, Unbounded Solutions, Infeasible Solutions, Primal And Dual Problems And Their Relations, Dual Simplex Method

3. Transportation Problem as LPP, Initial Solutions, North West Corner Rule, Lowest Cost Method, Vogels Approximation Method, Optimum Solutions of TPP, Degeneracy in Transportation, Transportation Algorithms ,

4. Assignment Problem , Assignment Problem as LPP, Hungarian Method, Travelling Salesman Problem, Solutions Of TSP, Sequencing Problems, N-Jobs Two Machine Problems, N-Jobs K Machines Problems, Two-Jobs M- Machine Problems, Crew Scheduling Problems

5. Network Representation of A Project, CPM and PERT , Critical Path Calculations, Time – Cost Optimizations, PERT Analysis and Probability Considerations, Resource Analysis in Network Scheduling.

6. Replacement Problems-Individual And Group Replacement Policy, Reliability & System Failure Problems, Inventory-Factors Effecting Inventory-EOQ, Inventory Problems With and Without Shortages, Inventory Problems With Price Breakups, Multi Item Deterministic Problems. Probabilistic Inventory Problems

7. Non Linear Programming, Dynamic Programming, Recursive Nature of Dynamic Programming , Forward and Backward Recursion, Solutions of LPP As Dynamic Programming Technique, Integer Programming , Branch and Bound Algorithms, Cutting Plane Algorithm,

8. Introduction To Simulation, Simulation Models, Event Type Simulations, Generation of Random Numbers, Monte-Carle Simulation, Simulation Of Networks; Two Person Zero Sum Games, Mixed Strategy Games and Their Algorithms.

Text Books:

1. Operations Research, Kanti Swaroop, P.K. Gupta, Man Mohan, Sulthan Chand& Sons Education
2. Publishers Operations Research – An Introduction, Handy A Taha – Pearson Education .

References:

1. Operations Research Panneer Selvan Prentice Hall Of India.
2. Operations Research By S.D Sharma
3. Introduction To Operations Research, F.S. Hiller, G.J. Liberman, TMH
4. Operations Research, Richard Bronson, Schaum's Series, Mcgrawhill

MCA 3.5	Elective-II	ARTIFICIAL INTELLIGENCE
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. Introduction to Artificial Intelligence: Artificial Intelligence, AI Problems, AI Techniques, The Level of the Model, Criteria For Success. Defining the Problem as a State Space Search, Problem Characteristics , Production Systems, , Production System Characteristics

2. Search: Issues in The Design of Search Programs, Un-Informed Search, BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A^* Algorithm, Problem Reduction, AO^*Algorithm, Constraint Satisfaction, Means-Ends Analysis.

3. Knowledge Representation: Procedural Vs Declarative Knowledge, Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation, Logic Programming Forward Vs Backward Reasoning,

4. Symbolic Logic: Propositional Logic, First Order Predicate Logic: Representing Instance and is-a Relationships, Computable Functions and Predicates, Syntax & Semantics of FOPL, Normal Forms, Unification &Resolution, Representation Using Rules, Natural Deduction.

5. Structured Representations of Knowledge: Semantic Nets, Partitioned Semantic Nets, Frames, Conceptual Dependency, Conceptual Graphs, Scripts, Matching Techniques, Partial Matching, Fuzzy Matching Algorithms and RETE Matching Algorithms.

6. Reasoning under Uncertainty: Introduction to Non-Monotonic Reasoning, Truth Maintenance Systems, Statistical Reasoning: Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Probabilistic Inference, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic & Fuzzy Systems.

7. Experts Systems: Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Acquisition and Validation Techniques, Black Board Architecture, Knowledge Building System Tools, Expert System Shells,

8. Natural Language Processing: Role of Knowledge in Language Understanding, Approaches Natural Language Understanding, Steps in The Natural Language Processing, Syntactic Processing and Augmented Transition Nets, Semantic Analysis, NLP Understanding Systems; Planning, Components of a Planning System, Goal Stack Planning, Hierarchical Planning, Reactive Systems

Text Book:

Artificial Intelligence, Elaine Rich, McGraw-Hill Publications

References:

1. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI
2. Artificial Intelligence, George F Luger, Pearson Education Publications
3. Artificial Intelligence, Robert Schalkoff, Mcgraw-Hill Publications

MCA 3.5	Elective-II	COMPILER DESIGN
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **The Theory of Automata**: Definition and description, Transition systems, properties, Acceptability of string, NDFA, Equivalence in between DFA & NDFA. Grammars, Types of Grammars, Grammars and Automata, Regular expressions, Finite Automata and Regular expressions, Regular sets and Regular Grammars.
2. **Overall view of Compilers**: Brief discussion on various phases of Compilers.
3. **Design of** lexical analyzer.
4. **Design of Parsers**: Shift Reduce parser, Operator Precedence Parser, Predictive Parser, LR parser, SLR parser. LALR parser.
5. **Syntax Directed Translation**: Syntax directed translation and implementation, Intermediate code, Postfix notation, parsing tree, Three address Code, Quadruples, Triples.
6. **Intermediate Code Optimization**: The principle sources of optimization, Loop Optimization, DAG, Global data flow analysis.
7. **Code Generation**: Problems, Machine model, A simple code generator, Register allocation and assignment, Code generation from DAG, Peep hole optimization.
8. **Brief discussion** on symbol tables, Run-time storage administration.

Chapters: 1,2,3,4,5,6,7,9,10,11,12,15 of the text book.

Text Book

Principles of Compiler Design by Aho, D. Ullman

Reference Books:

Compiler Construction by Kenneth. C. Louden, Vikas Pub. House.

MCA 3.5	Elective-II	IMAGE PROCESSING
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Fundamentals of Image Processing** : Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels, distance measures, connectivity , Image Geometry, Photographic film. Histogram: Definition, decision of contrast basing on histogram, operatio ns basing on histograms like image stretching, image sliding, Image classification. Definition and Algorithm of Histogram equalization.

2. **Image Transforms** : A detail discussion on Fourier Transform, DFT,FFT, properties, WALSH Transform , WFT, HADAMARD Transform, DCT.

3. **Image Enhancement**: (by SPATIAL Domain Methods)Arithmetic and logical operations, pixel or point operations, size operations, Smoothing filters-Mean, Median, Mode filters – Comparative study, Edge enhancement filters – Directorial filters, Sobel, Laplacian, Robert, KIRSCH Homogeneity & DIFF Filters, prewitt filter, Contrast Based edge enhancement techniques. – Comparative study, Low Pass filters, High Pass filters, sharpening filters. – Comparative Study, Comparative study of all filters, Color image processing.

4. **Image enhancement** : (By FREQUENCY Domain Methods) -esign of Low pass, High pass, EDGE Enhancement, smoothening filters in Frequency Domain. Butter worth filter, Homomorphic filters in Frequency Domain Advantages of filters in frequency domain, comparative study of filters in frequency domain and spatial domain.

5. **Image compression: Definition**: A brief discussion on – Run length encoding, contour coding, Huffman code, compression due to change in domain, compression due to quantization Compression at the time of image transmission. Brief discussion on:- Image Compression standards.

6. **Image Segmentatio**n: Definition, characteristics of segmentation.

7. Detection of Discontinuities, Thresholding Pixel based segmentation method. Region based segmentation methods – segmentation by pixel aggregation, segmentation by sub region aggregation, histogram based segmentation, spilt and merge technique. Use of motion in segmentation (spatial domain technique only)

8. **Morphology:** Dilation, Erosion, Opening, closing, Hit-and-Miss transform, Boundary extraction, Region filling, connected components, thinning, Thickening, skeletons , Pruning Extensions to Gray – Scale Images Application of Morphology in I.P

Text Book:

Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods Addision Wesley

Reference books:

1. Fundamentals of Electronic Image Processing by Arthyr –R – Weeks, Jr.(PHI)
2. Image processing, Analysis, and Machine vision by Milan Sonka vaclan Halavac Roger Boyle, Vikas Publishing House.

MCA 3.5	Elective-II	EMBEDDED SYSTEMS
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Examples of Embedded Systems** – Typical Hardware – Memory – Microprocessors – Busses – Direct Memory Access – Introduction to 8051 Microcontroller – Architecture-Instruction set – Programming.
2. **Microprocessor Architecture** – Interrupt Basics – The Shared-Data problem – Interrupt Latency.
3. **Round–Robin Architecture -** Round–Robin with Interrupts Architecture - Function-Queue- Scheduling Architecture – Real-Time Operating Systems Architecture – Selection of Architecture.
4. **Tasks and Task States** – Tasks and Data – Semaphores and Shared Data – Semaphore Problems – Semaphore variants.
5. **Message Queues** – Mailboxes – Pipes – Timer Functions – Events – Memory Management – Interrupt Routines in RTOS Environment.
6. **RTOS design** – Principles – Encapsulation Semaphores and Queues – Hard Real-Time Scheduling Considerations – Saving Memory Space – Saving Power.
7. **Host and Target Machines** – Linker/Locator for Embedded Software- Getting Embedded Software into the Target System.
8. **Testing on your Host Machine** – Instruction Set Simulators – Laboratory Tools used for Debugging.

Text Book:

The 8051 Microcontroller Architecture, Programming & Applications, Kenneth J. Ayala, Penram International.

An Embedded Software Primer, David E. Simon, Pearson Education , 2005.

Reference Book:

Embedded Systems: Architecture , Programming and Design, Raj Kamal, Tata McGraw-Hill Education, 2008

MCA 3.6	WEB TECHNOLOGIES LAB	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

1. Design of the Web pages using various features of HTML and DHTML
2. Client server programming using Servlets, ASP and JSP on the server side and java script on the client side
3. Web enabling of databases
4. Multimedia effects on web pages design using Flash.
5. Case Study: Design & Development of Websites with Database Connectivity and Multimedia Effects

Reference Books:

1. Internet and Web Technologies by Raj Kamal, Tata McGraw-Hill
2. Programming the World Wide Web by Robert W. Sebesta, Pearson Education

MCA 3.7	OPERATING SYSTEMS LAB	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

1. Study of laboratory environment:

   Hardware specifications, software specifications

2. Simple Unix-C programs:

   Programs using system calls, library function calls to display and write strings on standard output device and files.

3. Programs using fork system calls.
2. Programs for error reporting using errno, perror( ) function.
3. Programs using pipes.
4. Shell programming.
5. Programs to simulate process scheduling like FCFS, Shortest Job First and Round Robin.
6. Programs to simulate page replacement algorithms like FIFO, Optimal and LRU.
7. Programs to simulate free space management.
8. Programs to simulate virtual memory.
10. Programs to simulate deadlock detection.

References:

1. Unix Systems Programming : Communication, Concurrency and Threads, Kay Robbins, 2-Edition, Pearson Education
2. Unix concepts and applications, Sumitabha Das, TMH Publications.
3. Unix programming, Stevens, Pearson Education.
4. Shell programming, Yashwanth Kanetkar.
5. Operating System Concepts, Silberschatz, and Peter Galvin.

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IV SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 4.1	Network Security & Cryptography	4	--	70	30	100	4
MCA 4.2	Software Engineering	4	--	70	30	100	4
MCA 4.3	Data Warehousing & Data Mining	4	--	70	30	100	4
MCA 4.4	Elective III	4	--	70	30	100	4
MCA 4.5	MOOCS-I	4	--	70	30	100	2
MCA 4.6	Software Engineering Lab	--	3	50	50	100	2
MCA 4.7	Advanced Programming with R Lab	--	3	50	50	100	2
Total		20	6	450	250	700	22

Elective III : Distributed Systems/ Mobile Computing/ Design and Analysis of Algorithms

MOOCS-I :

Each student should learn any one of the following topics by registering for courses through Online instruction from standard e-learning portals like nptel, coursera, etc. and write the examination conducted as per the university norms.

List of topics for MOOCS-I:

Data Visualization using Tableau, Internet of Things, Recommender systems, Mobile Application Development, Social Network Analysis, DevOps.

MCA 4.1	NETWORK SECURITY AND CRYPTOGRAPHY	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

1. Introduction :Confidentiality -- Data Integrity -- Authentication -- Non-Repudiation-- Overview of Issues involved.

2. Classical Encryption Techniques: Monoalphabetic, Substitution Methods, Polyalphabetic Substation Methods -- Permutation Methods -- Cryptanalysis of these Methods.

3. Modern Encryption Techniques: Simplified DES -- DES -- Triple DES -- Block Cipher , Design Principles -- Block Cipher Modes of Operation. IDEA -- Security Issues Involved with these methods.

4. Confidentiality Using Conventional Encryption : Placement of Encryption -- Traffic Confidentiality -- Key Distribution -- Random Number , Generation.

5. Introduction to Number Theory: (Basics Pertaining to Security Related Algorithms).

6. Public Key Cryptography : Principles -- RSA Algorithm. Message Authentication and Hash Functions -- Hash an MAC Algorithms. Digi Signatures and Authentication Protocols -- Authentication Applications

7. Basic Overview of :Electronic Mail Security -- IP Security -- WEB Security
8. System Security : Intruders, Viruses and Worms -- Firewalls

Text Book:

Cryptography and Network Security, William Stallings. (Second Edition) Pearson Education Asia

Reference:

1. Network Security: The Complete Reference by Roberta Bragg, Mark Phodes-Ousley, Keith Strassberg Tata Mcgraw-Hill

2. Handbook of Applied Cryptography

MCA 4.2	SOFTWARE ENGINEERING	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

1. **Introduction to Software Engineering:** Nature Of The Software, Types Of Software , Software Engineering Projects, Software Engineering Activities, Software Quality, Introduction To Object Orientation, Concepts Of Data Abstraction, Inheritance & Polymorphism, Software Process Models-Waterfall Model, The Opportunistic Model , The Phased Released Model, The Spiral Model, Evolutionary Model, The Concurrent Engineering Model

2. **Requirements Engineering:** Domain Analysis, Problem Definition And Scope, Requirements Definition, Types Of Requirements, Techniques For Gathering And Analyzing Requirements, Requirement Documents, Reviewing, Managing Change In Requirements.

3. **Unified Modeling Language & Use Case Modeling:** Introduction To UML, Modeling Concepts, Types Of UML Diagrams With Examples; User-Centred Design, Characteristics Of Users, Developing Use Case Models Of Systems, Use Case Diagram, Use Case Descriptions, The Basics Of User Interface Design, Usability Principles, User Interfaces.

4. **Class Design and Class Diagrams**: Essentials Of UML Class Diagrams, Associations And Multiplicity, Other Relationships, Generalization, Instance Diagrams, Advanced Features Of Class Diagrams, Interaction And Behavioural Diagrams: Interaction Diagrams, State Diagrams, Activity Diagrams, Component And Deployment Diagrams.

5. **Software Design And Architecture**
   The Process Of Design, Principles Leading To Good Design, Techniques For Making Good Design Decisions, Writing A Good Design Document., Pattern Introduction, Design Patterns: The Abstraction-Occurrence Pattern, General Hierarchical Pattern, The Play-Role Pattern, The Singleton Pattern, The Observer Pattern, The Delegation Pattern, The Adaptor Pattern, The Façade Pattern, The Immutable Pattern, The Read-Only Interface Pattern And The Proxy Pattern; Software Architecture Contents Of An Architecture Model, Architectural Patterns: The Multilayer, Client-Server, Broker, Transaction Processing, Pipe & Filter And MVC Architectural Patterns

6. **Software Testing**
   Overview Of Testing, Testing Concepts, Testing Activities, Testing Strategies, Unit Testing, Integration Testing, Function Testing, Structural Testing, Class Based Testing Strategies, Use Case/Scenario Based Testing, Regression Testing, Performance Testing, System Testing, Acceptance Testing, Installation Testing, OO Test Design Issues, Test Case Design, Quality Assurance, Root Cause Analysis, Post-Mortem Analysis.

7. **Software Project Management**
   Introduction To Software Project Management, Activities Of Software Project Management, Structure Of Project Plan, Software Engineering Teams, Software Cost Estimation, Project Scheduling, Tracking And Monitoring.

Text Book:

1. Object-Oriented Software Engineering Practical software development using UML and Java by Timothy C. Lethbridge & Robert, Langaniere Mcgraw-Hill

References:

1. Object-Oriented Software Engineering: Using UML, Patterns and Java, Bernd Bruegge and Allen H. Dutoit, 2nd Edition, Pearson Education Asia.

2. Software Engineering: A Practitioner's Approach, Roger S Pressman.

3. A Practical Guide to Testing Object-Oriented Software, John D. McGregor; David A. Sykes, Addison-Wesley Professional.

MCA 4.3	DATA WAREHOUSING & DATA MINING	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

1. Introduction to Data Mining: Motivation and importance, What is Data Mining, Relational Databases, Data Warehouses, Transactional Databases, Advanced Database Systems and Advanced Database Applications, Data Mining Functionalities, Interestingness of a pattern Classification of Data Mining Systems, Major issues in Data Mining.
2. Data Warehouse and OLAP Technology for Data Mining: Data Warehouse, Multi-Dimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Development of Data Cube Technology, Data Warehousing to Data Mining
3. Data Preprocessing: Pre-process the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation
4. Data Mining Primitives, Languages and system Architectures,Data Mining Primitives: What defines a Data Mining Task?, A Data Mining query language, Designing Graphical Use Interfaces Based on a Data Mining Query language,Architectures of Data Mining Systems
5. Concept Description: Characterization and comparison ,Concept Description?, Data Generalization and summarization-based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between different Classes, Mining Descriptive Statistical Measures in large Databases
6. Mining Association rule in large Databases, Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint-Based Association Mining
7. Classification and prediction, Concepts and Issues regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back-propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods like k-Nearest Neighbor Classifiers, Case- Based Reasoning, Generic Algorithms, Rough Set Approach, Fuzzy Set Approaches, Prediction, Classifier Accuracy
8. Cluster Analysis: Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods

Text Book:

Data Mining Concepts and Techniques, Jiawei Han and Kamber, Morgan Kaufman Publications

Reference Books:

1. Introduction to Data Mining, Adriaan, Addison Wesley Publication

2. Data Mining Techniques, A.K.Pujari, University Press

MCA 4.4	Elective III	Distributed Systems	
Instruction: 3 Periods & 1 Tut/week			Credits:4
Internal: 30 Marks		University Exam: 70 Marks	Total: 100 Marks

1. Features of Distributed versus Centralized Databases, Principles Of Distributed Databases, Levels Of Distribution Transparency, Reference Architecture for Distributed Databases , Types of Data Fragmentation, Integrity Constraints in Distributed Databases.
2. Translation of Global Queries to Fragment Queries, Equivalence Trans-formations for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries.
3. Optimization of Access Strategies, A Framework for Query Optimization, Join Queries, General Queries.
4. The Management of Distributed Transactions, A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions.
5. Concurrency Control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control.
6. Reliability, Basic Concepts, Nonblocking Commitment Protocols, Re-liability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart, Distributed Database Administration, Catalog Management in Distributed Databases, Authorization and Protection
7. Architectural Issues, Alternative Client/Server Architectures, Cache Consistency Object Management, Object Identifier Management, Pointer Swizzling, Object Migration, Distributed Object Storage, Object Query Processing, Object Query Processor Architectures, Query Processing Issues, Query Execution , Transaction Management, Transaction Management in Object DBMSs , Transactions as Objects.
8. Database Integration, Scheme Translation, Scheme Integration, Query Processing Query Processing Layers in Distributed Multi-DBMSs, Query Optimization Issues. Transaction Management Transaction and Computation Model Multidatabase Concurrency Control, Multidatabase Recovery, Object Orientation And Interoperability Object Management Architecture CORBA and Database Interoperability Distributed Component Model COM/OLE and Database Interoperability, PUSH-Based Technologies

Text Books:

1. Distributed Database Principles and Systems, Stefano Ceri, Giuseppe Pelagatti, McGraw-Hill

2. Principles of Distributed Database Systems, M.Tamer Ozsu, Patrick Valduriez - Pearson Education.

3. Distributed Database Principles and Systems, Stefano Ceri, Giuseppe Pelagatti, McGraw-Hill

Reference Books:

Principles of Distributed Database Systems, M.Tamer Ozsu, Patrick Valduriez - Pearson Education.

MCA 4.4	Elective III	MOBILE COMPUTING
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. **Introduction to Mobile Communications and Computing:** Introduction to cellular concept, Frequency Reuse, Handoff, GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services, Introduction to mobile computing, novel applications, limitations, and architecture.

2. **Wireless LANs:** Introduction, Advantages and Disadvantages of WLANs, WLAN Topologies, Introduction to Wireless Local Area Network standard IEEE 802.11, Comparison of IEEE 802.11a, b, g and n standards, Wireless PANs, Hiper LAN, Wireless Local Loop

3. **Wireless Networking:** Introduction, Various generations of wireless networks, Fixed network transmission hierarchy, Differences in wireless and fixed telephone networks, Traffic routing in wireless networks, WAN link connection technologies, X.25 protocol, Frame Relay, ATM, Virtual private networks, Wireless data services, Common channel signaling, Various networks for connecting to the internet.

4. **Database Issues:** Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, file system, disconnected operations.

5. **Data Dissemination:** Communications asymmetry, classification of new data delivery mechanisms, push-based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques.

6. **Mobile IP and Wireless Application Protocol:** Introduction to Mobile IP, Introduction to Wireless Application Protocol, Application layer.

TEXT BOOKS:

1. Gottapu Sasibhushana Rao, "Mobile Cellular Communication", Pearson Education, First Edition, 2013.
2. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002.

MCA 4.4	Elective III	DESIGN AND ANALYSIS OF ALGORITHMS
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Course Objectives:
On completing this course student will be able to :

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Synthesize efficient algorithms in common engineering design situations.

Course Outcomes:

1. Students will be able to Argue the correctness of algorithms using inductive proofs and invariants and Analyze worst-case running times of algorithms using asymptotic analysis.
2. Describe the various paradigms of design when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm and synthesize them
3. Students will be able to Compare between different data structures. Pick an appropriate data structure for a design situation.

Syllabus

1. Introduction – Fundamentals of algorithmic problem solving – important problem type. Fundamentals of analysis of algorithms and efficiency – Analysis framework – Asymptotic Notations and Basic Efficiency classes – Mathematical Analysis of Non- recursive Algorithms – Mathematical Analysis of recursive Algorithms – Empirical Analysis of Algorithms – Algorithm Visualization

2. **Brute Force** – Selection Sort and Bubble sort – Sequential Search and Brute – Force String Matching – Closest Pair and Convex-Hull Problems by Brute Force – Exhaustive Search Divide-and-Conquer – Merge sort – Quick sort – Binary Search – Binary Tree Traversals and Related Properties – Multiplication of large integers and Strassen's Matrix Multiplication – Closest- Pair Convex-Hull Problems by Divide- and – Conquer

3. **Decrease – and – Conquer** – Insertion Sort – Depth-First Search and Breadth-First Search-Topological Sorting – Algorithms for Generating Combinatorial Objects – Decrease-by-a-Constant-Factor Algorithms – Variable-Size-Decrease Algorithms.

4. **Transform-and-Conquer** – Presorting – Gaussian Elimination – Balanced Search Trees – Heaps and Heap sort – Horner's Rule and Binary Exponentiation – Problem Reduction

   Space and Time Tradeoffs – Sorting by Counting – Input Enhancement in string Matching – Hashing – B-Trees

5. **Dynamic Programming** – Computing a Binomial Coefficient – Warshall's and Floyd's Algorithm – Optimal Binary Search Trees - The Knapsack Problem and Memory Functions

6. **Greedy Technique** – Prim's Algorithm – Kruskal's Algorithm – Dijkstra's Algorithm– Huffman Trees **Limitations of Algorithm Power** – Lower-Bound Arguments – Decision Trees – P, NP and NP – complete problems – Challenges of Numerical Algorithms

7. **Coping with the Limitations of Algorithms Power** – Backtracking – Branch-and-Bound – Approximation Algorithms for NP-hard Problems – Algorithms for solving Nonlinear Equations.

Text Book:

1. Introduction to Design & Analysis of Algorithms by Anany Levitin, Pearson Education, New Delhi, 2003
2. Fundamentals of Computer Algorithms, Horowitz and Sahni, Galgothia publications.

Reference Books:

1. Introduction to Algorithms by Thomas H. Corman, Charles E. Leiserson, Ronald R. Rivest & Clifford Stein, Prentice Hall of India, New Delhi, New Delhi.

MCA 4.6	SOFTWARE ENGINEERING LAB	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

1. The purpose of the Software Engineering Lab course is to familiarize the students with modern software engineering methods and tools, **Rational Products**. The course is realized as a project-like assignment that can, in principle, by a team of three/four students working full time. Typically the assignments have been completed during the semester requiring approximately 60-80 hours from each project team.
2. The goal of the Software Engineering Project is to have a walk through from the requirements, design to implementing and testing. An emphasis is put on proper documentation. Extensive hardware expertise is not necessary, so proportionate attention can be given to the design methodology.
3. Despite its apparent simplicity, the problem allows plenty of alternative solutions and should be a motivating and educating exercise. Demonstration of a properly functioning system and sufficient documentation is proof of a completed assignment
4. Term projects are projects that a group student or might take through from initial specification to implementation. The project deliverables include

Projects

:

- Documentation including
  - A problem statement
  - A requirements document
    - A Requirements Analysis Document.
    - A System Requirements Specification.
    - A Software Requirements Specification.
- A design document
  - A Software Design Description and a System Design Document.
- A test specification.
- Manuals/guides for
  - Users and associated help frames
  - Programmers
  - Administrators (installation instructions)

- A project plan and schedule setting out milestones, resource usage and estimated costs.
- A quality plan setting out quality assurance procedures
- An implementation.

References

1. Project-based software engineering: An Object-oriented approach, Evelyn Stiller, Cathie LeBlanc, Pearson Education
2. Visual Modelling with Rational Rose 2002 and UML, Terry Quatrini, Pearson Edusction
3. UML2 Toolkit, Hans-Erik Eriksson, etc; Wiley

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MCA 4.7	ADVANCED PROGRAMMING WITH R LAB	
Instruction: 3 Periods/week		Credits:2
Internal: 50 Marks	University Exam: 50 Marks	Total: 100 Marks

1.
   a. To create a data frame df1 to contain 10 observations and 3 variables, column 1 with letters, column 2 with random numbers and column 3 with first 10 natural numbers.
   b. Create df3 by merging df1 by column1 with another data frame df2 containing 20 observations and 2 variables column4 with letters, column5 with sequence of 20 real numbers from 0 to 1 in equal steps
   c. Find the dimensionality of data frame df3.
   d. Rename observations whose column1 value is 'D' from data frame df3

2.
   a. Create h1 to contain 1000 random numbers, distributed in normal distribution and plot the histogram with colors.
   b. Create a data frame to contain randomly drawn samples of 25 cards from 52 distinct cards with replacements. Use 'table' function to find the 'duplicated' and tabulate the list of cards and their frequency of occurrence in the sample.

1. Write R Program using 'apply' group of functions to create and apply normalization function on each of the numeric variables/columns of iris dataset to transform them into
   a. 0 to 1 range with min-max normalization.
   b. a value around 0 with z-score normalization.

2. Create a data frame with 10 observations and 3 variables and add new rows and columns to it using 'rbind' and 'cbind' function.

3. Create a function to discretize a numeric variable into 3 quantiles and label them as low, medium, and high. Apply it on each attribute of iris dataset to create a new data frame. 'discrete_iris' with Categorical variables and the class label.

4. Write R program to find the approximate value of π (pi) by simulation using a large number of uniformly distributed data points with their coordinates in the range of [-1,1] and find the ratio of number of points within the circle of radius 1, to total number of data points. Observe the improvement in accuracy of result with the increased number of data points distributed.

5. Write R programs to find the probability of a variable to have a given value in different distributions like Uniform, Normal, Poisson and Binomial using 'pnorm', 'ppois', and the other such functions.

8. Apply 'ddply' for data summarization of iris dataset based on 'species' and get the same summarization using 'sqldf'

9. After attaching data set 'mtcars' to access its variables, use R statements to visulalize the relationship between the variables of 'mtcars':

   a. using scatter plots with colors.
   b. boxplots showing the spread of the variable 'mpg' for different values of 'cyl'.
   c. Find correlations between all pairs of variables.

10. Write R program to implement linear and multiple regression on ‘mtcars’ dataset to estimate the value of ‘mpg’ variable, with best R^2 and plot the original values in ‘green’ and predicted values in ‘red’.

11. Write R program to create new variables in low dimensional space using
    a. PCA and
    b. SVD and use them for predicting the values of ‘mpg’ variable.

12. Write R Programs to apply k-mean clustering on ‘iris’ data set and get the summary statistics.
    Implement a mini-project to process a collection of text documents / tweets and apply tokenization, stopword removal and stemming to represent the collection as a document – term matrix reflecting the term frequencies. Cluster the documents using a simple clustering algorithm and estimate the purity of the clustering solution.

MASTER OF COMPUTER APPLICATIONS (M.C.A)

COURSE STRUCTURE AND SCHEME OF VALUATION W.E.F. 2016-17

V SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 5.1	Wireless Ad-hoc Networks	4	--	70	30	100	4
MCA 5.2	Big Data Analytics	4	--	70	30	100	4
MCA 5.3	Elective IV	4	--	70	30	100	4
MCA 5.4	Cyber Scurity and Digital Forensics	4	--	70	30	100	4
MCA 5.5	MOOCS-II	--	--	--	--	100	4
MCA 5.6	Data Analytics Lab	--	3	50	50	100	2
MCA 5.7	Mini Project Using DBMS & OOSE Concepts	--	3	50	50	100	2
Total		16	6	450	220	700	24

Elective IV: Cloud Computing / Soft Computing/ Bio-Informatics/ E-Commerce
MOOCS-II :

Each student should learn any one of the following topics by registering for courses through Online instruction from standard e-learning portals like nptel, coursera, etc. and write the examination conducted as per the university norms.

List of topics for MOOCS-II:

Python programming, Machine Learning, Agile Methods for Software Development, problem solving using Matlab, Programming in Rasberry Pi Platform, Mongo DB for Developers

MCA 5.1	WIRELESS AND AD-HOC NETWORKS	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

1. Introduction: Introduction to Wireless Networks, Various Generations of Wireless Networks, Virtual Private Networks- Wireless Data Services, Common Channel Signaling, Various Networks for Connecting to the Internet, Blue tooth Technology, Wifi-WiMax- Radio Propagation mechanism , Pathloss Modeling and Signal Coverage

2. WIRELESS LOCAL AREA NETWORKS: Introduction-WLAN topologies-IEEE 802.11 Standards , MAC Protocols,Comparision of 802.11 a,b,g and n Standards, HIPER LAN , ZigBee 802.15.4**,** Wireless Local Loop

3. Wireless Adhoc Networks: Basics of Wireless Networks, Infrastructured Versus Infrastructureless Networks – Properties of Wireless, AD hoc Networks, Types of Ad Hoc Networks, Challenges in AD Hoc Networks –Applications of Wireless AD Hoc Networks

4. Routing Protcols for Ad Hoc Networks:Introduction-Proactive Routing Protocols- Reactive Routing protocols-Hybrid Routing Protocols-QoS Metrics-Energy impact issues in Routing.

5. Mobile Ad Hoc Networks (MANETs): Overview, Properties of A MANET, Spectrum of MANET Applications, Routing and Various Routing Algorithms.

6. Other Wireless Technologies**:** Introduction, IEEE 802.15.4 and Zigbee, General Architecture, Physical Layer, MAC layer, Zigbee, WiMAX and IEEE 802.16, Layers and Architecture, Physical Layer, OFDM Physical layer.

7. Security in Ad Hoc Networks: Introduction- Security Attacks, Intrusion Detection System, Intrusion Prevention system, Intrusion Response system, Wired Equivalent Privacy(WEP) -A Security Protocol for Wireless Local Area Networks (WLANs), Security in MANETs.

Text Books:

1. Principles of Wireless Networks , Kaveth Pahlavan, K. Prasanth Krishnamurthy, Pearson Publications, Asia, 2002
2. Mobile Cellular Communications, G.Sasibhusan Rao, “”, Pearson Publications.

References:

1. Guide to Wireless Ad Hoc Networks: Series: Computer Communications and Networks, Misra, Sudip; Woungang, Isaac; Misra, Subhas Chandra, 2009, Springer

MCA 5.2	BIGDATA ANALYTICS	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Course Objectives:

On completing this course student will be able to

1. Understand big data and Apache Hadoop Eco system
2. Understand distributed , parallel, cloud computing and SQL concepts
3. Apply Hadoop concepts
4. Understand concepts of map and reduce and functional programming

Course Outcomes :

1. Gain conceptual understanding of analytics concepts, algorithms and statistical tests

2. Students will be able to look at the core projects used for both batch and real time data processing such as Hadoop
3. Students will be able to look at wider range of problems and data science based solutions

Syllabus:

1. **Introduction to Big Data:** Big Data-definition, Characteristics of Big Data (Volume, Variety, Velocity, Veracity, Validity), Importance of Big Data , Patterns for Big Data Development, Data in the Warehouse and Data in Hadoop,

2. **Introduction to Hadoop:** Hadoop- definition, Understanding distributed systems and Hadoop, Comparing SQL databases and Hadoop, Understanding MapReduce, Counting words with Hadoop—running your first program, History of Hadoop, Starting Hadoop - The building blocks of Hadoop, NameNode, DataNode, Secondary NameNode, JobTracker and Task Tracker

3. **MapReduce** -A Weather Dataset, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop, Scaling Out, Hadoop Streaming, Hadoop Pipes, Developing a MapReduce Application - The Configuration API, Configuring the Development Environment, Running Locally on Test Data, Running on a Cluster, Tuning a Job, MapReduce Workflows

4. **HDFS:** Components of Hadoop -Working with files in HDFS, Anatomy of a MapReduce program, Reading and writing the Hadoop Distributed File system -The Design of HDFS, HDFS Concepts, The Command-Line Interface, Hadoop Filesystem, The Java Interface, Data Flow, Parallel Copying with distcp, Hadoop Archives

5. **MapReduce Programming:** Writing basic Map Reduce programs - Getting the patent data set, constructing the basic template of a Map Reduce program, Counting things, Adapting for Hadoop's API changes, Streaming in Hadoop, Improving performance with combiners.

6. **MapReduce Advanced Programming:** Advanced MapReduce - Chaining MapReduce jobs, joining data from different sources, creating a Bloom filter, Passing job-specific parameters to

your tasks, probing for task-specific information, Partitioning into multiple output files, Inputting from and outputting to a database, keeping all output in sorted order

7. **Graph Representation in MapReduce:** Modeling data and solving problems with graphs, Shortest Path Algorithm, Friends-of-Friends Algorithm, PageRank Algorithm, Bloom Filter, Parallelized Bloom filter creation in MapReduce, Map-Reduce semi-join with Bloom filters

Textbooks:

1. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch ,"Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", 1st Edition, TMH,2012.

2. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly

Reference Books:

1. Hadoop in Action by Chuck Lam, MANNING Publ.
2. Hadoop in Practice by Alex Holmes, MANNING Publishers
3. Mining of massive datasets, Anand Rajaraman, Jeffrey D Ullman, Wiley Publications.

MCA 5.3	Elective-IV	CLOUD COMPUTING
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. Cloud Computing Basics - Cloud Computing Overview, Applications, Intranets and the Cloud, First Movers in the Cloud. The Business Case for Going to the Cloud - Cloud Computing Services, Business Applications, Deleting Your Datacenter, Salesforce.com, Thomson Reuters.

2. Organization and Cloud Computing - When You Can Use Cloud Computing, Benefits, Limitations, Security Concerns, Regulatory Issues, Cloud Computing with the Titans - Google, EMC, NetApp, Microsoft, Amazon, Salesforce.com, IBMPartnerships.

3. Hardware and Infrastructure - Clients, Security, Network, Services. Accessing the Cloud - Platforms, Web Applications, Web APIs,Web Browsers. Cloud Storage - Overview, Cloud Storage Providers, Standards - Application, Client, Infrastructure, Service.

4. Software as a Service - Overview, Driving Forces, Company Offerings, Industries Software plus Services - Overview, Mobile Device Integration, Providers, Microsoft Online.

5. Developing Applications - Google, Microsoft, Intuit QuickBase, Cast Iron Cloud, Bungee Connect, Development, Troubleshooting, Application Management.

6. Local Clouds and Thin Clients - Virtualization in Your Organization, Server Solutions, Thin Clients, Case Study: McNeilus Steel.

7. Migrating to the Cloud - Cloud Services for Individuals, Cloud Services Aimed at the Mid-Market, Enterprise-Class Cloud Offerings, Migration, Best Practices and the Future of Cloud Computing - Analyze Your Service, Best Practices, How Cloud Computing Might Evolve.

Text Books:

1. Cloud Computing-A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGrawHill.

MCA 5.3	Elective-IV	SOFT COMPUTING
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

1. Soft Computing: Introduction to Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Different Tools and Techniques, Usefulness and Applications.

2. Fuzzy Sets and Fuzzy Logic: Introduction, Fuzzy Sets Versus Crisp Sets, Operations on Fuzzy Sets, Extension Principle, Fuzzy Relations and Relation Equations, Fuzzy Numbers, Linguistic Variables, Fuzzy Logic, Linguistic Hedges, Applications,

3. Interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzifications and Defuzzificataions, Fuzzy Controller, Fuzzy Controllers, Fuzzy Pattern Recognition, Fuzzy Image Processing, Fuzzy Database.

4. Artificial Neural Network: Introduction, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, re-current networks. Various learning techniques, perception and convergence rule, Auto-associative and hetro-associative memory , Hebb's Learning, Adaline, Perceptron

5. Multilayer Feed Forward Network, Back Propagation Algorithms, Different Issues Regarding Convergence of Multilayer Perceptron, Competitive Learning, Self-Organizing, Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

6. Evolutionary and Stochastic Techniques: Genetic Algorithm (GA), Genetic Representations, (Encoding) Initialization and Selection, Different Operators of GA, Analysis of Selection Operations, Hypothesis of Building Blocks, Schema Theorem and Convergence of Genetic Algorithm, Simulated Annealing and Stochastic Models, Boltzmann Machine, Applications.

7. Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables and Applications.

8. Hybrid Systems: Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications

Text Books:

1. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, S. Rajsekaran and G.A. Vijayalakshmi Pai, Prentice Hall of India.
2. Rough Sets, Z.Pawlak, Kluwer Academic Publisher, 1991.
3. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher, 1997

References:

1. Artificial Intelligence and Intelligent Systems, N.P.Padhy, Oxford University Press.
2. Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice Hall PTR. Addison-Wesley
3. Learning and Soft Computing, V. Kecman, MIT Press, 2001
4. Fuzzy Sets and Fuzzy Logic, Klir & Yuan, PHI, 1997

MCA 5.3	Elective-IV	BIOINFORMATICS	
Instruction: 3 Periods & 1 Tut/week			Credits:4
Internal: 30 Marks		University Exam: 70 Marks	Total: 100 Marks

1. Introduction: Definitions, Sequencing, Biological Sequence/Structure, Genome Projects, Pattern Recognition a Prediction, Folding Problem, Sequence Analysis, Homology and Analogy.

2. Protein Information Resources: Biological Databases, Primary Sequence Databases, Protein Sequence Databases, Secondary Databases, Protein Pattern Databases, and Structure Classification Databases.

3. Genome Information Resources: DNA Sequence Databases, Specialized Genomic Resources

4. DNA Sequence Analysis: Importance Of DNA Analysis, Gene Structure And DNA Sequences, Features Of DNA Sequence Analysis, EST (Expressed Sequence Tag) Searches, Gene Hunting, Profile of A Cell, EST Analysis, Effects Of EST Data on DNA Databases.

5. Pair Wise Alignment Techniques :Database Searching, Alphabets and Complexity, Algorithm and Programs, Comparing Two Sequences, Sub-Sequences, Identity and Similarity, The Dotplot, Local and Global Similarity, Different Alignment Techniques, Dynamic Programming, Pair Wise Database Searching.

6. Multiple Sequence Alignment : Definition And Goal, The Consensus, Computational Complexity, Manual Methods, Simultaneous Methods, Progressive Methods, Databases of Multiple Alignments And Searching

7. Secondary Database Searching : Importance And Need of Secondary Database Searches, Secondary Database Structure and Building a Sequence Search Protocol .

8. Analysis Packages : Analysis Package Structure, Commercial Databases, Commercial Software, Comprehensive Packages, Packages Specializing in DNA Analysis, Intranet Packages, Internet Packages.

Text Books:

1. Introduction To Bioinformatics, By T K Attwood & D J Parry-Smith
Addison Wesley Longman

2. Bioinformatics- A Beginner's Guide By Jean-Michel Claveriw, Cerdric Notredame, WILEY
Dreamlech India Pvt. Ltd

Reference Books:

1. Introduction To Bioinformatics By M. Lesk OXFORD Publishers (Indian Edition)

MCA 5.3	Elective-IV	E-COMMERCE
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

1. Introduction: Electronic Commerce-Frame Work, Anatomy of E-Commerce Applications, E-Commerce Consumer Applications, E-Commerce Organization Applications. Consumer Oriented Electronic Commerce - Mercantile Process Models.

2. Electronic Payment Systems – Types of Electronic Payment Systems, Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment Systems, Designing Electronic Payment Systems

3. Electronic Data Inter Change, Inter Organizational Commerce - EDI, EDI Implementation, Value Added Networks.

4. Intra Organizational Commerce, Macro Forces And Internal Commerce, Work Flow Automation and Coordination, Customization And Internal Commerce, Supply Chain Management.

5. Business Cases for Document Library, Digital Document Types, Corporate Data Ware-Houses.

6. Advertising And Marketing: Information Based Marketing, Advertising On Internet, Online Marketing Process, Market Research. Consumer Search and Resource Discovery, Information Search and Retrieval, Commerce Catalogues, Information Filtering.

7. Multimedia-Key Multimedia Concepts, Digital Video and Electronic Commerce, Desktop Video Processing, Desktop Video Conferencing.

Text Books:

1. Frontiers of Electronic Commerce, Kalakata and Whinston, Pearson.

References

1. E-Commerce fundamentals and Applications, Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, John Wiley.
2. E-Commerce, S.Jaiswal, Galgotia.
3. E-Commerce, Efrain Turbon, Jae Lee, David King, H.Michael Chang.
4. E-Commerce - Business, Technology and Society, Kenneth C.Taudon, Carol Guyerico Traver.

MCA 5.4	CYBER SECURITY AND DIGITAL FORENSICS	
Instruction: 3 Periods & 1 Tut/week		Credits:4
Internal: 30 Marks	University Exam: 70 Marks	Total: 100 Marks

Introduction to Information Security Fundamentals and Best Practices

- Protecting Your Computer and its Contents
- Securing Computer Networks--Basics of Networking
- Compromised Computers
- Secure Communications and Information Security Best Practices
- Privacy Guidelines
- Safe Internet Usage

Ethics in Cyber Security & Cyber Law

- Privacy
- Intellectual Property
- Professional Ethics
- Freedom of Speech
- Fair User and Ethical Hacking
- Trademarks
- Internet Fraud
- Electronic Evidence
- Cybercrimes

Penetration Testing

- Overview of the web from a penetration testers perspective
- Exploring the various servers and clients
- Discussion of the various web architectures
- Discussion of the different types of vulnerabilities
- Defining a web application test scope and process
- Defining types of penetration testing

Web Application Security

- Common Issues in Web Apps
  What is XSS, SQL injection, CSRF, Password Vulnerabilities, SSL, CAPTCHA, Session Hijacking, Local and Remote File Inclusion, Audit Trails, Web Server Issues

Forensics & Network Assurance

- Forensic Technologies
- Digital Evidence Collection
- Evidentiary Reporting
- Layered Defense
- Surveillance and Reconnaissance
- Outsider Thread Protection

Information Risk Management

- Asset Evaluation and Business Impact Analysis
- Risk Identification
- Risk Quantification
- Risk Response Development and Control
- Security Policy, Compliance, and Business Continuity
- Forensic investigation using AccessData FTK, En-Case

Cyber Incident Analysis and Response

- Incident Preparation
- Incident Detection and Analysis
- Containment, Eradication, and Recovery
- Proactive and Post-Incident Cyber Services
- CIA triangle

Books:

1. The Official CHFI Study Guide for Computer Hacking Forensic Investigator by Dave Kleiman
2. CISSP Study Guide, 6th Edition by James M. Stewart
3. www.**nist**.gov/

MCA 5.6	DATA ANALYTICS LAB	
Instruction: 3 Periods & 1 Tut/week		**Credits:4**
Internal: 30 Marks	**University Exam: 70 Marks**	**Total: 100 Marks**

Module-I on Data Mining

1. Introduction to the WEKA machine learning toolkit or R programming

   Create an ARFF (Attribute-Relation File Format) file and read it in WEKA. Explore the purpose of each button under the preprocess panel after loading the ARFF file. Also, try to interpret using a different ARFF file, *weather.arff*, provided with WEKA**.**

2. Performing data preprocessing in Weka – Part1

   Study **Unsupervised Attribute Filters** such as***ReplaceMissingValues*** to replace missing values in the given dataset, ***Add*** to add the new attribute *Average*, ***Discretize*** to discretize the attributes into bins. Explore ***Normalize*** and ***Standardize*** options on a dataset with numerical attributes.

3. Perform data preprocessing in WEKA – Part 2

   Study the **Unsupervised Instance Filters such as *Remove Range*** filter to remove the last two instances,

4. Classification using the WEKA toolkit – Part 1

   Explore classification process using ID3 algorithm on categorical dataset(weather).

   Explore classification process using naïve Bayes algorithm on categorical dataset ('vote').

   Explore classification process using Random Forest algorithm on datasets containing large number of attributes.

5. Classification using the WEKA toolkit – Part 2

   Explore classification process using J48 algorithm on mixed type of dataset after discretizing numeric attributes. Generate classification rules from a small dataset. Perform cross-validation strategy with various fold levels. Compare the accuracy of the results.

6. Performing clustering in WEKA
   a. Apply hierarchical clustering algorithm on numeric dataset and estimate cluster quality.
   b. Apply DBSCAN algorithm on numeric dataset and estimate cluster quality.
   c. Apply COBWEB clustering algorithm on categorical dataset and estimate cluster quality.

7. Association rule analysis in WEKA with different support and confidence thresholds

   Apply Association Rule Mining on supermarket dataset using Apriori Algorithm.

   Apply Association Rule Mining on supermarket dataset using FP-Growth Algorithm.

Module-II on Bigdata Analytics

1. (i)Perform setting up and Installing Hadoop in its three operating modes:

- Standalone,
- Pseudo distributed,
- Fully distributed.

(ii)Use web based tools to monitor your Hadoop setup.

Implement the following file management tasks in Hadoop:

- Adding files and directories
- Retrieving files
- Deleting files

Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.

3. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

4. Write a Map Reduce program that mines weather data.

Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.

5. Implement Matrix Multiplication with Hadoop Map Reduce

6. Write a Map Reduce program to implement Join operations on RDBMS.

7. Write a Map Reduce program to determine statistical measures

a) Variance
b) Max
c) Min
d) Range of a large data collection.

MCA 5.6	MINI PROJECT USING DBMS & OOSE CONCEPTS	
Instruction: 3 Periods/week		**Credits:2**
Internal: 50 Marks	**University Exam: 50 Marks**	**Total: 100 Marks**

Scope of the Mini Project:

1. Object Oriented Concepts: Requirement Engineering, Design Such as architecture, User Interface Design, Testing, Preparations User Manuals Etc and also

2. Design of DBMS Schema Including Normalization, Forms design, Report Generation, Linking to Web Data Bases Etc. Preferably on Live Projects

3. Periodical Presentations and Discussions Among the Groups and their Outputs.

MASTER OF COMPUTER APPLICATIONS (M.C.A)

COURSE STRUCTURE AND SCHEME OF VALUATION W.E.F. 2016-17

V SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MCA 6.1	Project Work	--	--	50	50	100	14

1. Three Stages In Project adjudication:
   - Stage I: Presentation of Concept Note & Problem Approval by Guide
   - Stage II; Progress Approval by System Demonstration with results Internal -50 Marks
   - Stage III: Final Presentation with Documentation & External Viva-Voce - 50 Marks
2. Candidates can do their thesis work within the department or in any industry/research organization for two semesters (4th semesters). In case of thesis done in an industry/research organization, one advisor (Guide) should be from the department and one advisor(CO-Guide) should be from the industry/research organization.
3. A publication of a paper on the thesis work in a National/International Conference proceedings with presentation certificate or a paper on the thesis work be communicated to a National/International Journal & accepted for publication for the submission of thesis at the end of 4th semester is desirable.
4. The external examiner shall be nominated by the Chairman, Board of Examiners in CSSE as per the norms of the University.

Code	Name of the subject			Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
Total (Complete Course)		96	30	2230	1270	3600	132