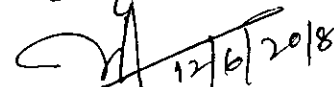



Minutes of the meeting held on 12/6/18 (10:30AM) regarding review of Syllabus and accordingly implementation of CBCS in MCA and M.Sc. (Comp. Sc.) programmes.

The committee gone through the entire syllabus of MCA and M.Sc. (Computer Science) provided by the office and prepared by T.M. B.U, Bhagalpur and recommends as follows :-

- i) The eligibility criteria for admission in M.Sc.(Comp.Sc.)/ MCA programme be given in detail, thereafter the committee can examine the courses offered in different semester is feasible or not.
- ii) The soft copy of the detailed syllabus provided in hard form be also given through mail as soon as possible to work out on the following points:-
  - a) To finalize the background of Credit system.
  - b) To finalize the detailed syllabus in the courses of the given programme, the committee feels that the syllabus should be well descriptive especially in M.Sc.(Comp.Sc.)
  - c) The syllabus of Cyber security (DSE-I, M.Sc.Comp.Sc.) is missing in the hard copy.

once we get the soft copy as suggested above, the committee will consult through mail and after final resolve the aforesaid issues will sit again on 21st June 18 (9:00 PM)

  
12/6/2018  
Prof. A.K. Nayak  
IIMM, Patna.

  
12/6/18  
Rajeev Ranjan  
CoE, AKU Patna

**Final recommendation regarding review of Syllabus and accordingly implementation of CBCS in MCA and M.Sc. (Comp. Sc.)**

**Suggestions in course structure of M.Sc. (Comp. Sc.):**

- 1) The new detailed Syllabus of DBMS and implementation (CC4) is being recommended as  
**Basic Concept:** Database Systems, Characteristics, Data Models, Database Languages, DBMS Architecture, Database Users and Data Independence.

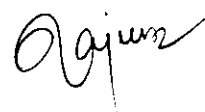
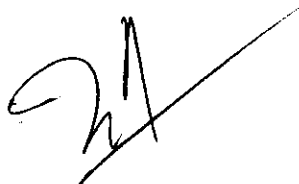
**Database Design using ER Model:** ER Modeling, relation types, role and Structural Constraints, Extended ER Modeling Features, Design of an ER Database Schema, Reduction of ER Schema to Tables. **Relational Model:** Codd's rules, Relational Model Concepts, Relational Algebra, Relational Calculus.

**Introduction to SQL:** SQL data types and literals, Types of SQL commands, SQL operators, Tables, views and indexes, Queries and sub queries, Aggregate functions, Cursors in SQL.

**Relational Database Design:** Functional and multi-valued Dependencies, Desirable Properties of Decomposition, Normalization up to 5 NF.

**Selected Database Issues:** Security, Transaction Management, Basic Algorithms to Query Processing and Query Optimization, Concurrency Control, Recovery Techniques, Case Study: Oracle/MS-SQL.

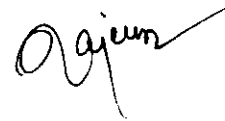
- 2) In paper Design and Analysis of Algorithms (CC1), Unit – Graph Algorithm 2 more topics namely DFS and BFS be added.
- 3) In paper Numerical Computing (EC1), Unit – Interpolation "Newton's divided differences interpolation formula" be replaced by Newton's Forward's and Backwards differences interpolation formula.



**Suggestions in course structure of MCA:**

- 1) In paper Compiler Design (CS- 45(I) , Unit 2 – Lexical & syntax Analysis "LR Parser concepts" be added and in unit 3 – Intermediate Code Generation "Type Checking and Symbol table" be added.

In the syllabus credit distribution in the form of L-T-P is not given and that should be designed by the respective institutions without any changes in the Credit of that paper.

A handwritten signature in black ink, appearing to be a stylized 'A' or similar character.A handwritten signature in black ink, appearing to be 'Ajay' or similar.



**TilkaManjhi Bhagalpur University**  
**Bhagalpur – 812007**

**MASTER OF COMPUTER APPLICATIONS (MCA)**

**Three Years (Six Semesters) Full Time Course**

**Curriculum and Syllabus**

**(For Students admitted from academic year 2018 – 2019 onwards)**

**(UNDER CHOICE BASED CREDIT SYSTEM)**



**UNIVERSITY DEPARTMENT OF COMPUTER APPLICATIONS**

**FACULTY OF SCIENCE**

**T. M. BHAGALPUR UNIVERSITY, BHAGALPUR- 812007**

*21*

**MASTER OF COMPUTER APPLICATIONS**  
**3-YEAR FULL-TIME PROGRAMME**

**STRUCTURE OF CURRICULUM**

The structure of MCA programme consists of six semesters as per UGC/AICTE norms, where each semester is having six courses each of 4 credits hours, except the 6<sup>th</sup> semester which is of 20 credit industrial project course. The total credit for MCA programme is 140 credit hours (Total marks = 3400). 1 Credit = 10 Contact hours.

The choice based credit system (CBCS) facilitates students to choose inter-disciplinary and skill oriented courses according to their learning needs and interests.

This MCA programme with CBCS offer at least two choices based course in each semester. There are five courses for CBCS, one each CBCS courses in each semester.

MCA programme also offer a CBCS course from SWAYAM portal in which students are required to register for appropriate course, as per UGC/AICTE guideline.

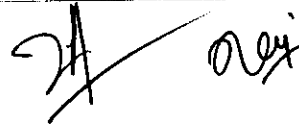
A handwritten signature in black ink, appearing to be 'D. Vij', is located in the lower right quadrant of the page.

**CODIFICATION OF PAPERS**

The schedule of papers prescribed for various semesters shall be as follows:

<b>MCA SEMESTER – I</b>					
Code	Title	External	Internal	Credit	Total Marks
CS-11	Information Technology	70	30	4	100
CS-12	Programming & Data Structure with 'C'	70	30	4	100
CS-13	Discrete Mathematical Structure	70	30	4	100
CS-14	Digital Logic & Computer Design	70	30	4	100
CS-15	Elective – I	70	30	4	100
CS-16	Practical	50	50	4	100
<b>Total</b>				<b>24</b>	<b>600</b>
<b>MCA SEMESTER – II</b>					
Code	Title	External	Internal	Credit	Total Marks
CS-21	Object Oriented Programming in C++	70	30	4	100
CS-22	Statistical & Numerical Computing	70	30	4	100
CS-23	Operating System & Shell Programming	70	30	4	100
CS-24	Formal Language and Automata Theory	70	30	4	100
CS-25	Elective-II	70	30	4	100
CS-26	Practical	50	50	4	100
<b>Total</b>				<b>24</b>	<b>600</b>
<b>MCA SEMESTER – III</b>					
Code	Title	External	Internal	Credit	Total Marks
CS-31	Advance Java Programming using J2EE	70	30	4	100
CS-32	Data Communication and Computer Network	70	30	4	100
CS-33	Database Management System	70	30	4	100
CS-34	Optimization Technique	70	30	4	100
CS-35	Elective-III	70	30	4	100
CS-36	Practical	50	50	4	100
<b>Total</b>				<b>24</b>	<b>600</b>
<b>MCA SEMESTER – IV</b>					
Code	Title	External	Internal	Credit	Total Marks
CS-41	Web Technologies	70	30	4	100
CS-42	Software Engineering	70	30	4	100
CS-43	Computer Graphics	70	30	4	100
CS-44	Big Data Analysis & Cloud Computing	70	30	4	100
CS-45	Elective-IV	70	30	4	100
CS-46	Practical	50	50	4	100
<b>Total</b>				<b>24</b>	<b>600</b>
<b>MCA SEMESTER – V</b>					
Code	Title	External	Internal	Credit	Total Marks
CS-51	Design and Analysis of Algorithm	70	30	4	100
CS-52	Data Mining & Data Warehousing	70	30	4	100
CS-53	Artificial Intelligence	70	30	4	100
CS-54	Advanced Computer Architecture	70	30	4	100
CS-55	Elective-V	70	30	4	100
CS-56	Practical	50	50	4	100
<b>Total</b>				<b>24</b>	<b>600</b>
<b>MCA SEMESTER – VI</b>					
Code	Title			Credit	Total Marks
CS-61	Project & Dissertation			20	400
<b>G. Total</b>				<b>140</b>	<b>3400</b>

<b>LIST OF ELECTIVE PAPERS</b>	
<b>Code</b>	<b>Select any one of the following for each Elective</b>
<b>Elective – I CS-15</b>	(I) Principles of Management (II) Organizational Behavior (III) SWAYAM
<b>Elective – II CS-25</b>	(I) Financial Accounting (II) E-Commerce (III) SWAYAM
<b>Elective – III CS-35</b>	(I) Parallel & Distributed Computing (II) Managerial Economics (III) SWAYAM
<b>Elective – IV CS-45</b>	(I) Compiler Design (II) Digital Image Processing & Multimedia (III) Information Security
<b>Elective – V CS-55</b>	(I) Cryptography (II) Quantum Computing (III) Visual Programming (IV) Satellite and Mobile Communication Networks (V) Machine Learning and Soft Computing



## MCA SEMESTER - I

**CS-11: Information Technology****Credit: 4**

**Unit-1. Introduction to computers:** Computer system concept, characteristics of computer, generations and types of computer, components of computer system, Booting process, classification of digital computer system. organization of computers.

**Unit-2. Computer software and hardware:** Software-System Software, application software, firmware, Programming languages classification: machine language, assembly language & high-level language. Evolution of programming languages: first generation, second generation, third generation & fourth generation Language, Language translator - Compiler, Interpreter, Assembler. Hardware-Input and Output devices, Storage devices

**Unit-3. Operating System:** Definition, Job, Objective and evolution of operating system, Types of operating system, Network operating system (NOS) .

**Unit-4. Network Communication and Internet:** Definition, Criteria, advantages and limitations of computer networking. Communication process, Communication types, Electronic data interchange (EDI), Types of computer network, Network topology, LAN and other network related protocols, OSI model. TCP/IP model, Networking Hardware & Software. Internet: Introduction, Internet basic, Internet protocols, Internet addressing, Browser WWW, E-mail, telnet, ftp, application, benefits and limitation of internet, electronic conferencing, and teleconferencing.

**Unit-5. Latest IT Trends and Role of IT:** IT Trends - E-Commerce, M-Commerce, Artificial Intelligence, Computational Intelligence, Geographic Information System (GIS), Data Mining . Role of IT: Role of IT in different Area – Education, Industry, Banking, Marketing, Public Services and others.

**Reference Books:**

1. Reema Thareja, Information Technology and its Applications in Business, OUP.
2. V. Rajaraman, Fundamental of Computers, PHI.
3. Ray & Acharya, IT Principles & Application, PHI.
4. Leon & M. Leon, Fundamental of IT, Vikas Publication.

**CS-12: Programming and Data Structure with C****Credit: 4**

**Unit-1. Introduction to Programming Language C:** Data Types, Instruction and its Types, Storage Classes, Operators and Hierarchy of Operations, Expressions in C, Control and Repetitive Statements, break, continue. Functions: User Defined Functions and Library Functions, Local and Global Variables. Parameter Passing, Pointers, Arrays, Strings, C Preprocessors, Structures, Input and Output in C, C-Library.

**Unit-2. Data Structure & Algorithm concept:** Definition, characteristics, classification, Operations, Complexity: Big O- Notation. time space trade-off.

**Unit-3. Linear Data Structure:** Linked List-Singly, circular, doubly, doubly & circular Linked List; Stack and Queue-Push, Pop. Conversion from infix to postfix evaluation of



postfix expression. Stack representation using array & linked list, Queue, insert, delete, representation using array & linked list, circular queue, deque, priority queue.

**Unit-4. Non-Linear Data Structure:** Tree-Definition, traversal, Threaded tree, heap tree, AVL tree-balancing, B-tree, Binary search tree, Huffman algorithm, Creation of Heap, Graph-Graph representation, Warshall algorithm, Shortest path, Kruskal & Dijkstra algorithm, Linked representation of graph. Traversing a graph.

**Unit-5. Searching and Sorting:** Search- Linear & Binary, Sorting-bubble, merge, quick, selection, insertion, shell, tournament, radix, heap.

**Reference Books:**

1. ReemaThareja, Programming in C, OUP.
2. Y. Kanetkar, Let us C, BPB.
3. Kernighan & Ritchie, C Programming Language, PE.
4. Langsam, Augustin & Tanenbaum, Data Structures Using C and C++, PHI.
5. D. Samanta, Classical Data Structure. PHI
6. S. Lipschutz, Data Structures, TMH

**CS-13: Discrete Mathematical Structure**

**Credit: 4**

**Unit-1. Sets, Relations & Functions:** Property of binary relations, equivalence, compatibility, partial ordering relations. hasse diagram. functions, inverse functions, composition of functions, recursive functions.

**Unit-2. Mathematical Logic:** Logic operators, Truth tables, Theory of inference and deduction, mathematical calculus, predicate calculus, predicates and quantifiers. Groups & Subgroups: Group axioms, Monoids, semi groups, Isomorphism, homomorphism, automorphism.

**Unit-3. Lattices & Boolean Algebra:** Truth values and truth tables, the algebra of propositional functions, Boolean algebra of truth values.

**Unit-4. Combinatorics & Recurrence Relations:** Permutation, Combination, Principle of Inclusion and Exclusion, Recurrence Relations. Generating Functions.

**Unit-5. Graph Theory:** Basic Concepts of Graphs and Trees, Adjacency and Incidence Matrices, Spanning Tree, Transitive Closure. Shortest Path, Planar Graphs, Graph Coloring, Eulerian and Hamiltonian graphs, Applications of Graph Theoretic Concepts to Computer Science.

**Reference Books:**

1. Chakraborty & Sarkar, Discrete Mathematics, OUP.
2. Kolman & Rehman, Discrete Mathematical Structures, PE.
3. C.L. Liu, Elements of Discrete Mathematics, TMH
4. Iyenger, Discrete Mathematics, Vikas Pub.

**CS-14: Digital Logic & Computer Design****Credit: 4**

**Unit-1. Digital logic fundamentals:** Number systems, Boolean algebra, gates, simplification of Boolean expressions. Combinational logic: adders, subtractors, Decoders, encoders multiplexer / demultiplexers. Sequential Logic: Flip-flops, Counters.

**Unit-2. Introduction to Intel s 8086/88:** Register model, Bus interface Unit, Execution unit, Control Unit: hardwired and microprogrammed control. Memory organization: Basic memory cell RAM, ROM and DRAM associative, cache and virtual memory organizations.

**Unit-3. Assembly Language Programming:** Instruction formats, addressing modes, Intel 8086/88 instruction mnemonics, timing, data transfer, arithmetic and machine control instructions - Introduction to Macro assembler.

**Unit-4. Input/Output organization:** Input interface, Data transfer techniques: synchronous, asynchronous, Interrupt driven, Intel 8086/88 interrupt organization, types, DMA, I/O processors, serial communication.

**Unit-5. Processor organization:** General register organization, stack organization. IBM PC architecture: Mother board, display adapters. add on cards, power supply. Architectural overview of Pentium, P-II, P-III and P-4.

**Reference Books:**

1. Mano, Computer Systems Architecture. PE.
2. Gibson, Microcomputer Systems the 8086/88 family, PHI.
3. Ray and Bhurchandi, Advanced Microprocessors and Peripherals, TMH.
4. Abel, IBM PC Assembly language and Programming, PHI.

**CS-15(I): Elective-1: Principles of Management****Credit: 4**

**Unit-1. Overview of management:** Definition, Management, Role of managers, Evolution of Management thought, Organization and the environmental factors, Trends and Challenges of Management in Global Scenario.

**Unit-2. Planning:** Nature and purpose of planning, Planning process, Types of plans, Objectives, Managing by objective (MBO) Strategies, Types of strategies, Policies, Decision Making, Types of decision, Decision Making Process, Rational Decision Making.

**Unit-3. Organizing:** Nature and purpose of organizing, Organization structure, Formal and informal groups organization, Line and Staff authority, Departmentation, Span of control, Centralization and Decentralization, Delegation of authority, Staffing, Selection and Recruitment. Orientation, Career Development, Career stages, Training, Performance Appraisal.

**Unit-4. Directing:** Creativity and Innovation, Motivation and Satisfaction, Motivation Theories, Leadership Styles, Leadership theories, Communication, Barriers to effective communication, Organization Culture. Elements and types of culture, Managing cultural diversity.

**Unit-5. Controlling:** Process of controlling, Types of control, Budgetary and non-budgetary control, Q-techniques, Managing Productivity, Cost Control, Purchase Control, Maintenance Control, Quality Control, Planning operations.

**Reference Books:**

1. Bhatt, Principle of Management, OUP.
2. Massie, Organization and Management, PHI.
3. Robbins and Coulter, Management, PHI.
4. Hill and McShane, Principles of Management, TMH.

**CS-15(II): Elective-1: Organizational Behavior**

**Credit: 4**

**Unit-1. Introduction to Organization Behavior:** Historical roots of Organizational Behavior, Fundamental concepts, Nature, Emerging trends in the organizational behavior, Limitation of Organization Behavior, Challenges & Opportunities for Organization Behavior.

**Unit-2. Motivation:** Importance of motivation at work, approaches to motivation, content theories, process theories, motivation and its effects, McGreoger theory X and Y, Maslow's need hierarchy, Herzberg's two factor theory, Vroom expectancy theory, OB modification.

**Unit-3. Power and Politics:** Definition and nature of Power, Types of Power, Contingencies of Power, Organizational Politics, Where does it occur, Types of political activity, Political strategies for power acquisition in modern organization, Coping with organizational politics, Empowerment, Organizational politics and its effects, Organizational politics and ethics.

**Unit-4. Conflicts and negotiation:** Conflict, Historical perspective behind conflict or approaches to conflict, Nature and type of conflict, Conflict Processes, Interpersonal Conflict Management Styles, Levels of conflict, Perceptual Errors Responsible For conflict, Consequences of conflict, coping strategies, Negotiation, strategies, processes, issues on negotiation.

**Unit-5. Communication, feedback, Stress and Leadership:** Transactional analysis, Johari window, job analysis and job design: issues, techniques and methodology. Stress: Nature of stress, causes, and consequences, Individual differences in resistance to stress; techniques of managing stress. Leadership: Concept and style, Fiedler's contingency mode, path-goal theory, leadership effectiveness.

**Reference Books:**

1. Chadha, Perspectives in Organizational Behavior, Galgotia Publications.
2. Luthans, Organizational Behavior, TMH.
3. Greenberg, Behavior in Organizations, PE.
4. McShane and VanGlinow, Organizational Behavior, TMH.

**CS-16: Practical based on Paper CS-12**

**Credit: 4**



## MCA SEMESTER - II

**CS-21: Object Oriented Programming in C++****Credit: 4**

**Unit-1. Principal of Object Oriented Programming:** Procedure oriented Vs Object oriented, OOP paradigm. Features of OOP, Basic Data types Tokens, Keywords, Constant, Variables, Operator I/O statements, Structure of C++ program, Arrays, pointers, Object modeling technique (OMT).

**Unit-2. Object and Class:** Defining class, Abstract class, Function prototype, Function with parameter. Passing object as a parameter, Constructor function, Types of constructor, Destructor Friend function, Friend class, Dynamic allocation operator new and delete.

**Unit-3. Polymorphism and Inheritance:** Types of polymorphism, Constructor overloading, Operator overloading, Template function Template class, Types of inheritance, private, protected and public derivation of class. Resolving ambiguity. Pointer to object, this pointer, Virtual class. virtual function.

**Unit-4. Input - output and File handling I/O classes:** File and stream classes, Opening and closing file Detecting end of file, String I/O, Char I/O, Object I/O. I/O with multiple object, File pointer. Disk I/O.

**Unit-5. Exception handling, Name spaces and Standard Template library (STL):** Need of Exception handling, try, catch and throws keywords, defining namespace, benefit of namespace. Component of STL.

**Reference Books:**

1. Reema Thareja, Object Oriented Programming with C++. OUP.
2. Deitel, C++ How to Program, PE.
3. Bajarnestroustroup. Object Oriented Programming Using C++, PE
4. Herbert Schildt, C++ - A Complete Reference, TMH.

**CS-22: Statistical & Numerical Computing****Credit: 4**

**Unit-1. Basic Statistics:** measure of central tendency, dispersion, Probability, distribution, introduction to mass function, density function, distribution function, estimation of parameters. Regression Analysis: Linear and Non linear regression, Multiple regression, Testing of Hypothesis: Test of Significance, Chi-square test, t-test, ANOVA, F-test.

**Unit-2. Interpolation:** Newtons Forward, Backward, Sterling & Bessel's Interpolation formula, Lagrange's Interpolation.

**Unit-3. Integration:** Trapezoidal, Simpson's 1/3 rd, Weddel's Rule, Romberg Integration, Gauss-Legendre two & three point formula, Newton Cotes Formula. Gram-Schmidt orthogonalisation, Tchebycheff Polynomial.

**Unit-4. Solution of transcendental and system of linear equations:** Method of Iteration, Method of Bisection, Newton - Raphson Method, Regula-Falsi method, Secant Method; Gauss Elimination Method, Gauss-Jacobi, Gauss-Seidel. LU factorization, Tri-diagonalisation, Inverse Interpolation. Least Square Curve fitting: linear & non-linear.

**Unit-5. Solution of Differential Equations:** Picard's method, Euler-modified method, Taylor's Series method, Runge-Kutta method, Milne's Predictor-Corrector method.

**Reference Books:**

1. Pal, Numerical Methods, OUP.
2. Balaguruswamy, Numerical and Statistical methods, TMH.
3. V. Rajaraman, Introductory methods of Numerical Analysis, PHI.
4. A.M. Goon, M.K. Gupta and T.S. Dasgupta, Fundamentals of Statistics, The World Press Pvt. Ltd.

**CS-23: Operating System & Shell Programming**

**Credit: 4**

**Unit-1. Introduction:** Definition, Design Goals, Evolution; Concept of User, job and Resources; Batch processing, Multi-programming, Time sharing; Structure and Functions of Operating System.

**Unit-2. Process Management:** Process states, State Transitions, Process Control block, Context Switching, Process Scheduling, Scheduling algorithm, Threads, Inter process synchronization and communication-need, Mutual exclusion, semaphore, Monitors, Messages, Deadlock, Deadlocks Prevention, Deadlocks Avoidance, Deadlocks Detection.

**Unit-3. Memory Management:** Address Binding, Dynamic Loading and Linking Concepts, Logical and Physical Addresses, Contiguous Allocation, Fragmentation, Paging, Segmentation, Combined Systems, Virtual Memory, Demand Paging, Page fault, Page replacement algorithms, Global Vs Local Allocation, Thrashing, Working Set Model, Paging.

**Unit-4. File and Secondary Storage Management:** File Attributes, File Types, File Access Methods, Directory Structure, File System Organization and Mounting, Allocation Methods, Free Space management; Disk Structure, Logical and Physical View, Disk Head Scheduling, Formatting, Swap Management, Operating System Security, Case Study of UNIX/ LINUX and WINDOWS Operating systems.

**Unit-5. Shell programming:** Need of Shell programming, types of Shells in Linux/Unix, Shell variables: User Defined Variables, environment variables, predefined variables, reading values into user defined variables, command substitution computation on shell variable , handling shell variables, passing arguments to the shell, shift command, conditional execution operators, conditional statements , test command, Iterative statements : for, while, until, break, continue statements , practical examples on shell programming, Exercises on shell programming.

**Reference Books:**

1. Chauhan, Principles of Operating System, OUP.
2. A. Tanenbaum, Operating System, PE.
3. W. Stalling, Operating System, PHI.
4. Yashwant Kanitkar, Unix Shell Programming, BPB.
5. Silberschatz and Galvin, Operating System Concepts, Addison Wesley.

**CS-24: Formal Language and Automata Theory****Credit: 4**

**Unit-1. Theory of Automata:** Definition of an automaton, Transition system, Acceptability of a string by FA, Nondeterministic finite state machine, equivalence of DFA and NFA, Mealy and Moore models. Minimization of Finite Automata.

**Unit-2. Formal Languages, Regular Sets and Regular Grammars:** Definition, Languages and their relation, Chomsky classification of language, Recursive and recursive enumerable sets, Regular expression, and Finite automaton, Pumping Lemma for regular sets, Application of Pumping lemma, Closure property of regular sets, Regular sets and regular grammar.

**Unit-3. Context-free Language:** Context free language and derivation trees, ambiguity in context free languages, Simplification of context free languages: (left recursion, unit production elimination, eliminating null values), Normal forms of context free languages, Pumping lemma.

**Unit-4. Pushdown Automation:** Definition, Acceptance by PDA, Push down automation and Context free languages, Parsing and Pushdown automata.

**Unit-5. Turing Machine:** Turing Machines model, Representation of TM, Languages acceptability by TM, design of TM, Universal Turing Machines (UTM), Turing machine and type, grammars, Halting problem, Linear bounded automata and languages.

**Reference Books:**

1. Hopcraft, Motwani and Ullman, Introduction to Automata Theory, Languages and Computation, PE.
2. Cohen, Introduction to Computer Theory, John Wiley.
3. Martin, Theory of Computation, TMH.
4. Papadimitrou, Elements of the Theory of Computation, PHI.

**CS-25(I): Elective-II: Financial Accounting****Credit: 4**

**Unit 1. Introduction:** Definition and objectives of Accounting. Accounting Equation, Basic Accounting Terms Theory Base of Accounting- GAAP Dual Aspect of Accounting, account process, drafting of financial statement- Journal, Ledger, Book.

**Unit 2. Financial Statements:** Trial Balance, Types of Errors, Rectification of Errors, Suspense Account, Financial Statements- Preparation of Trading A/C, Profit & Loss A/C and Balance sheet.

**Unit 3. Cost Accounting:** Costing, Marginal and Absorption Costing, Cost, Volume and Profit (C-V-P) Analysis, Break-Even Analysis, Determination of Break-Even Point, Profit-Volume (PV) Ratio, Margin of Safety..

**Unit 4. Financial Management:** Concept of Funds and relevant Inflow & Out flow, Capital Budgeting, Traditional Techniques, Discounted Cash-Flow or Time-Adjusted Techniques, Present Value Concept. Payback Period, Average Rate of Return (ARR). Present Value (PV), Net Present Value (NPV), Internal Rate of Return (IRR) Methods, Profitability Index.

**Unit-5. 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 (The concepts may be explained using available accounting package).

**Reference Books:**

1. Ambrish Gupta, Financial Accounting, PE.
2. Bhattacharyya, Financial Accounting for Business Managers, PHI.
3. Khan & Jain, Financial Management, TMH.
4. I.M. Pandey, Financial Management, Vikas Pub.

**CS-25(II): Elective-II: E-Commerce**

**Credit: 4**

**Unit-1. Introduction:** Definition, Objectives, Advantages and disadvantages. Forces driving E-Commerce, Traditional commerce Vs. E-Commerce, E-Commerce opportunities for industries, Growth of E-Commerce.

**Unit-2. E-Commerce Models:** Business to consumer, Business to Business, Consumer to Consumer, other models – Brokerage Model, Aggregator Model, Info-mediary Model, Community Model and value chain Model.

**Unit-3. Electronic Payment Systems:** Special features required in payment systems, Types of E-payment systems, ECash, E-cheque, credit card, Smart Card, Electronic Purses.

**Unit-4. E-Marketing:** E-Customer Relationship Management, E-Supply Chain Management.

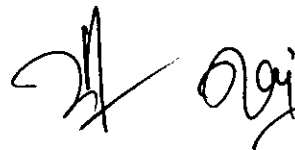
**Unit-5. Security Issues in E-Commerce:** Security risk of E-Commerce, Types of threats, Security tools and risk management approach, Cyber laws, Business Ethics, IT Acts.

**Reference Books:**

1. Bhaskar, Electronic Commerce – Frameroork Technologies and Applications, TMH.
2. Kalakota & Whinston, Frontiers of Electronic Commerce, PE.
3. Kamlesh, and Deeksha. Business on the Net Introduction to the E-Com., Macmillan India.
4. Joseph, E-Commerce: A Managerial Perspective, PHI.

**CS-26: Practical based on Paper CS-21**

**Credit: 4**



## MCA SEMESTER - III

**CS-31: Advance Java Programming****Credit: 4**

**Unit-1. Introduction to Java:** Review of Java Basic Features, Applets, AWT Controls, Event Handling, Multithreading, I/O files. Swing: Features, components, swing vs AWT, swing containers, controls, using Dialogs, sliders, progress bars, tables, creating user interface using swing.

**Unit-2. Java Database Connectivity:** Connectivity model, Java.SQL package, JDBC Exception classes, Database connectivity, Data manipulation and navigation, creating database applications. Java RMI: Distributed object technologies, RMI architecture, creating RMI applications.

**Unit-3. Java Networking:** Java Servlets: Servlets vs CGI, Servlet lifecycle, creating and running simple servlets. Networking: Networking basics, Client/server model, Java and the Net, TCP/IP client sockets, TCP/IP server sockets, Inet Address, URL, Data grams, creating simple networking applications.

**Unit-4. Java Beans:** Component architecture, Advantages of Beans, Bean Developer kit (BDK), JAR files, introspection. developing Beans, Using Bound properties, The Java Beans API, Introduction to EJB (Enterprise Java Beans), Types of EJB, Uses of EJB.

**Unit-5. Java Server Pages:** Introduction, JSP Architecture, JSP objects, developing simple Web Applications.

**Reference Books:**

1. Roy, Advance Java Programming. OUP.
2. H. Schildt, Java 2: The Complete Reference, TMH.
3. Deitel, Java- How to Program, PHI.
4. Seth & Juneja, Java, OUP.

**CS-32: Data Communication and Computer Network****Credit: 4**

**Unit-1. Introduction:** Data Transmission concepts, transmission impairments, switching, modulation, multiplexing; Network Hardware-LAN, MAN, WAN, Wireless networks, Internet-works; Network Software- Layer, Protocols, interfaces and services; Reference Models-OSI, TCP/IP and their comparison. Physical Layer: Transmission Media : Magnetic, twisted pair, coaxial cable, fiber optics. wireless transmission (radio, microwave, infrared), ATM, ISDN, Cellular radio and communication satellites.

**Unit-2. Data Link Layer:** Framing, Error control, Sliding window protocols (one bit, Go back n, selective repeat), Examples of DLL Protocols-HDLC, PPP. Medium Access Sub layer : Channel Allocation, MAC protocols – ALOHA, CSMA protocols, Collision free protocols, Limited Contention Protocols. Wireless LAN protocols, IEEE 802.3, 802.4, 802.5 standards and their comparison.

**Unit-3. Network Layer:** Design issues. Routing algorithms (shortest path, flooding, flow based, distance vector. hierarchical, broadcast, multicast, for mobile hosts), Congestion





control algorithms (Leaky bucket, Token bucket, Choke Packet, Load shedding), Internetworking, IP Protocol, ARP, RARP.

**Unit-4. Transport Layer:** Addressing, establishing and releasing connection, flow control, buffering, Internet Transport Protocol (TCP and UDP).

**Unit-5. Application Layer:** Domain name system, E-mail, File transfer protocol, HTTP, HTTPS, World Wide Web.

**Reference Books:**

1. Trivedi, Computer Network, OUP.
2. Tanenbaum, Computer Networks. PHI.
3. Stallings, Data and Computer Communications, PHI.
4. Forouzan, Data Communications and Networks, TMH.

**CS-33: Database Management System**

**Credit: 4**

**Unit-1. Basic Concept:** Database Systems, Characteristics, Data Models, Database Languages, DBMS Architecture, Database Users and Data Independence.

**Unit-2. Database Design using ER Model:** ER Modeling, relation types, role and Structural Constraints, Extended ER Modeling Features, Design of an ER Database Schema, Reduction of ER Schema to Tables. Relational Model: Codd's rules, Relational Model Concepts, Relational Algebra, Relational Calculus.

**Unit-3. Introduction to SQL:** SQL data types and literals, Types of SQL commands, SQL operators, Tables, views and indexes, Queries and sub queries, Aggregate functions, Cursors in SQL.

**Unit-4. Relational Database Design:** Functional and multi-valued Dependencies, Desirable Properties of Decomposition, Normalization up to 5 NF.

**Unit-5. Selected Database Issues:** Security, Transaction Management, Basic Algorithms to Query Processing and Query Optimization, Concurrency Control, Recovery Techniques, Case Study: Oracle/MS-SQL.

**Reference Books:**

1. Silberschatz, Database System Concepts, TMH.
2. Raghu Ramakrishnan, Database Management Systems, TMH.
3. Elmsari and Navathe, Fundamentals of Database Systems, PE.

**CS-34: Optimization Technique**

**Credit: 4**

**Unit-1. Introduction:** Nature and Meaning, History, Management Applications, Modeling, Principles. Characteristics, Scope, Development of OR In India, Role of Computers in OR.

**Unit-2. Linear Programming:** Introduction and Applications of LP, Limitations of LP Formulation of a LP Model, Graphical Solution of a LPP, Simplex Method, Two Phase Method, Big-M Method.

**Unit-3. Transportation, Assignment and Replacement Problem:** Introduction to Transportation Problem, Mathematical Formulation, Feasible Solution and Optimum Solution; Introduction to Assignment Problem, Mathematical Formulation, Traveling Salesman Problem; Introduction to Replacement Problem, Capital Equipment, Discounted Cost, Replacement in Anticipation of Failure.

**Unit-4. Queuing Problems:** Classification of self problems, processing of  $n$  jobs through two machines. three machines, processing of two jobs through  $m$  machines.

**Unit-5. Project Management by PERT-CPM:** Introduction, History & Applications, Basic Steps, Network Diagram Representation, Rules, Time Estimates and Critical Path in Network Analysis. Uses and Applications of PERT/CPM.

**Reference Books:**

1. Pai, Operation Research, OUP.
2. Panerselvam, Operation Research. PHI.
3. Hillier & Lieberman, Operations Research, TMH.

**CS-35(I): Elective-III: Parallel & Distributed Computing**

**Credit: 4**

**Unit-1. Introduction:** Need for Computational speed; Applications of parallel computers in various fields including Mathematics, Physics, Chemistry and Computer Science; Configuration of some existing Mainframe and Super Computers for parallel processing; issues in parallel processing.

**Unit-2. Parallel Processing Architectures:** Parallelism in Sequential Machines, Abstract model of parallel computer, multiprocessor architecture, programmability issues.

**Unit-3. Data Dependency Analysis:** Introduction, Types of Dependencies, Loop and Array Dependence, Loop Dependence Analysis, Solving Diophantine Equations.

**Unit-4. Shared Memory Programming:** General Model, Process Model under UNIX, Thread Management, Thread Implementation.

**Unit-5. Distributed Computing:** Message passing model, Parallel Virtual Machine (PVM), Remote procedure call, Algorithms for Parallel Machines: Speedup, Complexity and Cost, Parallel Reduction. Quadrature Problem, Matrix Multiplication, Parallel Sorting Algorithms and Solving Linear System.

**Reference Books:**

1. Sasikumar, Shikhara, Dinesh and Prakash, Introduction to Parallel Processing, PHI.
2. Rajaraman, Elements of Parallel Computing, PHI.
3. Susann, Parallel Programming, TMH.

**CS-35(II): Elective-III: Managerial Economics**

**Credit: 4**

**Unit-1. Demand and Supply:** Concept of demand, determinants of individual and market demand functions, elasticity of demand - price, income and cross elasticity. concept of

supply, determinants of individual and market supply functions, elasticity of supply, Equilibrium price.

**Unit-2. Production:** Production function in short run – law of variable proportion, production function in the long run – isoquants, isocosts, ridge lines, returns to scale; producer's equilibrium - optimum combination, Cost function – short run costs, long run average cost, long run marginal cost. Reasons of 'U' shape of short and long run cost curves, economies and diseconomies of scale.

**Unit-3. Market Structure:** Price and output determination under perfect competition and monopoly, Comparison between perfect competition and monopoly with respect to Efficiency.

**Unit-4. Pricing:** Demand and supply of factors of production, pricing of a single variable factor under perfect competition and monopoly; modern theory of rent, quasi-rent.

**Unit-5. Macroeconomics:** Meaning of macroeconomics, Keynesian theory of determination of income and employment in the three sector economy, multiplier analysis, IS-LM model of equilibrium income and interest rate, Meaning and objectives of fiscal and monetary policies.

**Reference Books:**

1. Damodaran, Managerial Economics, OUP.
2. Petersen, Managerial Economics, PHI.
3. Mote, Managerial Economics-Concepts and Cases, TMH.
4. Pindyck, Rubinfeld and Mehta, Microeconomics, PE.

**CS-36: Practical based on Paper CS-31 & CS-33**

**Credit: 4**

Two handwritten signatures in black ink. The first signature is a stylized 'A' with a long horizontal stroke extending to the right. The second signature is a cursive 'aj'.

## MCA SEMESTER - IV

**CS-41: Web Technologies****Credit: 4**

**Unit 1. Internet Concept:** Fundamental of Web, History of Web, Web development overview, Domain Name System (DNS), DHCP, and SMTP and other servers, Internet service provider (ISP), Concept of IP Address, Internet Protocol, TCP/IP Architecture and protocol (IP), Web Browser and Web Server.

**Unit-2. HTML & CSS:** HTML Tag, Rules of HTML, Text Formatting & Style, List, Adding Graphics to Html Document, Tables and Layout, Linking Documents, Frame, Forms, Project in HTML, Stylesheet, types of style sheets- Inline, External, Embedded CSS; text formatting properties, CSS Border, margin properties, Positioning, color properties, Use of classes in CSS.

**Unit-3. Scripting Language:** Java Script, Advantage of Java Script, JS object model and hierarchy, Handling event, Operators and syntax of JS, Function, Client side JS Vs Server side JS, JS security.

**Unit-4. XML:** Introduction to XML, XML in Action, Commercial Benefits of XML, Gaining Competitive advantage with XML, Programming in XML, XML Schema, XSLT, DOM structure model, XML quires and transformation.

**Unit-5. PHP:** Overview of PHP, Capabilities PHP, HTML embedding tags & syntax, PHP Language Core Variables, constants, data type, operators, flow control & loops Arrays, string, functions, Include & require statements, Simple File & Directory access operations Error handling Processing HTML form using GET, POST, SESSION, COOKIE variables Sending E-mail, Introduction of Object-oriented PHP, Database Operations with PHP, Built in functions, Connecting to My-SQL, Selecting a database, building & Sending Query, retrieving, updating & inserting data.

**Reference Books:**

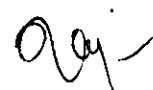
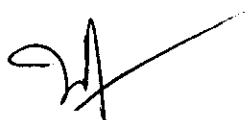
1. Roy, Web Technologies, OUP.
2. Sabesta, Programming the World Wide Web, PE.
3. Godbole & Kahate, Web Technologies, TMH.

**CS-42: Software Engineering****Credit: 4**

**Unit-1. Introduction to Software Engineering:** Definition, Software development and life-cycle models, CMM, Software Quality, role of metrics and measurement, Requirements Analysis and Specification: SRS Building Process, Specification Languages, Validation of SRS, metrics, monitoring and control, Object Oriented analysis.

**Unit-2. Software Project Planning:** Software Cost Estimation Techniques, Project Scheduling & Tracking, Project Team Standards, software configuration management, management.

**Unit-3. System Design and Implementation:** Design Concepts and Notations, Functional & Object Oriented Design Concepts, Design Strategies, Design specification and verification, Metrics, Design Translation Process.



**Unit-4. Software Testing:** Testing Strategies & Techniques, Debugging, Software Maintenance,

**Unit-5. Software Quality Assurance :** Quality Concepts, Matrix for Software Quality, Quality Movement, Software Quality Assurance, Software Review, Formal Technical Reviews, Formal Approaches to Software Quality Assurance, Software Reliability, ISO 9000 quality Standards, IEEE Standards.

**Reference Books:**

1. Jain, Software Engineering, OUP.
2. Pressman, Software Engineering, TMH.
3. Rajib Mall, Fundamentals of Software Engineering, PHI.
4. Sommerville, Software Engineering, PE.

**CS-43: Computer Graphics**

**Credit: 4**

**Unit-1. Introduction:** Fundamentals, Classification of Computer Graphics, Advantages and representative uses of Computer Graphics; Raster Scan and Random Scan, graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices.

**Unit-2. Graphics Primitives:** points and lines, Line drawing algorithms, Simple DDA and Symmetric DDA; Bresenham algorithm; Generation of other Curves, Circle generators.

**Unit-3. 2D viewing and clipping:** point clipping, line clipping, Cohen Sutherland line clipping algorithm, polygon clipping algorithm of Sutherland and Hodgman, viewing transformations.

**Unit-4. 2D Transformations:** Translation, Rotation and Scaling, Matrix Formulation of transformations and concatenation.

**Unit-5. 3D Concepts:** 3D representation, transformations, perspective and parallel projections, spline curves and surfaces, Quadtree and Octree data models for solid objects.

**Reference Books:**

1. Bhattachary, Computer Graphics, OUP.
2. Hearn and Baker, Computer Graphics, PHI.
3. Foley, Computer Graphics: Principals and Practices, Addison-Wesley.
4. Harrington, Computer Graphics, TMH.

**CS-44: Big Data Analysis & Cloud Computing**

**Credit: 4**

**Unit-1. Introduction To Big Data:** Challenges of Big Data, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting, Modern Data Analytic Tools, Statistical Concepts.

**Unit-2. Mining Data Streams:** Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating, Moments, Counting Oneness in a Window, Decaying Window.

**Unit-3. Hadoop:** The Hadoop Distributed File System, Components of Hadoop, Analyzing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS, Map Reduce: Map Reduce Features, How Map Reduce Works, Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort, Task execution, Map Reduce Types and Formats.

**Unit-4. Cloud Computing Fundamentals:** Private, Public and hybrid cloud, Evolution of Cloud Computing; Characteristics of Cloud, Cloud Types, Cloud Computing Benefits and Limitations, Cloud Architecture; Cloud computing vs. Cluster computing vs. Grid computing; Applications: Technologies and Process required when deploying Web services; Deploying a web service from inside and Outside of a Cloud.

**Unit-5. Cloud Computing service models and Vendors:** SaaS, IaaS, PaaS; Storage as a Service, Communication as a Service; Cloud-based big data/real time analytics, Understanding SOA; Improving Performance through Load Balancing. Virtualization Basics: Enterprise, VMware, Server Virtualization, Data Storage Virtualization. Cloud vendors: Amazon cloud, AWS Overview, Installation of AWS, Google app engine, azure cloud, salesforce.

**Reference Books:**

1. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", TMH.
2. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons.
3. Pete Warden, "Big Data Glossary", O'Reilly.
4. Cloud Computing : A Practical Approach by Anthony T. Velte Toby J. Velte, Robert Elsenpeter, TMH.
5. Cloud Computing Bible, Barrie Sosinsky, Wiley-India.
6. Cloud Computing: Principles and Paradigms, Editors: RajkumarBuyya, James Broberg, Andrzej M. Goscinski, Wiley-India.

**CS-45(I): Elective-IV:Compiler Design**

**Credit: 4**

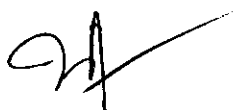
**Unit-1. Introduction to Compilation:** Compilers and phases of compilation, analysis-synthesis model of translation, compiler construction tools.

**Unit-2. Lexical & Syntax Analysis:** Process of lexical analysis, finite state automata, DFA and NFA, recognition of regular expressions, LEX; Process of syntax analysis, types of grammar, top-down and bottom-up parsing techniques, parser generator. Overview of syntax directed translation scheme LR parser concepts.

**Unit-3. Intermediate Code Generation:** Intermediate languages, generating intermediate code for declarative statement, assignment statement, Boolean expression, and case statement, Type checking and Symbol table

**Unit-4. Code Optimization:** Introduction to code optimization, potential cases of code optimization, optimization of basic blocks, loops in flow graphs, code improving transformation.

**Unit-5. Code Generation :** Issues in the design of a code generator, the target machine, dynamic storage management, translating basic blocks, a simple code generator, peephole




optimization, directed acyclic graphs and basic blocks, code generation from directed acyclic graphs.

**Reference Books:**

1. Muneeswaran, Compiler Design, OUP.
2. Aho, Ullman, & Sethi, Compilers : Principles, Techniques & Tools, Addison Wesley.
3. Henk Alblas et al., Practice & Principles of Compiler Building with C, PHI.
4. Trembley & Sorenson, Principles of Compiler Design, TMH.

**CS-45(II): Elective-IV: Digital Image Processing & Multimedia**

**Credit: 4**

**Unit-1. Introduction and Fundamental to Digital Image Processing:** What is Digital Image Processing, Origin of Digital Image Processing, Examples that use Digital Image Processing, Fundamental steps in Digital Image Processing, Components of Digital Image Processing System, Image sensing and acquisition, Image sampling, quantization and representation, Basic relationship between pixels.

**Unit-2. Image Enhancement:** Image Enhancement in the Spatial Domain & Frequency domain: Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and Sharpening Spatial filters, Introduction to Fourier Transform and the Frequency Domain, Discrete Fourier Transform. Smoothing and Sharpening Frequency-Domain filters.

**Unit-3. Image Restoration:** Image Degradation/Restoration Process, Noise models, Restoration in presence of noise, Inverse Filtering, Minimum Mean Square Filtering, Geometric mean filter, Geometric transformations. Color Image Processing: Color Fundamentals, Color models, Basis of full color image processing, Color transformations.

**Unit-4. Image Compression:** Fundamentals, Image compression models, Error free compression, Lossy compression.

**Unit-5. Image Segmentation and Representation:** Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region oriented segmentation. Representation, Description and Recognition: Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors-simple, topological descriptors, Pattern and Pattern classes-Recognition based on matching techniques.

**Reference Books:**

1. Sridhar, Digital Image Processing, OUP.
2. Gonzalez & Wood, Digital Image Processing, PE.
3. Jain, Digital Image Processing, PHI.
4. William K Pratt, Digital Image Processing, John Willey.

**CS-45(III): Elective-IV: Information Security**

**Credit: 4**

**Unit-1. Overview of Information Security:** Basic Concepts, Cryptosystems, Cryptoanalysis, Ciphers & Cipher modes, Symmetric Key Cryptography- DES, AES.

Asymmetric Key Cryptography- RSA algorithm, Key management protocols, Diffie Hellman Algorithm, Digital Signature, Digital Signatures, Public Key Infrastructure.

**Unit-2 System Security:** Program Security-Security problems in Coding, Malicious Logic, Protection. Database Security-Access Controls, Security & Integrity Threats, Defense Mechanisms. OS Security- Protection of System Resources, Models for OS security. Net Security-User based security, Code access security, Form authentication.

**Unit-3. Network Security:** LAN Security-Threats, Authentication & access control, Secured communication Mechanisms (IPSec, Kerberos, Biometric, PKI), Secured Design for LAN.

**Unit-4. Internet Security:** Firewall & IDS Firewall Techniques, Firewall Architecture, Types of IDS, IDS Tools. Email & Transaction Security Mechanisms Privacy Enhanced Mail (PEM), S/MIME, SET protocol, Client-Server Security on web.

**Unit-5. Wireless Security:** Wi-Fi & IEEE 802.11 Security -Protocol architecture, WEP, Access controls, Wireless Transport Layer- Security Transport Layer Security, SSL, IPSEC, WAP security, Bluetooth Security- Protocol architecture, Attacks, Security architecture.

**Reference Books:**

1. Charles P. Pfleeger, Security in Computing, PHI.
2. Merkow & Breithaupt, Information Security: Principles and Practices, PE.
3. D. Gollmann, Computer Security, John Wiley and Sons.
4. W. Stallings, Cryptography and Network Security Principles and Practices, PHI.

**CS-46: Practical based on Paper CS-41**

**Credit: 4**

Two handwritten signatures in black ink. The first signature is a stylized, cursive name that appears to be 'Raj'. The second signature is also cursive and appears to be 'Raj'.



## MCA SEMESTER - V

**CS-51: Design and Analysis of Algorithm****Credit: 4**

**Unit-1. Algorithms and Analysis:** Introduction, Algorithms specification, Recursive algorithms, space and time complexity, Asymptotic Notation ( $O$ ,  $\omega$ , and  $\Theta$ ,  $o$ ) practical complexities, Best, average and worst case performance of algorithms, examples, Introduction to recurrence relations.

**Unit-2. Divide and Conquer Methods:** Selection sort, Merge sort, Quick sort, Binary search, Strassen's Matrix Multiplication and analysis of these problems.

**Unit-3. Dynamic Programming:** Elements of Dynamic Programming, Assembly Line Scheduling, Matrix Chain Multiplication, Shortest paths, optimal search trees, etc.

**Unit-4. Greedy Techniques and Randomized algorithms:** Elements of Greedy Algorithms, Prim's algorithm- Kruskal's Algorithm- Dijkstra's Algorithm-Huffman Trees, Randomized Algorithms.

**Unit-5. Complexity Theory and Approximation algorithms:** Introduction, P, NP, NP-Hard, NPComplete and Associated Problems, Approximation Algorithm- Vertex Cover and Travelling Salesman-Problem.

**Reference Books:**

5. Sridhar, Design and Analysis of Algorithms, OUP.
6. Aho, The Design and Analysis of Computer Algorithms, Addison-Wesley.
7. Paneerselvam, Design and Analysis of Algorithm, PHI.
8. Dave, Design and Analysis of Algorithm, PE.
9. Goodman, Introduction to the Design and Analysis of Algorithms, TMH.

**CS-52: Data Mining & Data Warehousing****Credit: 4**

**Unit-1. Data Mining Concepts & Architecture:** Data Mining Definitions, Tools, Applications, Anatomy of Data Mining, Types of Knowledge, Knowledge Discovery Process- introduction, Evaluation, Stages, Operations and Architecture of Data Mining.

**Unit-2. Data Mining Techniques:** Visualization Techniques, Likelihood & distance, Neural Networks, Decision Tree technique, Constructing decision trees, ID3 algorithm, Genetic algorithms: Crossover & mutation, Clustering: Distance function, K-means algorithm Hierarchical Clustering, Association rules: Apriori algorithm, Real Time Applications and Future Scope.

**Unit-3. Data Warehousing Concepts & Architecture:** Goals, Process Architecture, Load Manager, Warehouse Manager, Query Manager, DWH Objects, Fact table & Dimension table, DWH Users, Data Warehouse Schemas: Star schemas, Snowflake Schemas.

**Unit-4. Data Warehouse Partitioning & Aggregation:** Horizontal Partitioning, Vertical Partitioning, Hardware Partitioning, Software partitioning, Methods, Aggregation, Designing Summary tables.




**Unit-5. Data Marts, Meta Data, Backup & Recovery:** Data Marts-Introduction, Estimating Design, Cost, Meta Data; Backup- Types of backup, Backup the data warehouse, SureWest Online Backup; Recovery: Strategies, various Testing Strategies, Various Recovery models, Disaster Recovery procedure.

**Reference Books:**

1. Prabhu and Venkatesan, Data Mining & Warehousing, New Age International.
2. Anahory and Murray, Data warehousing in real world, PE.
3. Berson and Smith, Data Warehousing, Data mining & OLAP, TMH.

**CS-53: Artificial Intelligence**

**Credit: 4**

**Unit-1. Introduction:** Definitions and approaches, Foundations of A.I., History of AI, Areas and state of the art in AI, AI Programming languages, Concept of Intelligent Agents.

**Unit-2. Problem Solving:** Problem solving as state space search, production system, control strategies and problem characteristics; Search techniques - Breadth First and Depth-first, Hill-climbing, Heuristics, Best-First Search, A\* algorithm, Problem reduction and AO\* algorithm, Constraints satisfaction, Means Ends Analysis, Game Playing.

**Unit-3. Knowledge Representation and Reasoning:** Syntactic and Semantic representation, Predicate and propositional logic, Resolution, Unification, Deduction and theorem proving, Question answering; Forward versus backward reasoning, Matching, Indexing; Ontological Engineering, Formal Theory of Beliefs, Semantic Net, Frames, Conceptual Dependencies and Scripts, Truth Maintenance Systems.

**Unit-4. Selected Topics and Applications:** Philosophical issues, Introduction to Natural Language Processing, Expert Systems and Multiagent Systems, Learning.

**Unit-5. Introduction to AI Programming:** LISP/PROLOG: Introduction to LISP programming: Syntax and numeric functions, Basic list manipulation functions, predicates and conditionals, input output and local variables, iterative and recursion, property lists and arrays.

**Reference Books:**

1. Padhy, Artificial Intelligence and Intelligent Systems, OUP.
2. Russel and Norvig, Artificial Intelligence: A Modern Approach, PE.
3. Rich and Knight, Artificial Intelligence, TMH.
4. Winston and Horn, LISP, PE.

**CS-54: Advanced Computer Architecture**

**Credit: 4**

**Unit-1. Parallel Computer Models:** The state of computing, multiprocessors and multicomputer, multivector and SIMD computers, architectural development tracks.

**Unit-2. Program and Network Properties:** Conditions of parallelism, program partitioning and scheduling, program flow mechanisms.

**Unit-3. System Interconnect Architectures:** Network properties and routing, Static interconnection network and dynamic interconnection networks.

**Unit-4. Processors and Memory Hierachy:** Advanced processor technology-CISC, RISC, Superscalar, Vector VLIW and symbolic processors, memory technology. Bus, Cache and Shared Memory.

**Unit-5. Pipeline and Vector Processing:** Linear Pipeline Processors, Nonlinear Pipeline, processors Instruction pipeline Design Multiprocessors System Interconnects Vector Processing Principles, Multivector Multiprocessors.

**Reference Books:**

1. D. Sima, T. Fountain, P. Kacsuk, Advanced Computer Architectures: A Design Space Approach, Addison Wesley.
2. Kai Hwang, Advanced Computer Architecture, TMH.
3. Kain, Richard Y., Advanced Computer Architecture, PHI.

**CS-55(I): Elective-V: Cryptography**

**Credit: 4**

**Unit-1. Foundations of Cryptography and security:** Security trends, The OSI Security architecture, Security attack, services and mechanism, Ciphers and secret messages, Mathematical tools for cryptography: substitution techniques, modular arithmetic, Euclid's algorithm, finite fields, polynomial arithmetic.

**Unit-2. Symmetric Cipher:** Symmetric cipher model, Design Principles of Block Ciphers, Theory of Block Cipher Design, Feistel cipher network structure, Data Encryption Standard (DES), Strength of DES, Triple DES, Modes of operation. Advance encryption Standard (AES)- Evaluation criteria of AES, AES cipher, key distribution.

**Unit-3. Public Key cryptography:** Prime numbers and testing for primality, factoring large numbers, Principles of public key cryptosystem, RSA algorithm. Key management: Diffi-Helman Key exchange, elliptic curve arithmetic, elliptic curve cryptography.

**Unit-4: Hash function:** Hash and Message authentication Code (MAC), Hash and MAC algorithms, Digital signature and Authentication protocol.

**Unit-5. IP and Web security protocols:** Authentication application 400, E-mail security, IP security and virtual private networks, secure socket layer and transport layer security. System security, Firewall and Intrusion Detection system (IDS).

**Reference Books:**

1. William Stallings, Cryptography and Network Security, PE.
2. Forouzan and Mukhopadhyay, Cryptography and Network Security, TMH.
3. Rhee, Network Security, John Wiley and Sons.

**CS-55(II): Elective-V: Quantum Computing**

**Credit: 4**

**Unit-1. Introduction to Quantum Mechanics:** Hilbert space, Unitary and stochastic dynamics, Probabilities and measurements, Entanglement, Density operators and correlations.

**Unit-2. Introduction to Quantum Information:** Classical information theory, Quantum information types and quantum channels, Dense coding, Teleportation, No cloning, Quantum cryptography.

**Unit-3. Quantum algorithms:** Classical computation, Shor factorization, Grover search, Measurement-based computation.

**Unit-4. Physical Realizations:** Optical lattices.

**Unit-5. Noise and Error Correction:** Quantum operations, Graph states and codes, Quantum error correction, Fault-tolerant computation.

**Reference Books:**

1. Phillip Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing. Oxford University Press.
2. McMahon, Quantum Computing Explained. John Wiley & Sons.
3. Sakurai, Modern Quantum Mechanics, Addison Wesley.

**CS-55(III): Elective-V: Visual Programming**

**Credit: 4**

**Unit-1. Introduction:** Development in a visual programming environment to develop interactive programs using a graphical user interface, iconic systems and their specifications, message and message passing/events and event-handling in visual programming environment. Introduction to .NET Technology, Software development using Visual Basic .NET.

**Unit-2. Programming:** Programming with graphics devices, interaction with the user in event based graphical environment, implementation of visual systems, different components and controls of visual system, Elementary data base usage. Visual Basic Fundamentals: The Visual Basic .NET Development Environment, The element of VB.NET, VB.NET operators, Software Design, Conditional Structure and Control Flow, Methods.

**Unit-3. Classes and Objects:** Types, Structure and Enumeration, Classes, Interfaces, Exception handling and Classes, Collections, Arrays and other Data Structure. Advance design concepts, Patterns, Roles and Relationships, Advanced Interface Patterns: Adapters and Delegates and Events Data Processing and I/O.

**Unit-4. Writing Software with Visual Basic .NET:** interfacing with the End User, Introduction to ASP.NET and C#.NET and their features.

**Unit-5. Project:** A programming project involving object oriented design, user interface design and implementation, and coding to support the interface and database linkages, it can be an Internet application in a visual programming environment.

**Reference Books:**

1. Rox, Beginner and Professional Edition VB.NET, TMH.
2. Alex Homer, Dave Sussman, Professional ASP.NET 1.1, Wiley Dreamtech.
3. T. Willis, J. Crossland and R. Blair, Beginning VB.NET, Wrox Publication.
4. Chris Ullman, Kauffman, Beg. ASP.NET 1.1 with VC#.NET, Wiley Dreamtech.



**CS-55(IV): Elective-V: Satellite and Mobile Communication Networks** **Credit: 4**

**Unit-1. Satellite Communication and Networks:** Geosynchronous satellite, low orbit satellite networks, polling, ALOHA, FDMA TDMA, CDMA, low orbit satellite for mobile communication, VSAT networks.

**Unit-2. Mobile Voice Communication and Networks:** Global Systems for Mobile communication (GSM), Code Division Multiple Access (CDMA).

**Unit-3. Mobile Data Communication and Networks:** High speed circuits switch data (HSCSD), GSM General Pocket Radio Service (GPRS), Third Generation Mobile Systems.

**Unit-4: Android Application Development:** Android Architecture, Getting started with Android, Mastering Android Development tools: Using Android Documentation, Working with Android Emulator; Building simple Android Applications: Using the Application Context, Working with Activities, Using callback methods, Working with intents, Dialogs, Fragments, Logging application information.

**Unit-5. Android Application Development:** Managing Application Resources: Working with Simple Resource values, Draw able Resources, Layouts, Files; Configuring the Android Manifest file and basic application Settings, registering activities, Designating the launch activity, Managing Application permissions, Designing an application framework.

**Reference Books:**

1. Dalal and Shukla, Wireless and Mobile communication, OUP.
2. Kamal, Raj, Mobile Computing ,Oxford Higher Education.
3. C.N. Thurwachter, Wireless Networking, PHI.
4. M. Richharia, Mobile Satellite Communications: Principles & Trends, PE.
5. Jochen Schiller, Mobile Communications, PHI.
6. Reto Meier, Professional Android 2 Application Development, Wrox Publications.

**CS-55(V): Elective-V: Machine Learning and Soft Computing** **Credit: 4**

**Unit-1. Introduction:** Introduction to soft computing, introduction to biological and artificial neural network; introduction to fuzzy sets and fuzzy logic systems.

**Unit-2. Introduction to Genetic Algorithm:** Genetic Operators and Parameters, Genetic Algorithms in Problem Solving, Theoretical Foundations of Genetic Algorithms, Implementation Issues.

**Unit-3. Artificial neural networks and applications:** Different artificial neural network models; learning in artificial neural networks; neural network applications in control systems, Neural Nets and applications of Neural Network.

**Unit-4. Fuzzy systems and applications:** fuzzy sets; fuzzy reasoning; fuzzy inference systems; fuzzy control; fuzzy clustering; applications of fuzzy systems. Neuro-fuzzy systems: neuro-fuzzy modeling; neuro-fuzzy control.

**Unit-5. Applications:** Pattern Recognitions, Image Processing, Biological Sequence Alignment and Drug Design, Robotics and Sensors, Information Retrieval Systems, Share Market Analysis, Natural Language Processing.

**Reference Books:**

1. Padhy, Soft Computing, OUP.
2. M. Mitchell, An Introduction to Genetic Algorithms, PHI.
3. S.N. Sivanandam and S.N. Deepa: Principles of Soft Computing, Second Edition, John Wiley.
4. Karray and Silva, Soft Computing and Intelligent Systems Design, PE.
5. Timothy J.Ross, Fuzzy Logic with Engineering Applications, TMH.
6. Davis E.Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley.
7. S. Rajasekaran and G.A.V.Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI.
8. D. E. Goldberg: Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley.

**CS-56: Practical based on Paper CS-53**

**Credit: 4**

A handwritten signature in black ink, appearing to read 'A. Raj' or similar, written in a cursive style.

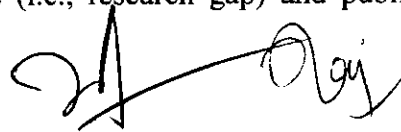
## MCA SEMESTER - VI

## CS-61: Project &amp; Dissertation

Credit: 4

This course consists of the development of a realistic application, representative of a typical real-life software system or to carry a research based project in an area related to CS & IT.

1. The students are expected to propose, analyze, design, develop, test and implement a real life software system using recent technologies.
  2. In case of a research based project, the students are required to follow a proper research methodology to propose a solution (in terms of a model/framework/algorithm, etc.) of a research problem related to computer science and IT.
  3. The student will deliver oral presentations, progress reports, and a final report.
- A. Depending on the topic of the project and the chosen software development methodology, the following themes may be addressed to some extent:
- Software development methodologies, static (products) and dynamic aspects (processes);
  - Requirement analysis (goals, use cases), software architectures, architectural styles and patterns, model-driven engineering (MDE);
  - Programming techniques, software development environments, refactoring;
  - Software validation through unit tests, integration tests, functional and structural tests, and code reviews.
  - Project management, planning, resource estimation, reporting.
  - Version management by using a version management tool.
  - Examples of kinds of systems to be developed are distributed systems, client/server systems, web based systems, secure systems, mobile systems, adaptable systems, optimizations of existing systems or data-intensive systems, etc.
- B. Typical process of research based problems may include selection of a research topic followed by an extensive literature survey with an aim to find the research gap. Proposing a solution based on the findings (i.e., research gap) and publishing the research work.



# **UNIVERSITY OF BIHAR**

## **Syllabus**

**For**

**The 2 Yrs. (Four Semesters)  
Post Graduate Degree Course  
M.Sc. (Computer Science) in the faculty of Science**

**Under**

**Choice Based Credit System(CBCS)  
(To be effective from 2018-19)**





**M. Sc. (COMPUTER SCIENCE)**  
**2 - YEAR FULL TIME PROGRAMME**

**1. PROGRAMME STRUCTURE**

The M.Sc.(Computer Science) Programme is divided into two parts as under. Each part will consist of two semesters to be known as Semester-1 and Semester-2.

		Semester-1	Semester-2
Part-I	First Year	Semester-I	Semester-II
Part-II	Second Year	Semester-III	Semester-IV

**1. CODIFICATION OF PAPERS**

The schedule of papers prescribed for various semesters shall be as follows:

**Part-I Semester I**

Paper No.	Title	L - T - P*	Credits	Total Marks
CC-1	Design & Analysis of Algorithms	3-1-0	5	100 [30+70]
CC-2	Artificial Intelligence	3-0-2	5	100 [30+70]
CC-3	Information Security	3-0-2	5	100 [30+70]
CC-4	Database Systems & Implementation	3-0-2	5	100 [30+70]
AECC-1	Ability Enhancement Compulsory Courses-1	3-0-0	5	100 [50+50]

**Part-I Semester II**

Paper No.	Title	L - T - P*	Credits	Total Marks
CC-5	Compiler Design	3-0-2	5	100 [30+70]
CC-6	Advanced Operating Systems	3-0-2	5	100 [30+70]
CC-7	Data Mining	3-0-2	5	100 [30+70]
CC-8	Advanced Computer Networks	3-0-2	5	100 [30+70]
CC-9	Computational Intelligence	3-0-2	5	100 [30+70]
AEC-1	Ability Enhancing Elective Paper	3-0-2	5	100 [50+50]

**Part-II Semester III**

Paper No.	Title	L - T - P*	Credits	Total Marks
CC-10	Digital Image Processing & Multi-media	3-0-2	5	100 [30+70]
CC-11	Neural Networks	3-0-2	5	100 [30+70]
CC-12	Cryptography	3-0-2	5	100 [30+70]
CC-13	Modeling and Simulation	3-0-2	5	100 [30+70]
CC-14	Embedded Systems	3-0-2	5	100 [30+70]
AECC-2	Ability Enhancement Compulsory Courses-2	3-0-2	5	100 [50+50]

## Part-II Semester IV

Paper No.	Title	L - T - P*	Credits	Total Marks
EC-1	Elective Course-1	3- 0 - 2	05	100 [30+70]
EC-2	Project Work & Viva Voce	3- 0 - 2	05	100 [30+70]
DSE-1	Discipline Specific Elective-1	3- 0 - 2	05	100 [30+70]

### Ability Enhancement Compulsory Courses(AECC):

University will run two Ability Enhancement Compulsory Courses (AECC) which are qualifying in nature and a student has to qualify in both these courses. The courses are:

AECC-1	Environmental Sustainability & Swachhha Bharat Abhiyan Activities	3 Credit 2 Credit
AECC-2	Human Values & Professional Ethics & Gender Sensitization	3 Credit 2 Credit

Students will do assignment/Project work related to institutional social responsibilities including Swachhha Bharat Abhiyan Activities during SEMESTER BREAK.

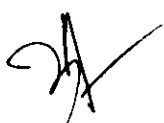
### Ability Enhancement Courses (AEC-1)

University will run a number of Ability Enhancement Courses (AEC) and skill Enhancement Courses; a student can choose one from these. e.g.,

- Computers and IT Skill
- Web Designing
- Financial Risk Management
- Solid Waste Management
- Mushroom Culture
- Bio-Fertilizer Production
- Environmental law
- Tourism & Hospitality Management
- Life Skill & Skill Development
- Yoga Studies

### Elective Courses-1 (EC-1)

- Numerical Computing
- Optimization Techniques



### **Discipline Specific Elective Course (DSE-1)**

- Advance Java Programming
- .Net Programming
- Parallel and Distributed Computing
- Big Data Analysis
- Cloud Computing
- R- Programming
- Machine Learning
- Soft Computing
- Cyber Security

**\* L – T – P: Lectures - Tutorials – Practical**

**\* \* \*** As per the elective offered by the concerned Department.

### **COURSE CONTENT FOR EACH PAPER**

#### **Part I Semester I**

#### **CC-1: DESIGN AND ANALYSIS OF ALGORITHMS**

**Credit: 5**

**Review** of algorithm design techniques like Iterative Techniques and Divide & Conquer through Sorting, Searching and Selection problems.

**Review of Lower Bounding techniques:** decision trees, adversary.

**String Processing:** KMP, Boyre-Moore, Rabin Karp algorithms.

**Introduction to randomized algorithms:** random numbers, randomized quick sort, randomly built binary search tree.

**Number Theoretic Algorithms:** GCD, addition and multiplication of two large numbers, polynomial arithmetic, Fast-Fourier transforms.

**Advanced Techniques to analyze algorithms:** Use and study advanced data structures union- find ( Disjoint Set Structure), Fibonacci heaps.

**Graph algorithms:** Matching and Flows, DFS and BFS.

**Parallel algorithms:** Basic techniques for sorting, searching and merging in parallel.

**Geometric algorithms:** Point location, Convex hulls and Voronoi diagrams.

**Complexity Theory:** Classes P, NP, NP-Hard, NP -z complete.

**Approximation Algorithms:** Introduction through examples.

**Reference Books:**



1. T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein, **Introduction to Algorithms**, McGraw-Hill, 2002.
2. Sara Baase, **Computer Algorithms: Introduction to Design and Analysis**, Addison Wesley, 1999
3. R. Motwani and P. Raghavan, **Randomized Algorithms**, Cambridge University Press, 1995.
4. Teofilo F. Gonzalez, **Handbook of NP-Completeness: Theory and Applications** Chapman & Hall, 2009.
5. Vijay V. Vazirani, **Approximation Algorithms**, Springer-Verlag, France, 2006.
6. S. Rajasekharan and John Reif, **Handbook of Parallel Computing: Models, algorithms and applications**, Chapman and Hall/CRC, 2007.
7. Gareth A. Jones and Josephine M. Jones, **Elementary Number Theory**, Springer, 1998.
8. F P Preparata and M I Shamos, **Computational Geometry: An Introduction** Springer, 1993.

## **CC-2: ARTIFICIAL INTELLIGENCE**

**Credit: 5**

**Introduction:** Introduction to AI applications and AI techniques, Production systems, control strategies, reasoning - forward and backward chaining.

**Intelligent Agents:** Definitions of a rational agent, reflex, model-based, goal-based, and utility-based agents, the environment in which a particular agent operates.

**Searching Techniques and Game Playing:** Breadth first search, depth first search, iterative deepening, uniform cost search, hill climbing, simulated annealing, genetic algorithm search, heuristic search, Best first search, A\* algorithm, AO\* algorithm, Minmax and game trees, refining minmax, Alpha – Beta pruning, constraint satisfaction.

**Knowledge Representation:** First order predicate calculus, resolution, unification, natural deduction system, refutation, logic programming, PROLOG, semantic networks, frame system, value inheritance, conceptual dependency, Ontologies.

**Planning:** basic representation for planning, symbolic-centralized vs. reactive-distributed, partial order planning algorithm.

**Uncertainty:** different types of uncertainty - degree of belief and degree of truth, various probability constructs - prior probability, conditional probability, probability axioms, probability distributions, and joint probability distributions, Bayes' rule, other approaches to modeling uncertainty such as Dempster-Shafer theory and fuzzy sets/logic.

**Natural language processing:** component steps of communication, contrast between formal and natural languages in the context of grammar, parsing, and semantics

### ***Reference Books:***

1. S. Russell and P. Norvig, **Artificial Intelligence: A Modern Approach** (2<sup>nd</sup> ed.), Pearson Education, 2006.
2. Elaine Rich and Kelvin Knight, **Artificial Intelligence**, Tata McGraw Hill, 2002.
3. Nils J Nilson, **Artificial Intelligence: A New Synthesis**, Morgan Kaufmann Publishers

Two handwritten signatures are present at the bottom of the page. The first signature is a stylized, cursive 'S' followed by a long horizontal stroke. The second signature is a cursive 'aji'.

- , Inc., San Francisco, California, 2000.
4. R. Akerkar, **Introduction to Artificial Intelligence**, Prentice-Hall of India, 2005
  5. Dan W. Patterson, **Introduction to Artificial Intelligence and Expert Systems**, Prentice Hall of India, 2006.
  6. Nils J. Nilson, **Principles of Artificial Intelligence**, Narosa Publishing House, 2001
  7. W.F. Clocksin and C.S. Mellish, **Programming in PROLOG**, Narosa Publishing House, 2002.
  8. Saroj Kaushik, **Logic and Prolog Programming**, New Age International Publisher, 2006.

### **CC-3: INFORMATION SECURITY**

**Credit: 5**

**Overview of Security:** Protection versus security; aspects of security—data integrity, data availability, privacy; security problems, user authentication, Orange Book.

**Security Threats:** Program threats, worms, viruses, Trojan horse, trap door, stack and buffer overflow; system threats- intruders; communication threats- tapping and piracy.

**Cryptography:** Substitution, transposition ciphers, symmetric-key algorithms-Data Encryption Standard, advanced encryption standards, public key encryption - RSA; Diffie-Hellman key exchange, ECC cryptography, Message Authentication- MAC, hash functions.

**Digital signatures:** Symmetric key signatures, public key signatures, message digests, public key infrastructures.

**Security Mechanisms:** Intrusion detection, auditing and logging, tripwire, system-call monitoring;

#### ***Reference Books:***

1. W. Stallng, **Cryptography and Network Security Principles and Practices** (4<sup>th</sup> ed.), Prentice-Hall of India, 2006.
2. C. Pfleeger and SL Pfleeger, **Security in Computing** (3<sup>rd</sup> ed.), Prentice-Hall of India, 2007.
3. D. Gollmann, **Computer Security**, John Wiley and Sons, NY, 2002.
4. J. Piwprzyk, T. Hardjono and J. Seberry, **Fundamentals of Computer Security**, Springer-Verlag Berlin, 2003.
5. J.M. Kizza, **Computer Network Security**, Springer, 2007.
6. M. Merkow and J. Breithaupt, **Information Security: Principles and Practices**, Pearson Education, 2006.

### **CC-4: DATABASE SYSTEMS & IMPLEMENTATION**

**Credit: 5**

**Unit-1. Basic Concept:** Database Systems, Characteristics, Data Models, Database Languages, DBMS Architecture, Database Users and Data Independence.

**Unit-2. Database Design using ER Model:** ER Modeling, relation types, role and Structural Constraints, Extended ER Modeling Features, Design of an ER Database Schema, Reduction of ER Schema to Tables. Relational Model: Codd's rules, Relational Model Concepts, Relational Algebra, Relational Calculus.

**Unit-3. Introduction to SQL:** SQL data types and literals, Types of SQL commands, SQL operators, Tables, views and indexes, Queries and sub queries, Aggregate functions, Cursors in SQL.

**Unit-4. Relational Database Design:** Functional and multi-valued Dependencies, Desirable Properties of Decomposition, Normalization up to 5 NF.

**Unit-5. Selected Database Issues:** Security, Transaction Management, Basic Algorithms to Query Processing and Query Optimization, Concurrency Control, Recovery Techniques, Case Study: Oracle/MS-SQL.

**Reference Books:**

1. Silberschatz, Database System Concepts, TMH.
2. Raghu Ramakrishnan, Database Management Systems, TMH.
3. Elmsari and Navathe, Fundamentals of Database Systems, PE.

**AECC-1: Environmental Sustainability & Swachchha Bharat Abhiyan Activities**

**Credit: 5**

**Introduction to environmental studies:** Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

**Ecosystems:** Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

**Natural Resources (Renewable and Non-renewable Resources):** Land resources and land use change; Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water : Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

**Environmental Pollution:** Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution; Nuclear hazards and human health risks. Solid waste management : Control measures of urban and industrial waste. Pollution case studies.

**Environmental Policies & Practices:** Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

**Reference Books:**

1. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.

Two handwritten signatures in black ink are located at the bottom right of the page. The first signature is a stylized, cursive 'S' followed by a vertical line and a diagonal stroke. The second signature is a cursive 'aj'.

2. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
3. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
4. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.

## **Part I Semester II**

### **CC-5: COMPILER DESIGN**

**Credit: 5**

**Compiler Structure:** Analysis-synthesis model of compilation, various phases of a compiler, tool based approach to compiler construction.

**Lexical Analysis:** Interface with input, parser and symbol table, token, lexeme and patterns; difficulties in lexical analysis; error reporting; regular definition, transition diagrams, Lex.

**Syntax Analysis:** CFGs, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence grammars, LR parsers, Yacc.

**Syntax Directed Definitions:** Inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions.

**Type Checking:** Type system, type expressions, structural and name equivalence of types, type conversion.

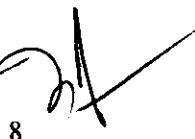
**Run Time System:** Storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation.

**Intermediate Code Generation:** Intermediate representations, translation of declarations, assignments, control flow, boolean expressions and procedure calls, implementation issues.

**Code Generation and Instruction Selection:** Issues, basic blocks and flow graphs, register allocation, code generation, dag representation of programs, code generation from dags, peep hole optimization, code generator generators, specifications of machine.

#### ***Reference Books:***

1. A.V. Aho, R. Sethi and J. D. Ullman, **Compilers: Principles, Techniques, and Tools** (US edition), Addison Wesley, 1986.
2. A. Holub, **Compiler Design in C**, Prentice-Hall of India, 2006.
3. R. Mak, **Writing Compilers and Interpreters** (2<sup>nd</sup> ed.), John Wiley & Sons, 1996.
4. D. Galles, **Modern Compiler Design**, Pearson Education, 2007.
5. S. Chattopadhyay, **Compiler Design**, Prentice-Hall of India, 2005.




## **CC-6: ADVANCED OPERATING SYSTEMS**

**Credit: 5**

Detailed study of contemporary popular operating systems for the chosen operating system (s), detailed design of the following modules will be discussed.

**Process and Processor Management:** Scheduling schemes, Interprocess communication, threads.

**File Management:** Interface between file systems and IOCS, directory structures, allocation of disk space, file protection, file system reliability.

**I/O Management:** I/O system, I/O strategies, buffering.

**Memory Management:** Swapping, demand paging, segmentation

### ***Reference Books:***

1. Maurice J. Bach, **Design of the UNIX Operating System**, Prentice Hall, 1986.
2. Gary Nutt, **Kernel Projects for Linux**, Addison Wesley, 2001.
3. William Stallings, **Operating Systems: Internals and Design Principles** (5<sup>th</sup> ed.), Prentice-Hall of India, 2006.
4. D.M. Dhamdhare, **Operating Systems: A Concept Based Approach** (2<sup>nd</sup> ed.), Tata McGraw-Hill, 2007.

## **CC-7: DATA MINING**

**Credit: 5**

**Introduction:** The process of knowledge discovery in databases, predictive and descriptive data mining techniques, supervised and unsupervised learning techniques.

**Techniques of Data Mining:** Link analysis, predictive modeling, database segmentation, score functions for data mining algorithms, Bayesian techniques in data mining.

**Issues in Data Mining:** Scalability and data management issues in data mining algorithms, parallel and distributed data mining, privacy, social, ethical issues in Knowledge Discovery in Databases (KDD) and data mining, pitfalls of KDD and data mining.

### ***Reference Books:***

1. Margaret H. Dunham, **Data Mining: Introductory and Advanced Topics**, 2002.
2. Jiawei Han and Micheline Kamber, **Data Mining: Concepts and Techniques** (2<sup>nd</sup> Ed.), Morgan Kaufmann, 2006.
3. Arun Pujari, **Data Mining Techniques**, University Press, 2001.
4. G.K. Gupta, **Introduction to Data Mining with Case Studies**, Prentice-Hall of India, 2006
5. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, **Introduction to Data Mining**, Addison Wesley, ISBN: 0-321-32136-7, 2005.



## CC-8: ADVANCED COMPUTER NETWORKS

Credit: 5

**Wireless Communication Principles:** Wireless propagation characteristics, transmission error, multipath fading, intrusion.

**Modulation techniques and bandwidth estimations:** Amplitude Shift Keying, Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulations, Direct Sequence and Frequency Hopping Spread Spectrum technologies.

**Multiple access and Duplexing techniques:** Frequency Division Multiple Access, Time Division Multiple Access, Code Division Multiple Access, Space Division Multiple Access, Wavelength Division Multiple Access, duplexing techniques- Time Division Duplexing, Frequency Division Duplexing.

**Mobile cellular networks:** Global Systems for Mobile combinations (GSM), General Packet Radio Service (GPRS), Enhanced Data rates for GSM Evolution (EDGE), Wireless Local loops, Mobility and Hands-off in mobile cellular networks.

**Wireless Local Area Networks:** Carrier Sense Multiple Access (CSMA/CA) protocol, Distributed Coordination Function, Point Coordination Function, Infrastructure based WLAN, ADHOC WLAN, IEEE 802.11 WLAN standards.

### **Reference Books:**

1. A. S. Tanenbaum, **Computer Networks (4<sup>th</sup> Ed.)**, PHI Learning Private Limited.
2. B. A. Forouzan, **Data Communications and Networking (4<sup>th</sup> Ed.)**, Tata McGraw-Hill Publishing Company Limited.
3. K. Pahlavan and P. Krishnamurthy, **Principles of Wireless Networks, A unified Approach**, Pearson Education Asia, 2002.
4. P. Nicosopolitidis, M. S. Obaidat, G. I. Papadimitriou and A. S. Pomportis, **Wireless Networks**, John Wiley and Sons, Ltd. 2003.

## CC-9: COMPUTATIONAL INTELLIGENCE

Credit: 5

**Introduction** to Computational Intelligence, Computational Intelligence vs Artificial Intelligence.

**Rough Sets:** Introduction, Set Approximation, Decision Tables.

**Fuzzy Logic Systems:** Notion of fuzziness, fuzzy modeling, operations on fuzzy sets, T-norms and other aggregation operators, basics of approximate reasoning, compositional rule of inference, fuzzy rule based systems, (Takagi-Sugeno and Mamdani-Assilian models), schemes of fuzzification, inferencing, defuzzification, fuzzy clustering, fuzzy rule based classifier.

**Artificial Neural Networks:** The neuron as a simple computing element, the Perceptron, Multilayer Neural Networks, Supervised Learning Neural Networks, Unsupervised Learning Neural Networks, Radial Basis Function Networks, Reinforcement Learning



**Evolutionary Computation:** Genetic operators, building block hypothesis, evolution of structure, genetic algorithms based on tree and linear graphs, applications in science and engineering.

**Reference Books:**

1. Leszek Rutkowski, **Computational Intelligence: Methods and Techniques**, Springer 2008.
2. Amit Konar, **Computational Intelligence: Principles, Techniques and Applications**, Springer, 2005.
3. Andries P. Engelbrecht, **Computational Intelligence: An Introduction**, John Wiley and Sons, 2007.
4. K.H. Lee, **First Course on Fuzzy Theory and Applications**, Springer, 2005
5. D. E. Goldberg, **Genetic Algorithms in Search, Optimization, and Machine Learning**, Addison-Wesley, Reading, 1989
6. E. Alpaydin, **Introduction to Machine Learning**, Prentice-Hall of India, 2004

**AEC-1: ABILITY ENHANCING ELECTIVE PAPER** **Credit: 5**

**Computer and IT Skills**

**Basics of Computer:** Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information; Applications of IECT; Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.

**Operating Computer using GUI Based Operating System:** Operating System; Basics of Popular Operating Systems; The User Interface, Using Mouse; Using right Button of the Mouse and Moving Icons on the screen, Use of Common Icons, Status Bar, Using Menu and Menu-selection, Running an Application, Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows; Using help; Creating Short cuts, Basics of O.S Setup; Common utilities.

**Understanding Word Processing:** Word Processing Basics; Opening and Closing of documents; Text creation and Manipulation; Formatting of text; Table handling; Spell check, language setting and thesaurus; Printing of word document.

**Using Spread Sheet: Basics of Spreadsheet:** Manipulation of cells; Formulas and Functions; Editing of Spread Sheet, printing of Spread Sheet.

**Introduction to Internet, WWW and Web Browsers:** Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing softwares, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website.

**Reference Books:**

1. ReemaThareja, Information Technology and its Applications in Business, OUP.

2. V. Rajaraman, Introduction to Information Technology, PHI.
3. Leon & M. Leon, Fundamental of IT, Vikas Publication.

## **Web Designing**

**Internet Concept:** Fundamental of Web, History of Web, Web development overview, Domain Name System (DNS), DHCP, and SMTP and other servers, Internet service provider (ISP), Concept of IP Address, Internet Protocol, TCP/IP Architecture and protocol (IP), Web Browser and Web Server.

**HTML:** HTML Tag, Rules of HTML, Text Formatting & Style, List, Adding Graphics to Html Document, Tables and Layout, Linking Documents, Frame, Forms, Project in HTML.

**CSS:** Style sheet, types of style sheets- Inline, External, Embedded CSS; text formatting properties, CSS Border, margin properties, Positioning, color properties, Use of classes in CSS.

**Scripting Language:** Java Script, Advantage of Java Script, JS object model and hierarchy, Handling event, Operators and syntax of JS, Function, Client side JS Vs Server side JS, JS security.

**XML:** Introduction to XML, XML in Action, Commercial Benefits of XML, Gaining Competitive advantage with XML, Programming in XML, XML Schema, XSLT, DOM structure model, XML queries and transformation.

### **Reference Books:**

1. Roy, Web Technologies, OUP.
2. Sabesta, Programming the World Wide Web, PE.
3. Godbole & Kahate, Web Technologies, TMH.

## **Part II Semester III**

### **CC-10: DIGITAL IMAGE PROCESSING & MULTI-MEDIA Credit: 5**

**Fundamental Steps in Image Processing:** Element of visual perception, a simple image model, sampling and quantization, some basic relationships between pixel, image geometry in 2D, image enhancement in the spatial domain.

**Introduction to spatial and frequency methods:** Basic gray level transformations, histogram equalization, local enhancement, image subtraction, image averaging, basic spatial, filtering, smoothing spatial filters, sharpening spatial filters.

**Introduction to the fourier transformation:** Discrete fourier transformation, fast fourier transformation, filtering in the frequency domain, correspondence between filtering in the spatial and frequency domain smoothing frequency-domain filters, sharpening frequency-domain filters, homomorphic filtering, dilation and erosion, opening and closing, hit-or-miss transformation.

**Some basic morphological algorithms:** Line detection, edge detection, gradient operator, edge linking and boundary detection, thresholding, region-oriented segmentation, representation schemes like chain codes, polygonal approximations, boundary segments, skeleton of a region, recognition and interpretation patterns and pattern classes, decision-theoretic methods, introduction to neural network.

**Introduction to Image Compression:** JPEG, MPEG, Wavelets, operating system issues in multimedia, real time OS issues, interrupt latency etc., network management issues Like QOS guarantee, resource reservation, traffic specification etc., security issues like digital watermarking, partial encryption schemes for video stream encryption.

Latest developments in field of multimedia like VOIP, video on demand and video conferencing.

**Reference Books:**

1. Rafael C. Gonzalez and Richard E. Woods, **Digital Image Processing**, Prentice-Hall of India, 2002.
2. William K. Pratt, **Digital Image Processing: PIKS Inside** (3<sup>rd</sup> ed.), John Wiley & Sons, Inc., 2001.
3. Bernd Jahne, **Digital Image Processing**, (5<sup>th</sup> revised and extended edition), Springer, 2002.
4. S. Annadurai and R. Shanmugalakshmi, **Fundamentals of Digital Image Processing**, Pearson Education, 2007.
5. M.A. Joshi, **Digital Image Processing: An Algorithmic Approach**, Prentice-Hall of India, 2006.
6. B. Chandra and D.D. Majumder, **Digital Image Processing and Analysis**, Prentice-Hall of India, 2007.

**CC-11: NEURAL NETWORKS**

**Credit: 5**

**Introduction:** Neuron as basic unit of Neurobiology, McCulloch-Pitts model, Hebbian Hypothesis; limitations of single-layered neural networks.

**Supervised Learning:** Single-layered neural networks, Hopfield-Little model, perceptron rules, Gradient-descent algorithms; Multi-layered neural networks: first order methods, back propagation algorithm, second order methods, RBF networks; Constructive algorithms: single- hidden layer algorithms, upstart algorithm, cascade correlation algorithm; Unsupervised Learning: competitive learning, competition through lateral inhibition.

**Kernel methods and support vector machines:** binary classification, multiclass classification, allowing for training errors: soft margin techniques; neural networks and temporal sequences: sequence recognition, sequence generation; applications.

**Reference Books:**

1. S. Haykin, **Neural Networks: A Comprehensive Foundation** (2<sup>nd</sup> ed.), Prentice Hall, 1999
2. R.Rojas and J. Feldman, **Neural Networks: A Systematic Introduction** (1<sup>st</sup> ed.), Springer, 1996.



3. C.M. Bishop, **Neural Networks for Pattern Recognition**, Oxford University Press, 1995.
4. S.N. Sivanandam, S. Sumathi and S.N. Deepa, **Introduction to Neural Networks using MATLAB 6.0**, Tata McGraw-Hill, 2006.
5. B. Yegnanarayana, **Artificial Neural Networks**, Prentice-Hall of India, 2006.

**CC-12: CRYPTOGRAPHY Credit: 5**

**Elementary number theory:** Prime numbers, Fermat's and Euler's theorems, Testing for primality, Chinese remainder theorem, discrete logarithms.

**Finite fields:** Review of groups, rings and fields; Modular Arithmetic, Euclidean Algorithms, Finite fields of the form  $GF(p)$ , Polynomial Arithmetic, Finite fields of the form  $GF(2^n)$ .

**Data Encryption Techniques:** Algorithms for block and stream ciphers, private key encryption – DES, AES, RC4; Algorithms for public key encryption – RSA, DH Key exchange, KERBEROS, elliptic curve cryptosystems.

Message authentication and hash functions, Digital Signatures and authentication protocols, Public key infrastructure, Cryptanalysis of block and stream ciphers.

**Reference Books:**

1. W. Stallings, **Cryptography and Network Security Principles and Practices** (4<sup>th</sup> ed.), Prentice-Hall of India, 2006
2. C. Pfleeger and S.L. Pfleeger, **Security in Computing** (3<sup>rd</sup> ed.), Prentice-Hall of India, 2007
3. MY Rhee, **Network Security**, John Wiley and Sons, NY, 2002.

**CC-13: MODELING AND SIMULATION Credit: 5**

**Systems and environment:** Concept of model and model building, model classification and representation, Use of simulation as a tool, steps in simulation study.

**Continuous-time and Discrete-time systems:** Laplace transform, transfer functions, state-space models, order of systems, z-transform, feedback systems, stability, observability, and controllability. Statistical Models in Simulation: Common discrete and continuous distributions, Poisson process, and empirical distributions.

**Random Numbers:** Properties of random numbers, generation of pseudo random numbers, techniques of random number generation, tests for randomness, random variate generation using inverse transformation, direct transformation, convolution method, acceptance-rejection.

**Design and Analysis of simulation experiments:** Data collection, identifying distributions with data, parameter estimation, goodness of fit tests, selecting input models without data, multivariate and time series input models, verification and validation of models, static and dynamic simulation output analysis, steady-state simulation, terminating simulation,

confidence interval estimation, Output analysis for steady state simulation, variance reduction techniques.

**Queuing Models:** Characteristics of queuing systems, notation, transient and steady-state behavior, performance, network of queues.

**Large Scale systems:** Model reduction, hierarchical control, decentralized control, structural properties of large scale systems.

**Reference Books:**

1. Narsingh Deo, **System Simulation with Digital Computer**, Prentice Hall of India, 1999.
2. Averill Law, **Simulation Modeling and Analysis (3<sup>rd</sup> Ed.)**, Tata McGraw-Hill, 2007.
3. G. Gordan, **System Simulation (2<sup>nd</sup> Ed.)**, Pearson Education, 2007.
4. A.F. Seila, V. Cerić and P. Tadikamalla, **Applied Simulation Modeling** (International Student Edition), Thomson Learning, 2004.
5. Jerry Banks, **Handbook of Simulation: Principles, Methodology, Advances, Applications, and Practice**, Wiley Inter Science, 1998.
6. J. Banks, J.S. Carson, B.L. Nelson, **Discrete Event System Simulation (4<sup>th</sup> Ed.)**, Prentice-Hall of India, 2004.
7. N.A. Kheir, **Systems Modeling and Computer Simulation**, Marcel Dekker, 1988.  
B.P. Zeigler, T.G. Kim, and H. Praehofer, **Theory of Modeling and Simulation (2<sup>nd</sup> Ed.)**, Academic Press, 2000.

**CC-14: EMBEDDED SYSTEMS**

**Credit: 5**

**Introduction to Embedded Systems:** Overview of embedded systems, features, requirements and applications of embedded systems, recent trends in the embedded system design, common architectures for the ES design, embedded software design issues, interfacing and communication Links, introduction to development and testing tools.

**Embedded System Architecture:** Basics of 8 – bit RISC microcontroller (PIC), block diagram, addressing modes, instruction set, timers, counters, stack operation, programming using PIC controller, basics of 32 – bit microprocessor (ARM), processor and memory organization, data operations, flow of control, pipelining in ARM, ARM bus (AMBA).

**Embedded Software:** Programming in embedded environment, Programming for microcontrollers such as Intel 8051 and PIC, overview of Java 2 micro edition (J2ME), concept of a MIDLET, applications of J2ME in mobile communication.

**Applications of Embedded Systems:** Industrial and control applications, networking and telecom applications, DSP and multimedia applications, applications in the area of consumer appliances, concept of smart home.

**Reference Books:**

1. Daniel W. Lewis, **Fundamentals of Embedded Software, where C and assembly meet**, Pearson Education 2001.



2. John B. Peatman, **Design with PIC Microcontrollers**, Pearson Education, 1997.
3. Robert B. Reese, **Microprocessors: From assembly language to C using PIC18Fxx2**, Shroff Publishers and Distributors Pvt Ltd. 2005.
4. Wayne Wolf, **Computers as Components: Principles of Embedded Computing System Design**, Elsevier Publication 2000.
5. Michael Juntao Yuan, **Enterprise, J2ME – Developing Mobile Java Applications**, Pearson Education, 2003.
6. Andrew N. Sloss, Dominic Symes, Chris Wright, **ARM System Developer's Guide – Designing and Optimizing System Software**, Elsevier Publications, 2007.
7. A. Silberschatz, P.B.Galvin and G. Gagne, **Operating System Concepts (6<sup>th</sup> ed.)**, John Wiley & Sons, Inc., 2001
8. K.V.K.K.Prasad, **Embedded/Real Time Systems: Concepts, Design and Programming**, Dreamtech Press, New Delhi, India, 2003.

**AECC-2: Human Values, Professional Ethics & Gender Sensitization Credit: 5**

**Human Values:** Morals, values, ethics – integrity – work ethics –service learning –civic virtue – respect for others- living peacefully - Caring –sharing –honesty – courage –valuing time – cooperation – commitment –empathy – self-confidence –spirituality – character.

**Professional Ethics:** Profession- and professionalism - Two models of professionalism – Professional etiquette -Three types of Ethics or morality Responsibility in Engineering – Engineering standards –Engineering Ethics – Positive and Negative Faces. Professional Codes and Code of conduct of Institute of Engineers.

**Professional Responsibilities:** Ethical standards Vs Professional Conduct – Zero Tolerance for Culpable Mistakes – Hazards and Risks- Risk benefit analysis– congeniality, collegiality and loyalty. Respect for authority – conflicts of interest.

**Professional Rights:** professional rights and employee rights communicating risk and public policy – Whistle blowing - Professionals /engineers as managers, advisors, experts, witnesses and consultants – moral leadership- Regulatory compliances, Monitoring and control.

**Ethics in global context:** Global issues in MNCs- Problems of bribery, extortion, and grease payments – Problem of nepotism, excessive gifts – paternalism – different business practices – negotiating taxes.

***Reference Books:***

1. Dr. Rajan Mishra, Human Values: Laxmi Publications Pvt. Ltd.
2. S B George, Human Values and Professional Ethics, Vikas Publishing.
3. P.S. Rathore. Business Ethics And Communication; S.Chand Publishing.

## Part II Semester IV

EC-1: ELECTIVE COURSE-1

Credit: 5

### NUMERICAL COMPUTING

**Solution to Transcendental and Polynomial Equations:** Iterative methods, bisection method, secant method, Newton-Raphson method, fixed point iteration, methods for finding complex roots.

**Matrices and Linear System of Equations:** LU decomposition method for solving systems of equations, Symmetric positive definite matrices and least square approximation, iterative algorithms for linear equations.

**Interpolation:** Polynomial interpolation, Newton-Gregory, Stirling's, Bessel's and Lagrange's interpolation formula, Newton's forward and backward differences interpolation formulae.

**Curve fitting:** B-spline and Approximation: Fitting linear and non-linear curves, weighted least square approximation, method of least square for continuous functions.

**Numerical Differentiation and Integration:** Numerical differentiation and errors in numerical differentiation, Newton-Cotes formulae, trapezoidal rule, Simpson's rule, Gaussian integration.

**Numerical Solutions of Ordinary Differential Equations:** Picard's and Taylor's series, Euler's and Runge-Kutta (RK) methods, Predictor-corrector's, Milne-Simpson's, Adams-Bashford, Adams-Moulton methods.

**Finite Element Method:** Boundary value problems, Rayleigh and Galerkin methods of approximation, applications.

#### **Reference Books:**

1. K.E. Atkinson, W. Han, **Elementary Numerical Analysis**, 3rd Edition, Wiley, 2003.
2. C. Xavier, S. S. Iyengar, **Introduction to Parallel Algorithms** (Wiley Series on Parallel and Distributed Computing, Wiley-Interscience, 1998).
3. Kharab, R.B.Guenther, **An Introduction to Numerical Methods: A MATLAB Approach** (1<sup>st</sup> ed.), Chapman & Hall/CRC, 2001.

### OPTIMIZATION TECHNIQUE

**Introduction:** Nature and Meaning, History, Management Applications, Modeling, Principles, Characteristics, Scope, Development of OR In India, Role of Computers in OR.

**Linear Programming:** Introduction and Applications of LP, Limitations of LP Formulation of a LP Model, Graphical Solution of a LPP, Simplex Method, Two Phase Method, Big-M Method.

**Transportation, Assignment and Replacement Problem:** Introduction to Transportation



Problem, Mathematical Formulation, Feasible Solution and Optimum Solution; Introduction to Assignment Problem, Mathematical Formulation, Traveling Salesman Problem; Introduction to Replacement Problem, Capital Equipment, Discounted Cost, Replacement in Anticipation of Failure.

**Queuing Problems:** Classification of self problems, processing of  $n$  jobs through two machines, three machines, processing of two jobs through  $m$  machines.

**Project Management by PERT-CPM:** Introduction, History & Applications, Basic Steps, Network Diagram Representation, Rules, Time Estimates and Critical Path in Network Analysis, Uses and Applications of PERT/CPM.

**Reference Books:**

1. Pai, Operation Research, OUP.
2. Paneerselvam, Operation Research, PHI.
3. Hillier & Lieberman, Operations Research, TMH.

**EC-2: ELECTIVE COURSE-2**

**Credit: 5**

**PROJECT WORK**

Each student will be assigned some project work at the starting of the fourth semester. Each student (or group of at most 2 students) is expected to take a unique problem under the guidance/supervision of a faculty member of the Department.

The problem should be such that the students get a chance to explore one or two technologies in depth and grab good command over those technologies after successful completion of the project. Repetition of the problems already attempted by students of the previous years should not be encouraged unless the problem has exceptionally great research importance and scope. Application problems, if found interesting and arisen at the demand of a particular situation, may also be assigned; but typical information management systems with just two or three simple database tables and/or data entry forms are to be discouraged. The project may be done in other Institutes/Organizations with prior permission from the concerned department of the College and in this case also one project supervisor should have to be from the concerned department in the College. The work will have to be submitted in the form of a dissertation. Project presentation and evaluation will have to be done as per the regulation of PG course semester system of G.U. with choice based credit and grading system.

This is an industrial project. Each student has to complete the industrial training for at least 3 months. The project is evaluated by internal and external examiners. It may include dissertation, seminar, viva voce etc.

**DSE-1: DISCIPLINE SPECIFIC ELECTIVE COURSE-1**

**Credit: 5**

**ADVANCE JAVA PROGRAMMING**

**Java Utilities:** Collections – I/O streams – Networking – Event Handling.

**AWT:** Windows, Controls, Layout Managers and Menus – Swing. Multimedia: Images,

Animation and Audio – JDBC.

**Java Servlets:** Design – Life Cycle – Constituents of javax.servlet package – cookies – session tracking – Java Server Pages: Overview – Implicit Objects – Scripting – Standard actions – Directives.

**Remote Method Invocation:** Remote Interface – The Naming Class – RMI Security Manager Class – RMI Exceptions – Creating RMI Client and Server classes – RMI – I IOP.

**Java Beans:** Events – Customization – Introspection – Persistence – EJB: Introduction – EJB Container – Classes – Interfaces – Deployment description – Session Bean – Entity Java Bean – Jar file.

**Reference Books:**

1. Roy, Advance Java Programming, OUP.
2. Deitel, Java- How to Program, PHI.
3. Seth & Juneja, Java, OUP.
4. H. Schildt, Java 2: The Complete Reference (5th ed.), TMH.

**.NET PROGRAMMING**

**Microsoft .NET Framework:** The .NET Framework classes – Common Language Runtime – Common Type system and Common Language specification – Visual studio .NET IDE. Visual Basic .NET – Visual Basic .NET IDE – Variables – Data types – Constants – Arrays – Dynamic arrays – Controlling the flow – if statement – select case – Loops.

**Procedures:** modular coding, arguments – Structures- Collections: Advanced array, Arraylist and hash table. Lists- sorted list. Creating custom class, adding methods and properties. Building Windows Applications – working with forms.

**Basic windows controls:** common dialog controls- Rich text box control- Debugging and Error Handling: types of errors, Exceptions and structured exception handling – Accessing databases – Building Database applications with ADO .Net- ADO .Net objects.

**ASP .NET:** Introducing web developer tools -- Introduction to ASP .NET server Programming – Using variables and constants in web forms – Working with web objects to store data – Designing .NET web Applications – Programming with Visual Basic .NET – Advanced web controls – Managing data with ASP .NET

**C# Programming:** Evolution of C# and .NET – Why C# - Elements of C# program – Programming Example – Data types and Expressions – Making decisions – Repeating Instructions – Arrays and Collection – Controls – Programming based on events – Database access with ADO .NET

**Reference Books:**

1. David Chappell, Understanding .NET , Pearson education.
2. David.S.Platt, Introducing Microsoft .Net , PHI.
3. G.AndrwDuthie , Microsoft ASP .NET Programming with Microsoft Visual C# .NET step by step , PHI.

4. George Shepherd, Microsoft ASP .NET 3.5 , PHI.

## **PARALLEL AND DISTRIBUTED COMPUTING**

**Introduction:**Need for Computational speed; Applications of parallel computers in various fields including Mathematics, Physics, Chemistry and Computer Science; Configuration of some existing Mainframe and Super Computers for parallel processing; issues in parallel processing.

**Parallel Processing Architectures:**Parallelism in Sequential Machines, Abstract model of parallel computer, multiprocessor architecture, programmability issues.

**Data Dependency Analysis:**Introduction, Types of Dependencies, Loop and Array Dependence, Loop Dependence Analysis, Solving Diophantine Equations.

**Shared Memory Programming:**General Model, Process Model under UNIX, Thread Management, Thread Implementation.

**Distributed Computing:**Message passing model, Parallel Virtual Machine (PVM), Remote procedure call.

**Algorithms for Parallel Machines:**Speedup, Complexity and Cost, Parallel Reduction. Quadrature Problem, Matrix Multiplication, Parallel Sorting Algorithms and Solving Linear System, Parallel Programming Languages:Fortran 90, nCUBE C, Occam, C-Linda.

### ***Reference Books:***

1. Sasikumar, Shikhara,Dinesh and Prakash, Introduction to Parallel Processing, PHI..
2. Rajaraman, Elements of Parallel Computing, PHI.
3. Susann, Parallel Programming, TMH.

## **BIG DATA ANALYSIS**

**Introduction To Big Data:** Introduction to Big Data, Challenges of Big Data, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting, Modern Data Analytic Tools. Statistical Concepts: Sampling Distributions, Statistical Inference, Prediction Error.

**Mining Data Streams:** Introduction To Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform(RTAP) Applications.

**Hadoop:** History of Hadoop, The Hadoop Distributed File System, Components of Hadoop, Analyzing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS, Map Reduce Introduction, Map Reduce Features, How Map Reduce Works, Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort, Task execution, Map Reduce Types and Formats. Hadoop Environment: Setting up a Hadoop Cluster, Cluster specification, Cluster Setup and Installation, Hadoop Configuration, Security in Hadoop,

Hadoop in the cloud.

**HIVE AND HIVEQL, HBASE:** Introduction to No Query Language, Hive Architecture and Installation. Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

**Reference Books:**

1. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", TMH.
2. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons.
3. Pete Warden, "Big Data Glossary", O'Reilly.

**CLOUD COMPUTING**

**Cloud Computing Fundamentals:** Cloud Computing definition: private, public and hybrid cloud; Evolution of Cloud Computing; Characteristics of Cloud, Cloud Types; Cloud Computing Benefits and Limitations, Cloud Architecture; Cloud computing vs. Cluster computing vs. Grid computing; Applications: Technologies and Process required when deploying Web services; Deploying a web service from inside and Outside of a Cloud.

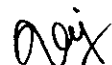
**Cloud Computing service models:** Introduction to Cloud Services: : SaaS, IaaS, PaaS; Storage As a Service. Communication As a Service; Cloud-based big data/real time analytics, Understanding SOA; Improving Performance through Load Balancing. Virtualization Basics: Objectives, Benefits of Virtualization, Emulation, Virtualization for Enterprise, VMware, Server Virtualization, Data Storage Virtualization.

**Cloud vendors and Service Management:** Amazon cloud, AWS Overview, Installation of AWS, Google app engine, azure cloud, salesforce. Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously , Managing Data: Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud , Large Scale Data Processing.

**Security Concepts:** Cloud security challenges, Cloud security approaches: encryption, tokenization/obfuscation, cloud security alliance standards, cloud security models and related patterns, Cloud security in mainstream vendor solutions, Mainstream Cloud security offerings: security assessment, secure Cloud architecture design, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations. Case Study on Open Source & Commercial Clouds: Eucalyptus, Microsoft Azure, Amazon EC2.

**Reference Books:**

1. Cloud Computing : A Practical Approach by Anthony T. Velte Toby J. Velte, Robert Elsenpeter, TMH.
2. Cloud Computing Bible, Barrie Sosinsky, Wiley-India.



3. Cloud Computing: Principles and Paradigms, Editors: RajkumarBuyya, James Broberg, Andrzej M. Goscinski, Wiley-India.

## **R-PROGRAMMING**

**Introduction**, How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion. Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.

**R Programming Structures**, Control Statements, Loops, - Looping Over Nonvector Sets,- If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation-Extended Extended Example: A Binary Search Tree.

**Doing Math and Simulation in R**, Math Function, Extended Example Calculating Probability- Cumulative Sums and Products-Minima and Maxima- Calculus, Functions for Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product- Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /out put, Accessing the Keyboard and Monitor, Reading and writer Files,

**Graphics**, Creating Graphs, The Workhorse of R Base Graphics, the plot() Function Customizing Graphs, Saving Graphs to Files.

**Probability Distributions**, Normal Distribution- Binomial Distribution- Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests,- ANOVA.

**Linear Models**, Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models-Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests,

### ***Reference Books***

1. The Art of R Programming, Norman Matloff, Cengage Learning
2. R for Everyone, Lander, Pearson
3. R Cookbook, Paul Teetor, Oreilly.
4. R in Action, Rob Kabacoff, Manning

## **MACHINE LEARNING**

**Overview and Introduction to Bayes Decision Theory:** Machine intelligence and applications, pattern recognition concepts classification, regression, feature selection, supervised learning class conditional probability distributions, Examples of classifiers bayes optimal classifier and error, learning classification approaches.

**Linear machines:** General and linear discriminants, decision regions, single layer neural

network, linear separability, general gradient descent, perceptron learning algorithm, mean square criterion and widrow-Hoff learning algorithm; multi-Layer perceptrons: two-layers universal approximators. backpropagation learning, on-line, off-line error surface, important parameters.

**Learning decision trees:** Inference model, general domains, symbolic decision trees, consistency, learning trees from training examples entropy, mutual information, ID3 algorithm criterion, C4.5 algorithm continuous test nodes, confidence, pruning, learning with incomplete data.

**Instance-based Learning:** Nearest neighbor classification, k-nearest neighbor, nearest neighbor error probability.

**Machine learning concepts and limitations:** Learning theory, formal model of the learnable, sample complexity, learning in zero-bayes and realizable case, VC-dimension, fundamental algorithm independent concepts, hypothesis class, target class, inductive bias, occam's razor, empirical risk, limitations of inference machines, approximation and estimation errors. Tradeoff.

**Machine learning assessment and Improvement:** Statistical model selection, structural risk minimization, bootstrapping, bagging, boosting.

**Support Vector Machines:** Margin of a classifier, dual perceptron algorithm, learning non-linear hypotheses with perceptron kernel functions, implicit non-linear feature space, theory, zero-Bayes, realizable infinite hypothesis class, finite covering, margin-based bounds on risk, maximal margin classifier.

### **Reference Books:**

1. E. Alpaydin, **Introduction to Machine Learning**, Prentice Hall of India, 2006.
2. T. M. Mitchell, **Machine Learning**, McGraw-Hill, 1997.
3. C. M. Bishop, **Pattern Recognition and Machine Learning**, Springer, 2006.
4. R. O. Duda, P. E. Hart, and D.G. Stork, **Pattern Classification**, John Wiley and Sons, 2001.
5. Vladimir N. Vapnik, **Statistical Learning Theory**, John Wiley and Sons, 1998.
6. J. Shawe-Taylor and N. Cristianini, Cambridge, **Introduction to Support Vector Machines**, University Press, 2000.

### **SOFT COMPUTING**

**Rough Sets:** Information Systems, decision tables, indiscernibly relation, set approximation, approximation of family of sets, analysis of decision tables.

**Type-2 Fuzzy Sets:** Notion of uncertainty of membership in a fuzzy set, foot print of uncertainty, embedded fuzzy sets, operations on type-2 fuzzy sets, type-2 fuzzy relations, type reduction, type-2 fuzzy inference system.

**Fuzzy Clustering:** Limitations of hard partitioning and need for fuzzy clustering, FCM, PCM, GK, and FMLE algorithms, cluster validity measures,

**Projected Clustering:** The problem of high dimensionality in clustering, use of projected clustering methods to address the problem of high dimensionality – grid based, density based, centroid based, and hierarchical approaches.

**Rough Set Based Methods:** Information granulation using rough sets, decision rules in rough set models, classification, and clustering methods based on rough sets.

**Neuro Fuzzy Systems:** Neuro fuzzy systems of Mamdani, logical, and Takagi-Sugeno type, flexible neuro fuzzy systems.

**Reference Books:**

1. L. Rutkowski, **Computational Intelligence, Methods and Techniques**, Springer, 2008
2. J. Valente de Oliveira, W. Pedrycz, **Advances in Fuzzy Clustering and its Applications**, John Wiley & Sons, 2007.
3. J. Stepaniuk, **Rough-Granular Computing in Knowledge Discovery and Data Mining**, Springer, 2008.
4. F. Hopner, F. Hoppner, F. Klawonn, **Fuzzy Cluster Analysis: Methods for Classification, Data Analysis and Image Recognition**, John Wiley & Sons, 1999.

Two handwritten signatures in black ink, one on the left and one on the right, appearing to be initials or names.