Minutes of the meeting held on 12/6/18 (10:30AM) regarding review of Syllabus and accordingly implementation of CBS 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:

1) The eligibility criteria for admission in MSc. (Comp. Sc.)/MCA programme be given in detail, thereafter the committee can examine the Courses offered in different semester is feasible or not.

2) 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 described especially in MSc. (Comp. Sc.)

c) The syllabus of Cyber security (BSc. E-I, MSc. Comp.) is missing in the hard copy.

Once we get the soft copy as suggested above, the committee will consult through mail and after finalising, resolve the aforesaid issues will sit again on 21st June 18 (3:00PM)

Prat A.K. Nayar
IIIT M, Patna

[Signature]

Rajeev Ranjan
CoE, AKU Patna

[Signature]
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.
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)
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 6th 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 course 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.
CODIFICATION OF PAPERS

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

### MCA SEMESTER – I

<table>
<thead>
<tr>
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<tr>
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<td>70</td>
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<tr>
<td>CS-12</td>
<td>Programming &amp; Data Structure with ‘C’</td>
<td>70</td>
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<tr>
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<td>Discrete Mathematical Structure</td>
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<tr>
<td>CS-23</td>
<td>Operating System &amp; Shell Programming</td>
<td>70</td>
<td>30</td>
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<tr>
<td>CS-24</td>
<td>Formal Language and Automata Theory</td>
<td>70</td>
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<tr>
<td>CS-25</td>
<td>Elective-II</td>
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<td>Advance Java Programming using J2EE</td>
<td>70</td>
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<tr>
<td>CS-32</td>
<td>Data Communication and Computer Network</td>
<td>70</td>
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<td>Database Management System</td>
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<td>Optimization Technique</td>
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<td>CS-35</td>
<td>Elective-III</td>
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<td>CS-42</td>
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<td>CS-44</td>
<td>Big Data Analysis &amp; Cloud Computing</td>
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<td>CS-52</td>
<td>Data Mining &amp; Data Warehousing</td>
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<td>Artificial Intelligence</td>
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### MCA SEMESTER – VI

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**LIST OF ELECTIVE PAPERS**

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<tr>
<th>Code</th>
<th>Elective - I</th>
<th>Elective - II</th>
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<tr>
<td></td>
<td>(I) Principles of Management</td>
<td>(I) Financial Accounting</td>
<td>(I) Parallel &amp; Distributed Computing</td>
<td>(I) Cryptography</td>
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<td>(III) SWAYAM</td>
<td>(III) SWAYAM</td>
<td>(III) SWAYAM</td>
<td>(III) Information Security</td>
<td>(IV) Satellite and Mobile Communication Networks</td>
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<td>(V) Machine Learning and Soft Computing</td>
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MCA SEMESTER - 1

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-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 Thereja, Information Technology and its Applications in Business, OUP.
2. V. Rajaraman, Fundamental of Computers, PHI.
3. Ray & Acharya, IT Principles & Application, PHI.

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


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.


Reference Books:
1. Reema Thareja, Programming in C, OUP.
2. Y. Kanetkar, Let us C, BPB.
3. Kernighan & Ritchie, C Programming Language, PE.
4. Langsam, Augustein & 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

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


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. Chakrabory & Sarkar, Discrete Mathematics, OUP.
2. Kolman & Rehman, Discrete Mathematical Structures, PE.
3. C.L. Liu, Elements of Discrete Mathematics, TMH
CS-14: Digital Logic & Computer Design
Credit: 4


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-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.

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-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.

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


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, 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-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.
4. Herbert Schildt, C++ - A Complete Reference, TMH.

Credit: 4


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


Reference Books:
1. Pal, Numerical Methods, OUP.
2. Balaguruswamy, Numerical and Statistical methods, TMH.
3. V. Rajaraman, Introductory methods of Numerical Analysis, PHI.

CS-23: Operating System & Shell Programming

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


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-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. Hopcroft, Motwani and Ullman. Introduction to Automata Theory, Languages and Computation, PE.
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 4. Financial Management: Concept of Funds and relevant Inflow & Outflow, 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.

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

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.


Reference Books:
2. Kalakota & Whinston, Frontiers of Electronic Commerce, PE.

CS-26: Practical based on Paper CS-21

Credit: 4
CS-31: Advance Java Programming  

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-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. Schilddt, 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  


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

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


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.

CS-34: Optimization Technique


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.


Reference Books:
1. Pai, Operation Research, OUP.
2. Paneerselvam, 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.


Reference Books:
1. Sasikumar, Shikara, 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
MCA SEMESTER - IV

CS-41: Web Technologies

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, Table 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-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 MySQL, 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

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


**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.

**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-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.


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.

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

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. Muneswaran, Compiler Design, OUP.
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-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.

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


Reference Books:
MCA SEMESTER - V

CS-51: Design and Analysis of Algorithm

Unit-1. Algorithms and Analysis: Introduction, Algorithms specification, Recursive algorithms, space and time complexity, Asymptotic Notation (O, \_ \_ and \_ \_ \_), 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.


Reference Books:
5. Sridhar, Design and Analysis of Algorithms, OUP.
7. Paneriselvam, Design and Analysis of Algorithm, PHI.
8. Dave, Design and Analysis of Algorithm, PE.

CS-52: Data Mining & Data Warehousing


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

22 | Page

Reference Books:
1. Prabhuand 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

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-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

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

Reference Books:
2. Kai Hwang, Advanced Computer Architecture, TMH.

CS-55(I): Elective-V: Cryptography
Credit: 4


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:
2. Forouzan and Mukhopadhyay, Cryptography and Network Security, TMH.

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:**
3. Sakurai, Modern Quantum Mechanics, Addison Wesley.

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**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-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.

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25 | Page
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-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.
3. C.N. Thurwachter, Wireless Networking, PHI.
4. M. Richharia, Mobile Satellite Communications: Principles & Trends, PE.
5. Jochen Schiller, Mobile Communications, PHI.

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-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.

Reference Books:
1. Padhy, Soft Computing, OUP.
2. M. Mitchell, An Introduction to Genetic Algorithms, PHI.
5. Timothy J.Ross, Fuzzy Logic with Engineering Applications, TMH.

CS-56: Practical based on Paper CS-53  
Credit: 4
MCA SEMESTER - VI

CS-61: Project & 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.

<table>
<thead>
<tr>
<th>Part</th>
<th>Year</th>
<th>Semester-1</th>
<th>Semester-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part-I</td>
<td>First</td>
<td>Semester-1</td>
<td>Semester-2</td>
</tr>
<tr>
<td>Part-II</td>
<td>Second</td>
<td>Semester-I</td>
<td>Semester-III</td>
</tr>
</tbody>
</table>

1. CODIFICATION OF PAPERS

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

**Part-I Semester I**

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Title</th>
<th>L - T - P*</th>
<th>Credits</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC-1</td>
<td>Design &amp; Analysis of Algorithms</td>
<td>3-1-0</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-2</td>
<td>Artificial Intelligence</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-3</td>
<td>Information Security</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-4</td>
<td>Database Systems &amp; Implementation</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>AECC-1</td>
<td>Ability Enhancement Compulsory Courses-1</td>
<td>3-0-0</td>
<td>5</td>
<td>100 [50+50]</td>
</tr>
</tbody>
</table>

**Part-I Semester II**

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Title</th>
<th>L - T - P*</th>
<th>Credits</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC-5</td>
<td>Compiler Design</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-6</td>
<td>Advanced Operating Systems</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-7</td>
<td>Data Mining</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-8</td>
<td>Advanced Computer Networks</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-9</td>
<td>Computational Intelligence</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>AECC-1</td>
<td>Ability Enhancing Elective Paper</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [50+50]</td>
</tr>
</tbody>
</table>

**Part-II Semester III**

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Title</th>
<th>L - T - P*</th>
<th>Credits</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC-10</td>
<td>Digital Image Processing &amp; Multimedia</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-11</td>
<td>Neural Networks</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-12</td>
<td>Cryptography</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-13</td>
<td>Modeling and Simulation</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>CC-14</td>
<td>Embedded Systems</td>
<td>3-0-2</td>
<td>5</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>AECC-2</td>
<td>Ability Enhancement Compulsory Courses-2</td>
<td>3-0-2</td>
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<td>100 [50+50]</td>
</tr>
</tbody>
</table>
Part-II Semester IV

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Title</th>
<th>L - T - P*</th>
<th>Credits</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC-1</td>
<td>Elective Course-1</td>
<td>3-0-2</td>
<td>05</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>EC-2</td>
<td>Project Work &amp; Viva Voce</td>
<td>3-0-2</td>
<td>05</td>
<td>100 [30+70]</td>
</tr>
<tr>
<td>DSE-1</td>
<td>Discipline Specific Elective-1</td>
<td>3-0-2</td>
<td>05</td>
<td>100 [30+70]</td>
</tr>
</tbody>
</table>

**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 & Swachchha 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 Swachchha 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-complete.

Approximation Algorithms: Introduction through examples.

Reference Books:

CC-2: ARTIFICIAL INTELLIGENCE

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.


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:

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:


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-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.

AECC-1: Environmental Sustainability & Swachhha 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.


Reference Books:

Part I Semester II

CC-5: COMPILER DESIGN

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, associatively, 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.


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:
CC-6: ADVANCED OPERATING SYSTEMS  Credit: 5

Detailed study of contemporary popular operating systems for the chosen operating system (s), detached 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:


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:

2. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques (2nd Ed.), Morgan Kaufmann, 2006.
CC-8: ADVANCED COMPUTER NETWORKS

Credit: 5

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


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:


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, defuzzificatin, 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:


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 Spreadsheet, 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.

**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.


**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:


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


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:


**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:**


**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 an 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**:


**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**:


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


**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:**
Part II Semester IV

EC-1: ELECTIVE COURSE-1  Credit: 5

NUMERICAL COMPUTING


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.


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

Reference Books:


OPTIMIZATION TECHNIQUE

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


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.


Reference Books:
1. Pai, Operation Research, OUP.
2. Pancerselvam, 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


Animation and Audio – JDBC.


Reference Books:
1. Roy, Advance Java Programming, OUP.
2. Deitel, Java- How to Program, PHI.
3. Seth &Juneja, Java, OUP.

.NET PROGRAMMING


Reference Books:
1. David Chappell, Understanding .NET, Pearson education.
3. G.AndrewDuthie, 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


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.

**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.


**Reference Books:**
R-PROGRAMMING


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.


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
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.


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:


SOFT COMPUTING


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 FML 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**: