UNIVERSITY
OF NORTH BENGAL

SYLLABUS
For
M.C.A.
(To be implemented from Session 2015-16)
## Proposed Courses Structure for a Six Semester (Full Time) M.C.A Programme in Computer Science and Application

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<thead>
<tr>
<th>Year</th>
<th>Semester</th>
<th>Paper</th>
<th>Paper Type</th>
<th>Periods / Week</th>
<th>Exam. Marks</th>
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**Note:** One ‘Period’ is of 1 Hr. duration.
Proposed Paper Structure for a Six Semester (Full Time) M.C.A Programme in Computer Science and Application

<table>
<thead>
<tr>
<th>Year</th>
<th>Semester</th>
<th>Paper</th>
<th>Paper Type</th>
<th>Exam. Marks</th>
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### List of Electives

**IT 3E1 Electives**
- E31: Automata Theory & Formal Languages
- E32: Principles of Programming Languages
- E33: Real Time and Embedded Systems
- E34: Mobile and Pervasive Computing

**IT 4E1 Electives**
- E41: Computer Graphics
- E42: Digital Image Processing and Steganography
- E43: Adhoc and Sensor Networks
- E44: Human Computer Interaction

**IT 5E1 Electives**
- E51: System Software and Compiler Constructions
- E52: Information Security and Cyber Forensics
- E53: Cryptography and Network Security
- E54: Cloud and Grid Computing

**IT 5E2 Electives**
- E55: AI and Expert System
- E56: Data Warehousing & Data Mining
- E57: Soft Computing
- E58: Software Project Management and SQA

**The allotment of electives depends on the availability of teachers.**
Detailed Syllabus of Compulsory Papers

Year 1: Semester 1

IT 11: Computer Concepts and Programming in C

Introduction to Computer Systems: Computer- definition, history, properties, use, basic components and structure of a computer; essential computer hardware, essential computer software; classification of Computers; Memory- use, types and hierarchy; Software- program, software, types and need

Storage Media and Operating Systems: Storage media- use, types, performance; Operating Systems- concept, role and functions, types, UNIX, Linux, Windows

Basics of Programming: Approaches to problem solving, concept of flowchart and algorithm, Termination and correctness, Algorithms to programs, Programming Environment, Specification, top-down and bottom-up development and stepwise refinement; Programming Languages-concepts, use, types; structured programming,

Introduction to C Language: Background, C Programs, Identifiers, Types, Variables, Constants, standard I/O, structure of a C Program

Operators and Expressions: Operators- concepts, types, arithmetic, relational, logical and bitwise operators; type conversions, expressions; operator precedence and associativity; evaluating expressions, type conversion, statements,

Fundamental Data Types and Storage Classes: Data type- definition, importance and need, types; Storage Classes- concepts, types, scope and use

Arrays and Strings: Array- concepts, need, use, notations, representation, manipulating, two and multi-dimensional arrays, arrays of unknown or varying size, advantages and applications; Strings- concepts, string I/O, operations, string handling functions

Selection – Making Decisions, Looping: Selection- concepts, purpose, applying if and switch statements, nesting if and else, restrictions on switch values, use of break, continue and default with switch, multi-way selection; Looping- concept, purpose, pre-test and post-test loops, initialization and updating, event controlled and count controlled loops, For Loop, While Loop, Do-While Loop, Multiple Loop Variables, No Data Found, other statements related to looping

Functions: Concept of structured programs and design; Functions- concept, need, use, types, declaration Vs definition, scope, calling; Parameter Passing- concepts, needs, types; inter-function communication, recursion, functions with Arrays, function with variable number of arguments, separate compilation and linkage, building your own modules.

Pointer: Introduction, declaration and initialization of pointers, pointer and address arithmetic, pointer operations and declarations, using pointers as function arguments,

Dynamic Memory Allocation: Memory allocation- concepts, type, dynamic memory allocation functions

Structure, Union and Enumeration: Concepts, purpose, declaration, assignment and use of structure, union and enumerated data types; pointers to these types of objects

File handling: File concept, functions associated to file operation, math functions

Preprocessor: Concept of macro, macro Vs functions, defining and calling macros, utilizing conditional compilation, passing values to the compiler,

Advancements in C and other related issues
References:
1. Norton, Peter; Introduction to Computers, 4th Ed., TMH
2. Brian W. Kernighan and Robert Pike; The Practice of Programming, Pearson Education, 1999
3. Jones, A., Kenith Harvow; C Programming with Problem Solving, Wiley India Pvt. Ltd
6. Byron S. Gottfried; Programming with C.
9. Y.P. Kanetkar; Let us C
10. Y. Kanetkar; Graphics Under C
12. Moolish Kooper; Spirit of C
13. R. Hutchison; Programming in C
14. Gookin, Dan; C Programming, Wiley India Pvt. Ltd.
15. Balgurusamy; Programming in ANCI C
16. R.G.Dromey; How to Solve it by Computer, Pearson Education, 2007

IT 12: Digital Systems and Microprocessors

Electronic Systems: Introduction to Analog and Digital Systems, Comparison and Difference between Analog and Digital Systems, advantages of digital systems

Number systems: Foundation of number systems, Binary, octal, and hexadecimal number systems, Conversion of one Number System to another, r's and (r-1)'s complement, Arithmetic operations on Binary numbers, Representation of negative numbers, Signed Binary numbers, floating point representations;

Binary codes: Binary Coded Decimal (8421 BCD, Excess-3 BCD) , Addition of BCD numbers, Gray code, Error detecting code and correction codes, Seven-segment display code, other Alphanumeric codes (ASCII, EBCDIC, ISCII, UNICODE);

Boolean algebra and Logic Gates: Boolean Algebra: Law's, Postulates and theorems, logic functions, minimization of boolean functions using different techniques; Writing Boolean functions from truth table, different logic gates and truth tables, realizing logical expressions using different logic gates and comparing their performance, logic diagrams, converting circuits to universal logic, Sum of Product and Product of Sum, Universal logic operations

Logic Families: Classification and characteristics, Bipolar transistors characteristic and families (RTL, DTL, I^2L, HTL, TTL, ECL), MOS families (MOSFET, CMOS, BiCMOS); Tri state logic, Design of Combinational Circuits- designing different combinational circuits i.e. Half-adder,
Full-adder, Sequential adder, binary Parallel adder, Carry-Look-Ahead adder, Adder, Subtractor, multiplication, code conversion, Decoders and Encoders, Magnitude Comparator, Multiplexer, Demultiplexers, Parity generator and checker. Hardware aspects related to logic design: delays and hazards; Design of Sequential Circuits—Flip Flops and their types, Conversion of flip-flops, excitation tables, practical clocking aspects concerning flip-flops, timing and triggering; Registers and their types, Counters and their types, A/D and D/A converters, Memory Devices and their types, PLAs, PLDs and implementation of circuits using PLDs; Control logic Design—Hard-wired control, micro program sequencer,

**Microprocessors:** Microprocessor, microcontrollers, digital signal processors, processor evolution, microprocessor architecture and its operations, memory input/output; addressing modes; instruction set, format and classification; arithmetic and data transfer instructions; subroutine call and return instruction, restart as software instruction; logic and branch operation, looping, counting and indexing, timings and operation status; stack, parallel input/output, interfacing devices, 8085/8086 based microcomputer system; 8087 coprocessor, 8051 and 8096 microcontroller; 8255 programmable peripheral interface, 8253 programmable timer, 8259 programmable interrupt controller, direct memory access and 8257 DMA controller

**Assembly Language Programming:** Assembler, assembly language and instructions, assembly directives, ALP

**References:**

4. Digital Principles and Applications: Malvino and Leach, TMH
10. An introduction to Digital Computer Design: Rajaraman and Radhakrishnan, PHI.
11. Microprocessor and Interfacing: D. V. Hall, TMH
12. The Intel Microprocessors: Barry B. Bray, PHI

**MT 11: Discrete Mathematics and Graph Theory**

**Set Theory:** Definition of sets, countable and uncountable sets, Venn Diagrams, proofs of some general identities on sets, Paradoxes in set theory; ordered set, hasse diagram of partially ordered set, isomorphic ordered set, well ordered set

**Functions and Relations:** Definition and type of functions, mappings, injection, bijection and surjection, inverse function, recursive functions, composite function, growth of functions, Definition and types of relation, properties of relations, equivalence relations and partitions, partial ordering relation, Lattices and their applications, generating functions, recurrence relations, solution of linear homogeneous and non-homogeneous recurrence relations by the method of generating functions and particular solution method

**Mathematical/Propositional Logic:** Mathematical reasoning, Proposition, First order logic, Basic logical operations, Tautologies, Contradictions, connectives, conditionals and bi-conditionals, well formed formulas, equivalence of formulas, Algebra of Proposition, Logical implication, Logical equivalence, duality law, Normal forms, Inference Theory for propositional calculus, Predicates, quantifiers, free and bound variables, inference theory of predicate calculus
**Algebraic Structures:** Groups, Rings and Fields; Group Codes; Concepts of Vector Spaces;

**Graph Theory:** Basic terminology of graphs, types of graphs, paths and circuits, reachability and connectedness; operations on graphs, Euler and Hamiltonian graph, matrix and storage representation, manipulation of graphs, Trees and Minimum Spanning Trees, Traveling Salesperson problem, Graph traversals- BFS, DFS and their applications.

**References:**

1. Trembley, J.P and R., Manohar; Discrete Mathematical Structure with Application to Computer Science, TMH
4. Narsingh Deo, Graph Theory With Applications To Engineering And Computer Science, PHI Learning
6. Liptschutz, Seymour; Discrete Mathematics; TMH.
7. Kenneth H. Rosen; Discrete Mathematics and its applications; TMH.
10. W. K. Grassmann and J. P. Tremblnlay, Logic and Discrete Mathematics

**BM 11: Introduction to Management Functions**

**Introduction to Management:** Management Thought; Meaning and nature of management; Functions and Principles of Management; Corporate social responsibility, Management systems and processes; Tasks and responsibilities of a professional manager; Managerial skills.

**Human Resource Development:** Importance and Functions, Scope of HRM, selection, appraisal, training and information systems, Human Resource Management in a changing environment,

**Marketing:** Understand the concept of marketing mix. These marketing mix elements consist of product policy and design, pricing, choice of marketing intermediaries, methods of physical distribution, use of personal selling, advertising and sales promotion, marketing research, and marketing organization.

**Finance:** Finance function (concept, scope, and its relationship with other functions) : tools of financial analysis (funds and cash flow analysis, ratio, analysis, risk-return trade-off): financial forecasting (proforma income statement and balance sheet, cash flow forecasting under uncertainty, financial planning): estimation and management of working capital (operating cycle concept, inventory, accounts receivables, cash and accounts payables, working capital requirements).

**Manufacturing:** Operations Planning and Control (aggregate planning, multiple product batch, production cycles, short-term scheduling of job shop, setting production rate in continuous production systems, activity scheduling in projects, introduction to project time calculations through PERT/CPM): Management of supply chain, materials management (introduction to materials management, systems and procedures for inventory management planning, and procurement of materials): quality management (quality concept and planning, standardizations, quality circles).
Strategy: Firm and its Environment: strategies and resources; industry structure and analysis; evaluation of corporate strategy; strategies for growth and diversification; process of strategic planning.

References:


BM12: Business and Technical Communication

Introduction: Means of Communication- Meaning, definition, process, functions, objectives, importance, language as a tool of communication, essentials of good communication, communication barriers, 7Cs of communication; Levels of communication- Interpersonal, organizational, mass communication; flow of communication downward, upward, lateral or horizontal, art of condensation various steps.

Types of Communication: Oral Communication- Meaning, nature and scope, principle of effective oral communication, techniques of effective speech, media of oral communication (face-to-face conversation, teleconferences, press conference, demonstration, radio recording, dictaphone, meetings, rumour, demonstration and dramatisation, public address system, grapevine, group discussion, oral report, closed circuit tv), the art of listening, principles of good listening; Written Communication- Purpose of writing, clarity in writing, principles of effective writing, writing techniques, electronic writing process.

Forms of Technical Communications: Business Letters- Need and functions of business letters, kinds of business letters- sales and credit letters, complaints and follow-up sales letters, letter of enquiry and reply, placing and fulfilling orders, letter of quotation, claim and adjustment letters; Official Letters- Circulars, notices, D.O. letters, govt. letters, letters to authorities, circular letters, application for employment and resume, job application and resumes; Business Reports- Essentials of effective correspondence, types, objective, purpose, significance, style & writing of reports, technical proposal, technical paper, project;

Writing Skills: Comprehension- reading, writing, froms, reasons for poor comprehension and developing skills; Precy writing- techniques writing, topic sentences and its arrangement; Essay- definition, writing, types, use, relevant essay writing for engineers/ professionals, dimensions of essay writing-literary, scientific, sociological; horizons of essay writing- narrative essays, descriptive essays; reflective essays, expository essays, argumentative and imaginative essays, contemporary problem solving essays


Presentation Strategies: Defining purpose, audience & locale, organizing contents, preparing outline, audio-visual aids, nuances of delivery, body language, space, setting nuances of voice dynamics, time- dimension.

References:

7. Munter, M., Business Communication: Strategy and Style, PHI, 1987
9. R.C. Sharma, Krishna Mohan, Business Correspondence and Report Writing, TMH
10. V.N. Arora and Laxmi Chandra, Improve Your Writing, Oxford Univ. Press

**IT 11L: Programming Using C Lab**

The experiments including the following and alike should be practiced:

1. Non-iterative control structures
2. Using single and multi dimensional arrays
3. Pointer data type
4. Iterative control structures and arrays
5. Programs using functions- recursive, non-recursive and Library functions
6. Functions with parameters
7. Programs using structures, nested structures and union
8. Programs for passing aggregate data types as parameters between functions
9. Functions with arrays - structures as arguments
10. Character and String Handling Libraries
11. Files – Sequential access and random access
12. Preprocessor directives for other features like macros - conditional compilation
13. Programs for dynamic memory allocation and de-allocation
14. Programs for self-referential structure – Implementing linked list etc.

**IT 12L: UNIX and Shell Programming Lab**

Students should use shell script in various applications including the followings:

1. Write a shell script that accepts the name of a text file and finds: No. of sentences, No. of words, No. of words having more than five characters, No. of words that start with a vowel, No. of articles in the text file etc.
2. Write a shell script that presents a multiple choice question, gets the user's answer, and reports back whether it is right or wrong. Finally it shall display the score.
3. Write a shell script that accepts a matrix and finds and prints the row and column totals Modify the calendar so that it knows about weekend: On Friday, tomorrow include Saturday, Sunday and Monday, Modify calendar to handle leap years. Calendar should know about our college holidays. How would you arrange it.
4. Write shell script which simulates the important DOS commands with various switches.
5. Write a shell script that receives a file name and informs whether it exists or not.
6. If it exists, then it shall give the details of its access permission, its size etc.
7. Write a program using proper system calls to exchange data between your program and a specified file.

8. Write a shell script which will accept input and then check if the input is a directory file and is readable and writeable. If so then all ordinary files under the directory should be listed out one by one and for each ordinary file that is writeable, the user should be asked if the file is to be deleted or not. If yes, then the deletion should be done else next files processed. At the end of execution of the script, should display the following messages: Ordinary files deleted from the directory, Ordinary files remaining in the directory.

9. Write a program that passes some amount of data from the client to the server using
   a. message Queues
   b. files

10. Write a program that enables you to run two or more shells on a single terminal.

11. Write a program to implement character or file I/O device driver for any device.

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Year 1: Semester 2

IT 21: Data and File Structures

Introduction to Basic Data Structures: From problems to programs, recap of concepts of array and pointers with its advantages and limitations, basic terminology, elementary data organization, concept of abstract data types (ADTs); introduction to stacks, queues, linked lists and binary trees, data structure operations, introduction to algorithm, complexity and time-space trade-off,

Linear Data Structures:

Linked list- Introduction, representation and implementation of singly linked lists, two-way header list, traversing and searching of linked list, overflow and underflow, insertion and deletion to/from linked lists, algorithms, doubly linked list, linked list in array, polynomial representation and addition, generalized linked list, garbage collection and compaction.

Stacks- Introduction, graph as ADT, Array and linked list representation and implementation, operations associated with stacks, application of stack- conversion of infix to prefix and postfix expressions, evaluation of postfix expression using stack.

Queues: Introduction, graph as ADT, Array and linked representation and implementation, operations associated with queues- create, add, delete, full and empty; circular queue, deque, priority queue, applications of queues

Non-linear Data Structures:

Graphs- Introduction, terminology, graphs & multi-graphs, directed and undirected graphs, Graph as ADT, Array and linked representation and implementation, adjacency list and matrices, graph traversal, connectedness and components, articulation points and bi-connected components, spanning trees, minimum cost spanning trees, single-source and all-pairs shortest path problem, graph matching

Trees- Introduction, terminology, trees as ADT, binary trees and its array and linked representation, complete binary tree, extended binary trees, binary search tree (BST), insertion and deletion in BST, AVL trees, B and B+ trees, traversing binary trees, threaded binary trees, traversing threaded binary trees, huffman algorithm, algebraic expressions,

Searching: Introduction, importance and significant, application domain, linear and binary search, internal and external searching, comparison and analysis
Sorting: Introduction, sorting schemes i.e. insertion, bubble, shell, heap, merge sort, quick sort, bin sorting, sorting on different keys, internal and external sorting schemes, practical consideration for internal sorting; Applications of string algorithms-pattern matching, text editor etc.

File Organizations and File Operations: Introduction, sequential, indexed sequential, direct, inverted, multi-list, directory systems, indexing using b-tree, b+ tree and their variants, hashing, hash table and implementation, hash functions, extendible hashing, collision resolution strategies, basic file system operations i.e. create, open, close, extend, delete, read-block, write-block, protection mechanisms, ISAM.

Physical Devices: Characteristics of storage devices such as disks and tapes, I/O buffering.

Memory Management: Garbage collection algorithms for equal sized blocks, storage allocation for objects with mixed size, buddy systems, dictionary implementation, application of data structures and recent advances

References:

3. Samanta, Classic Data Structures, PHI
6. A. Michael Berman, Data structures via C++, Oxford University Press, 2002
10. Robert L. Kruse and A.J. Ryba, Data structures and program design in C++, PHI, 1998
11. B. Stroupstrup, The C++ Programming Language, Addison Wesley, 2004

IT 22: Data Communications and Computer Networks

Introduction to Communication Systems: Analog and digital signals and communications, communication channel, data communications and networking, data transmission concepts and terminology, theoretical basis of data communication; modulation and demodulation, interfaces and modems, DTE- DCE Interface, bandwidth, channel, baud rate of transmission, asynchronous and synchronous transmission, transmission modes and medium, broadband and baseband transmission, problems with digital transmission, Transmission impairments, Attenuation, Distortion, Noise, Data rate limits for noisy and noiseless channels, Performance criteria of a communication system;

Encoding and Decoding: Data encoding and modulation techniques, line and block coding, scrambling techniques, pulse code modulation, variable length codes, transmission errors and error handling mechanisms, Error detection codes, information theory, measure of information, entropy, Discrete and Continuous channel, Shannon's encoding algorithms, Shannon-Hantlly theorem, Data compression;
**Bandwidth utilization techniques:** Multiplexing concepts; frequency, time and wave division multiplexing, spread spectrum concepts, baseband data transmission and pulse shaping, Inter Symbol Interface (ISI), Dubinary Baseband PAM, signaling schemes, Equalisation, Synchronisation Scrambler and Unscrambler; Band-pass data transmission system ASK, PSK, FAK, DPSK & PSK, MSK modulation schemes; coherent and Non Coherent detector, Probability of Error (PE), performance analysis and comparison; synchronous and asynchronous transmission, serial interface, circuit switching, packet switching, hybrid switching,

**Introduction to Computer Network:** Need of computer networking, topology, protocols, architecture of computer network, need of layered architecture, types of computer networks, OSI and TCT/IP reference model, Novel Netware, telephone networks, mobile networks, example networks

**Physical Layer:** Transmission media - guided media, twisted pair cable, coaxial cable and fibre optic cable, unguided media, different propagation modes, radio waves, terrestrial microwaves, satellite communication; concept of spreading spectrum, frequency hopping spread spectrum and Direct sequence spread spectrum; physical layer issues and devices, Error detection and correction- LRC, VRC, CRC, checksum and hammimg Code, HDLC, interconnection of LANs; repeaters, bridges, routers; ATM cell-switching

**Data Link Layer:** Link Layer Services, Error detection and Correction Techniques, Multi Access Protocols, Link Layer Addressing, Ethernet, Hubs, Switch, Point to Point Protocol, Asynchronous Transfer Mode, Multiprotocol Label Switching;

Host-to-host communication: RS-232 over serial line, handshaking and error handling, circuit switching, packet switching, message switching, cell switching, reliable transmission - stop-and-wait, sliding window; logical connections; Multiple co-located hosts: addressing, LAN access methods; CSMA/CD, Ethernet, Token passing, Token Ring, FDDI, wireless LANs; Simple performance models; WAN access methods – PPP

**Network Layer:** Introduction, Virtual Circuit and Datagram Networks, IP Addressing, Subnetting, Routing Algorithms (Link State, Distance Vector, Hierarchical), Routing in the Internet (RIP, OSPF, BGP), Broadcast and Multicast Routing Algorithms, Routers, ICMP, IPv6 ;

**Transport Layer:** Introduction to Transport Layer Services, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection Oriented Transport: TCP, Principles of Congestion Control, TCP, Congestion Control, Sockets, Quality of services (QOS);

**Application Layer:** Web and HTTP, Application protocols for email, FTP, web, DNS, security threats and solutions; Domain Name Space (DNS), Electronic Mail (SMTP, MIME, IMAP, POP3), IPv6; ATM; Multimedia applications and its impact on networking, Cryptology Basics

**References:**

1. A. S. Tanenbaum, Computer Networks; Pearson Education Asia, 4th Ed., 2003
2. Behrouz A. Forouzan, Data Communication and Networking, 3rd Ed., TMH, 2004
4. Bertsekas and Gallagher Data Networks, PHI
10. P.C. Gupta, Data Communications and Computer Networks, PHI,2006
IT 23: Computer Architecture and Organization

Fixed point Arithmetic: Arithmetic and logical operations of signed numbers and their implementation, Concepts of floating point numbers and operations, Bit-slice processors and Emulation

Principles of Computer design: Basic concepts, Instruction Set Architecture, Hardware System Architecture, Classifications of Computer Architecture: von Neumann's classification, Flynn's classification, Machine language instructions, Instruction formats, Instruction cycle and execution cycle, sequencing, Addressing modes, instruction types, Instruction set selection, Stacks, Queues, Subroutines (Example instruction set may be used: INTEL/ARM/MOTOROLA/others),


Hardwired Control: Concepts, Data path and control path design, Fetching and storing word from/in main memory, Register transfers, Operations, execution of a complete instruction Hardwired control

Micro-programmed control: outline of microprogrammed control organization, control word, microprogram, next address generator (sequencer), control address register, control memory and control data register, advantages over hardwired control, address sequencing, mapping and associated hardware.

RISC Vs CISC, Pipelining in CPU design, Superscalar processors, Concepts of pipelining

I/O organization: Input-output processing, bus interface, Programmed data transfer; I/O interrupts-advantage over programmed transfer, DMA transfer, Performance evaluation - SPEC marks, Transaction Processing benchmarks.

Memory: Basic concepts, memory system, storage technologies, memory array organization, RAM, ROM – different types, characteristics, cache memories, memory hierarchy, virtual memory, address translation, secondary memories, interleaving, cache and virtual memories and architectural aids to implement these, input-output devices and characteristics.

References:
7. Tannenbaum, Structured Computer Organization, PHI
8. Vravice, Zaky & Hamacher, Computer Organization, TMH

MT 21: Probability and Combinatorics
**Probability:** Sample space, Events, Axioms, Conditional probability, Bayes rule, Random variables: Discrete and continuous, Distribution and density functions, Marginal and conditional distributions, Stochastic independence.

**Expectation:** Expectation of a function, Conditional expectation and variance, Moment generating function, Cumulant generating functions, Characteristic functions, Distributions, Discrete and continuous distributions.

**Combinatorics:** Counting techniques, Permutations and Combinations, the inclusion-exclusion principle, Probabilistic methods in Combinatorics, Combinatorics from generating functions, Pigeonhole principle

**References:**


**BM 21: Accounting and Management Control**

**Basic Accounting and conventions underlying preparation of Financial Statements:** Balance sheet highlighting accounting equation, profit and loss statement; accounting processes; basic accounts, trial balance and financial statements; issues such as provisions for bad debts tax, dividends, losses such as bad debts, missing information, classification effect, cost of assets, rentals, etc.

**Income Measurement:** Revenue; recognition and matching costs and revenues; inventory valuation, Depreciation Accounting; Intangible Assets Accounting; Understanding published annual accounts including funds flow statement.

**Basic Cost Concepts:** Introduction; cost classification; allocation, appointment and absorption; cost centers

**Cost Analysis for Managerial Decisions:** Direct costing, break-even analysis; relevant costs; pricing; pricing-joint costs; make or buy; relevant fixed costs and sunk costs, cost Analysis for Control-standard costing; variances; material, labour, overhead, sales, and profit.

**Standard Cost Accounting:** Budgeting and control; elements of budgeting; control of manufacturing and manufacturing expenses; performances appraisal, evaluation of cost control systems.

**Introduction to Management Control Systems:** Introduction, Goals, Strategies, and Key Variables; Performance Measures; Responsibility Centers and Transfer Price; Investment Centers; Reporting Systems; Management by Objectives; Budgeting and Control; Organizational Relationships in Control; Control Dynamics; Top Management and Control; Strategic and Long-Range Planning; Control of Service Organizations; Control of Projects; Control of Non-Profit Organizations; Control of Multinational Companies.

**References:**

1. Bhattacharya, S.K., and Dearden, John, Accounting for Management, PHI
2. Chadwick, The Essence of Financial Accounting, PHI
3. Chadwick, The Essence of Management Accounting, PHI
4. Homgren, Sundem and Selto, Introduction to Management Accounting, 9th Ed., PHI,
5. Welch, Hilton and Gordon (5th ed), Budgeting: Profit Planning and Control, 5th Ed., PHI

**IT 21L: Data and File Structures Lab**

Students should practice design and implementation including the followings and alike using C/C++:

1. Classes and Objects and Interfaces.
2. Exception handling with user defined Exceptions.
3. String Handling (String Class objects - String Manipulation functions).
4. Streaming
5. Multiple Threads Creation, Thread Synchronization using any application.
6. Reading and Writing Objects using Serialization.
7. Creation of User Interfaces using SWING.
8. Creation and Manipulation of generic objects.
9. Implementation of any Information System using JDBC.
10. Database Connectivity using Java Bean.
11. Abstract Data type Implementation of List - Stack and Queues.
12. Array and Linked List implementation of Stack, Queue, Circular Queue.
13. Set ADT- Bit Vector Implementation
14. Tree Representation and Traversals (preorder, inorder, postorder)
15. Graph Representations and Traversals
17. Spanning Tree Implementation.
20. File structure relater programming

**IT 22L: Network programming Lab**

Configuration of networking in Linux using ifconfig, route, bind, etc.; configuration of firewall and masquerading in Linux; network trouble-shooting and performance monitoring using netstat, ping, tcpdump, etc.

Configuration and performance measurement of commonly-used Linux servers such as E-Mail (sendmail, pop3/imap) and Web (Apache).

Communication Protocol, Internet protocols, Novell, network system, System network architecture. UUCP.IPX/SPX for LANs, Protocol comparisons.

**Socket Programming:** TCP and UDP, peer-to-peer applications; reliable communications using unreliable datagrams; client-server using RPC; concurrent servers using threads or processes, Winsock Programming

**Application Development:** Design of file transfer protocol, remote login protocol etc., using socket interface

**Berkeley sockets:** Overview, Unix domain protocols, Socket addresses, Socket system calls Reserved ports, Passing file descriptors, I/O asynchronous and Multiplexing, socket implementation.

**Winsock programming:** Using the windows socket, API Window sockets and blocking I/O, Other windows extensions. Network dependent UNRI() DLL, Sending and receiving data over connections, Termination.
Novel IPX/SPX- Novel's windows drivers, Netware C interface for windows, IPX/SPX procedure. Datagram communication, Connection oriented communication with SPX, IPX/SPX implementation of DLL.

**Programming applications:** Time and date routines, Ping, Trivial file transfer protocol, Remote login.

**References:**

2. Steven, R., Unix Network Programming, PHI, 1994

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**Year 2: Semester 3**

**IT 31: Object Oriented Paradigm Using JAVA**

**Basics of Java:** Introduction, History and Features of Java, Internals of Java Program, Difference between JDK, JRE and JVM, Internal Details of JVM, Variable and Data Type, Unicode System, Naming Convention.

**OOPS Concepts:** Object and Class, Method Overloading and Overriding, Constructor, static variable, method and block, this keyword, Inheritance, Aggregation and Composition, Covariant Return Type, super keyword, Instance Initialize block, final keyword, Runtime Polymorphism, static and dynamic binding, Abstract class and Interface, Downcasting with instance of operator, Package and Access Modifiers, Encapsulation, Object Cloning, Java Array, Call By Value and Call By Reference, strictfp keyword, Creating API Document, Advantage of OOPs

**String Handling:** Introduction, Immutable String, String Comparison, String Concatenation, Substring, Methods of String class, StringBuffer class, StringBuilder class, Creating Immutable class, toString method, StringTokenizer class.

**Exception Handling:** Introduction, try and catch block, Multiple catch block, Nested try, finally block, throw keyword, Exception Propagation, throws keyword, Exception Handling with Method Overriding, Custom Exception

**Nested Classes:** Introduction, Member Inner class, Annonymous Inner class, Local Inner class, static nested class, Nested Interface

**Multithreading:** Introduction, Life Cycle of a Thread, Creating Thread, Thread Scheduler, Sleeping a thread, Joining a thread, Thread Priority, Daemon Thread, Thread Pooling, Thread Group, ShutdownHook, Performing multiple task by multiple thread, Garbage Collection, Runnable class

**Synchronization:** Synchronization : What and Why?, synchronized method, synchronized block, static synchronization, Deadlock, Inter-thread Communication, Interrupting Thread

**Input and output:** FileOutputStream & FileInputStream, ByteArrayOutputStream, SequenceInputStream, BufferedReader & BufferedReaderStream, FileWriter & FileReader, CharArrayWriter, PrintStream and PrintWriter class, Compressing and Uncompressing File, Reading and Writing data simultaneously, DataInputStream and DataOutputStream, StreamTokenizer class
**Serialization:** Serialization & Deserialization, Serialization with IS-A and Has-A, transient keyword

**AWT and Event Handling:** AWT Controls, Event Handling by 3 ways, Event classes and Listener Interfaces, Adapter classes, Creating Games and Applications

**Swing:** Basit of Swing, JButton class, JRadioButton class, JTextArea class, JComboBox class, JTable class, JColorChooser class, JProgressBar class, JSlider class, Digital Watch, GraphitIT in swing, Displaying Image, Edit Menu for Notepad, Open Dialog Box, Creating Notepad, Creating Games and applications

**Layout Managers:** BorderLayout, GridLayout, FlowLayout, BoxLayout, CardLayout

**Applet:** Life Cycle of Applet, GraphitIT in Applet, Displaying image in Applet, Animation in Applet, EventHandling in Applet, JApplet class, Painting in Applet, Digital Clock in Applet, Analog Clock in Applet, Parameter in Applet, Applet Communication, Creating Games

**Reflection API:** Reflection API, newInstance() & Determining the class object, javap tool, creating appletviewer, Accessing private method from outside the class

**Collection:** Collection Framework, ArrayList class, LinkedList class, ListIterator interface, HashSet class, LinkedHashSet class, TreeSet class, PriorityQueue class, ArrayDeque class, Map interface, HashMap class, LinkedHashMap class, TreeMap class, Hashtable class, Comparable and Comparator, Properties class etc.

**JDBC:** JDBC Drivers, Steps to connect to the database i.e. Access, Oracle, MySQL, DriverManager; Connection, Statement and ResultSet interface; PreparedStatement, ResultSetMetaData, DatabaseMetaData, Storing and Retrieving image, Storing and Retrieving file, Stored procedures and functions, Transaction Management, Batch Processing, JDBC New Features

**Java New Features:** Assertion, For-each loop, Varargs, Static Import, Autoboxing and Unboxing, Enum Type, Annotation etc.

**Internationalization:** Internationalization, ResourceBundle class, I18N with Date, I18N with Time, I18N with Number, I18N with Currency

**References:**

5. Balaguruswamy E, Programming with Java: A Primer, TMH
8. Patrick Naughton, The JAVA handbook, TMH

**IT 32: Operating Systems**

**Introduction to OS:** OS- Definition, concepts, evolution, types, views, components and structure, services; computer system operation; System Calls- concept, types and traps; system programs and virtual machines.
**Process Management:** Processor- as resource, utilization; multi-processing and time sharing; Process and Thread- concepts, definition, views, states and transitions, operations, scheduling; Schedulers- purpose, levels, short-term, middle-term and long term schedules; context switching, state information, cooperating processes; Process and Thread Scheduling- concepts, criteria, algorithms; process management and services needed; Multithreading.

**Process Coordination:** Shared Resources- concepts, need, examples, allocation and scheduling; Process Synchronization- concept, importance, critical section problem and solutions; synchronization HW and SW approaches; semaphore, critical region and monitors; classical problems of process synchronization and solutions; Deadlock-concept, why and when, characterization, method of deadlock handling; deadlock detection, avoidance, prevention and recovery policies;

**Memory Management:** Motivation; need of primary and secondary memory management, code compilation and memory relocation, linking and loading; Primary memory management- logical and physical address space, memory allocation policies and their critiques; internal and external fragmentation; Memory Management Strategies- swapping, contiguous allocation, paging, segmentation; Virtual Memory- concept, need and purpose; demand paging; page replacement policies and issues, page fault and thrashing, design issues for paging systems,

**Storage management:** File- concept, view, types, operations, access methods and rights; File Systems- secondary storage and disc structure, Inode or FAT structure, file control blocks, impact of block size; contiguous, chained and indexed allocations; allocation policies and their impact, free space management and recovery; Disk- concept, structure, attachment, scheduling and management; Swap-Space management, RAID, disk reliability; Distributed File Systems- Design, implementation, trends

**I/O Systems:** I/O- HW, device controllers, interface, kernel, operation and management; devices and modes, programmed and memory I/O, polling; interrupt mode, types, priority, vectors and servicing; direct memory access (DMA); Principles of I/O Software- Goals, interrupt handlers, device drivers and interrupt handling, buffer management, User space I/O software; related issues

**OS Protection and Security:** Protection- goal, need, principles, domains, techniques; access matrix and control an issues; Security- problem, threats, domain, authentication, policies, techniques; revocation of access rights, language based protection, OTP, encryption, design considerations for security and protection; internet and general network security

**RTOS:** Real time Systems, classification and Architecture, Micro kernels Characteristics, scheduling in RTOS, rate monotonic scheduling, priority inversion, RTOS for hand-held devices.

**OS Tools:** Search, sort tools, commands to sort with their options; AWK tool; productivity tools, Make tool, Other useful tool i.e. Tar and other utilities, file compression tools, profiling tools; Version control tool i.e. sccs, cvs etc, OS primer, editor tools.

**CASE STUDY:** History, Design Principles, System Components, Kernel Modules, Environmental subsystems, Process Management, Scheduling, Memory management, File systems, Input and Output, Inter-process Communication, Network Structure, Security in MS-DOS, WINDOWS, UNIX and LINUX, MULTICS and other operating systems

**Reference:**
IT 33: Design and Analysis of Algorithms


Algorithm Design Techniques: Introduction to Iterative techniques, Divide and conquer, dynamic programming, greedy algorithms.

Divide and Conquer Technique: Introduction, Binary Search, Merge Sort, Quick Sort, Multiplication of Large Integers, Sorting, Median Finding, Surfing Lower Bounds, Closest Pair, Strassens Matrix Multiplication algorithm.

Dynamic Programming: Combinatorial Search, Longest common subsequence, 0-1 Knapsack Problem, Matrix chain multiplication or Optimal search trees, A machine scheduling problem, shortest path, Travelling salesman problem.

Greedy Algorithms: Introduction, Set of Intervals, Minimum spanning tree, Union find, Set cover, Knapsack problem, Fractional Knapsack, Huffman Coding, Pattern Matching

Searching and Sorting Techniques: Review of elementary sorting techniques-selection sort, bubble sort, insertion sort; more sorting techniques-quick sort, heap sort, merge sort, shell sort; external sorting; Comparison Tree, Lower bound on comparison-based sorting, Sorting in Linear Time, Counting Sort, Radix Sort.

Lower bounding techniques: Decision Trees, Adversaries.


Graphs: Analysis of Graph algorithms Depth-First Search and its applications, minimum Spanning Trees and Shortest Paths.

String Processing: KMP, Boyre-Moore, Robin Karp algorithms.

Introduction to randomized algorithms: Random numbers, randomized Qsort, randomly Built BST, Advanced Techniques to analyze algorithms: Use and study advanced data structures unionfind (Disjoint Set Structure), Fibonacci heaps.

Complexity Analysis: Complexity measures, Worst, Best and Average Case, Upper and Lower bounds, Order Notations, Introduction to Branch and Bound and backtracking techniques.


References:
2. Sahni and Horowitz: Fundamentals of Computer Algorithms
4. S. Baase, Computer algorithms: Introduction to Design and Analysis, Addison Wesley, 1999

IT 3E1: Elective-1

Select one from the list of IT3E1 electives and follow the specific syllabus.

MT 31: Numerical and Statistical Computing


Simultaneous Linear Equations: Solutions of system of Linear equations, Gauss Elimination method, Gauss Jacobi and Gauss Seidel iterative methods, pivoting, Ill Conditioned system of equations,

Interpolation: Polynomial interpolation , Newtons forward and backward formula, Central Difference Formulae: Gauss forward and backward formula, Sterling's, Bessels, Everett's formula, Lagranges Interpolation, Newton Divided difference formula, Hermits Interpolation for unequal intervals.

Basic Statistics: Theory of sampling, Measures of central tendencies, Measures of dispersion, Frequency distributions, Moments, Correlation coefficient, Regression analysis, Time series and forecasting, Statistical Quality control methods- Factor analysis.,

Curve Fitting and Approximations: Method of least squares, fitting of straight lines, polynomials, exponential curves etc., Approximation of functions by Chebyshev polynomials.

Test of Significance: Chi-Square Test, t-test and F-test.

References:
1. E. Balaguruswamy, Numerical Methods, THM
3. T. Veerarajan and T. Ramachandran, Theory and Problems in Numerical Methods, THM
4. N. Dutta, Computer Programming and Numerical Analysis, University Press
5. Rajaraman V., Computer Oriented Numerical Methods, PHI

**IT 31L: Oops Using JAVA Jab**

Design and Implement java programs that deals including the following types:

1. Classes and Objects and Interfaces
2. Exception Handling with user defined Exceptions
3. String Handling (String Class objects - String Manipulation functions)
4. Streaming (Image File Handling using Byte Streams - Text File Manipulation using Character Streams)
5. Multiple Threads Creation
6. Implementation of Thread Synchronization using any application
7. Reading and Writing Objects using Serialization
8. Creation of User Interfaces using SWING
9. Creation of Smileys Drawings Cartoons Symbols - Simple animations using Java Graphics
10. Usage of Recursion
11. Creation and Manipulation of generic objects
12. Implementation of any Information System using JDBC
13. Database Connectivity using Java Bean
14. Remote Method Access using RMI Implementation
15. Database access using Hibernate

**MT31L: Numerical and Statistical Computing Lab**

Students should practice programs including the following and alike using suitable programming languages:

1. Implementation of different numerical methods/techniques.
2. Computer generation of random numbers with different distributions.
3. Writing a questionnaire analysis program for data from surveys.
4. Analysis of significance of the results of survey.
5. Curve fitting to experimental data.
6. Programs to obtain frequency charts for large data sets and fitting a distribution.
7. Use of a statistical package to perform factor analysis and tests of significance.
Year 2: Semester 4

IT 41: Internet and Web Technologies

Internet and Web: Introduction and Evolution of Internet, WWW, Understanding Browsers, Internet protocols and applications i.e. FTP, Telnet, Email, Chat etc.; Semantic Web Information System, Quality Evaluation and Web Engineering and Application Development, Web Design and Development issues, challenges, Web Design Methods; Web Protocols: TCP, IP and HTTP, SMTP, POP3, FTP; Measuring and Evaluating Web Application

Static Web Design with HTML: Introduction, Evolution, Features of HTML, Filenames in HTML, Tools required, Tags and their Types, Attributes, Comments, Structures of HTML tag, Rules for writing a HTML program, starting a HTML document i.e. How to open Notepad, How to open HTML page, Editing the HTML program, Building web pages with different HTML tags, Frames, forms etc. HTML Editors and Tools- Use of different HTML editors and tools like Microsoft Front Page, Dreamweaver etc., Designing Web Application with Web ML and Web Ratio; Graphical and Animation Tools- Use of Different graphical and animation tools like Abode Photoshop, Gif Animator, Macromedia flash etc.


Client side scripting: JavaScript, JavaScript Objects, DOM, Java Script, ASP.NET, VB Script

Server Side Scripting: Overview of servlets, Servlet API, Servlet life cycle, Servlet based Web Application, Servlet configuration, Running Servlet with database connectivity, Servlet support for cookies, Session tracking; BasiiIT of ASP, JSP, PHP, ASP.NET, Comparison of ASP, PHP and JSP technologies

JAVA GUI and Database Connectivity: Generic classes, Generic methods, Applets, Applet life cycle methods, Applets based GUI, GUI components, Basic of Swings, Accessing database with JDBC, basiiIT.

Enterprise Application Development: Three Tier Architecture, Working With MVC, JCP, J2EE, Overview of Java beans, XML Based APIs, Application Servers, Presentation Tier and EIS Tier, Java Mail, JMS, Java Transactions, JNDI, Java Authentication and Authorization Services, Java Cryptography

Hosting Website & Security: Hosting a Website, Web Security and issues, Firewalls, cyber laws

Database Integration: Designing the Databases and linking the web pages with the database using PHP

Advanced Topics: SOA-SOA BasiiIT, Principles, Evolution and implementation; Components and Frameworks- Service and Data Tier, EJB Architecture, Session Beans, Entity Beans, Message Driven Beans, J2EE Connector Architecture, Web Services, J2EE Web Services, Patterns, Presentation, Service Tier and Data Tier Patterns, J2ME, Struts, Hibernate, Spring;

References:
1. A Navarro, Mastering XML, BPB
2. Achyut S Godbole and Atul Kahate, Web Technologies, TMH
4. C. Xavier, Web Technology and Design, TMH
5. David A Chappell, Tyler Jewell, Java Web Services
6. David Busch, Cascating Style Sheets complete, McGrawHill
8. Ivan Bayross, Sharanam Shah, PHP 5.1 for Beginners (Book/CD-Rom), 2006
11. Patrick Naughton and Herbertz Schildt, Java-2 The complete Reference, TMH
12. Raj Kamal, Internet and Web Technologies, TMH

IT 42: Data Base Management System and RDBMS

Introduction to DBMS: Database- users, purpose, characteristics, components and system models, and architecture; abstraction and data integration, views of data, data modeling for a database, overview of relational, network, hierarchical data models, relation, schema-instance distinction, attribute, keys, and other relational constraints, various levels of data definition and abstraction, data independence, advantages and challenges of dbms

Database Design: Importance, problems with schema designs; Entity- types, set, attribute and key, relationships, relation types, roles and structural constraints; Functional Dependencies, Armstrong's axioms for FD's, Closure of a set of FD's, Minimal covers, Lossy and Non-loss Decomposition, Motivation for normal forms, 1NF, 2NF, 3NF , Dependency Preservation and BCNF, Algorithms for 3NF and BCNF normalization, Multi-valued Dependencies and 4NF, Join dependencies and definition of 5NF; ERD, Extended Entity Relationship model Relational Model, lossless join and dependency preserving decomposition, conversion of ER diagrams to relations, integrity constraints, Mapping and Participation Constraints, Aggregation, Converting the database specification in E/R notation to the relational schema

Relational Model, Languages and Systems: Relation Algebra- Evaluation, algebra Expressions, model; ER to relational mapping; Basic Operators- Selection, Projection, Cross product; Various types of joins, Division, Example queries; Relational Calculus- domain & tuple
calculus; SQL- Introduction, features, queing; Embedded and Dynamic SQL; Creation and Basic Query Structure: Data definition in SQL, DDL, DML, DCL; Update behaviors, Views and Triggers, Basic and nested queries, Aggregation functions group by and having clauses, Nested Subqueries and Sets, Introduction to Oracle Architecture, PL/SQL, IBM DB2 case study-Architecture of DB2, EER to Relational mapping, Translating SQL into relational algebra

**Transactions Management:** Transaction- concepts, needs, states, features, properties, recover; Heuristics in query optimization, Selectivity and cost estimates in query optimization, Semantic query optimization, Conflicts and Aborts, Serial and concurrent schedules, Serializability and testing, Recoverable and non-recoverable schedules, Cascading rollbacks, Cascadeless schedules; Two Phase Commit, Log based Recovery, Checkpoint/Save Points, Concurrency, Serialized and non-serialized schedules, Testing for serializability, Need for Concurrency, Concurrency issues, Concurrency control, Lock compatibility matrix, Locking and serializability, Lock based Protocols, Two Phase Locking, Time Stamp based Protocol, Deadlocks and starvation, deadlock handling, Recovery Isolation Levels, Recoverable Schedule etc, SQL Facilities for Concurrency, Classification of failures, System Recovery, Media Recovery, Log based recovery, shadow paging, buffer management, SQL Facilities for recovery, OLTP environments,

**Database recovery, Security and Authentication:** Recovery concepts, Deferred updates technique, Immediate update technique, Shadow paging, ARIES recovery algorithm, Discretionary access control, Mandatory access control and multi-level security, Statistical database security

**Advanced Topics:** Distributed databases and issues, Data fragmentation, replication and allocation in distributed databases, Types of distributed database systems Query processing in distributed databases, Concurrency control and recovery in distributed databases; NoSQL, CAP Theorem and BASE Properties, Types of NoSQL Systems; Dimensionality reduction techniques; Active database concepts, Temporal databases, Spatial databases, multi-media databases, Graph Databases, Big Data;

**References:**

IT 43: Software Engineering

**Introduction to Software Engineering:** Program vs. Software, definition, origin, importance, evolution, paradigm, principles, characteristics of software engineering, software crisis, product and process

**Software Processes:** SW process and phases, different SDLC models, risk-driven, evolutionary and prototyping approaches, Fourth Generation Techniques, Agile methods, Software Components and CBSD.

**Requirement Engineering:** Role and skills of system analyst, requirement gathering techniques, problem analysis and tools, feasibility study, software requirements and types, requirement engineering process, elicitation, requirements definition, requirement review and verification, static and dynamic requirement specifications, characteristics of a good SRS, prototype outline for SRS-IEEE


**Coding:** Programming Languages and types, selection of programming languages, coding standards, guidelines, practices, programming styles, structured and object oriented programming, Information Hiding, Selection of suitable database system, reusability, extensibility, robustness, code documentation, static analysis, symbolic execution, code quality and efficiency

**Software Testing:** Introduction, software bugs, error, fault, failure, cost of bugs, objectives and purpose of testing, taxonomy of software testing, verification and validation, test case, test data suit preparation, test coverage; testing methodology- functional and structural testing, static and dynamic testing, data testing, state testing, formal reviews, code review checklist, data coverage, code coverage; testing approaches- black box testing techniques, equivalence class partition and boundary value analysis, white box testing techniques, domain and path testing, component testing; level of testing- unit testing, component testing, integration testing, system testing, alpha testing, beta testing, acceptance testing; testing types- configuration testing, compatibility testing, foreign language testing, usability testing, security testing, website testing; automated testing and test tools- benefits of automation and tools, viewers and monitors, drivers, stubs, stress and load tools, analysis tools; test documentation- goal of test planning, test phases, test strategy, resource requirements.

**Software Maintenance:** Software maintenance and its need, Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering, Maintainability, Documentation to facilitate maintenance

Software Configuration Management- Base Line, SCM process, Version Control, Change Management, Software Configuration Items

Computer Aided Software Engineering- CASE, Tools for Project management Support, Analysis & design, Programming, Prototyping, Maintenance, advantages, limitations, Future of CASE

References:

7. Ivar Jacobson, Object Oriented Software Engineering, Pearson Education, 1992

IT 4E1: Elective -2

Select one from the list of IT4E1 electives and follow the specific syllabus.

MT 41: Optimization Techniques

Linear Programming: Formulation, Graphical solution, Central problem of linear programming various definitions, statements of basic theorems and properties, Simplex method - Two-phase method, revised simplex method, primal and dual simplex method, sensitivity analysis transportation problem and its solution, assignment problem and its solution.

Non-Linear Programming: Constrained Problems, Equality constraints, Lagrangean Method, Inequality constraints Karush-Kuhn-Tucker (KKT) conditions, Quadratic Programming

Integer Programming: Gomory cutting plane methods, Branch and Bound method.

Dynamic Programming: Dynamic programming, Principle of optimality, Forward and backward recursion Applications of dynamic programming, Problem of dimensionality.

Simulation Modeling: Monte Carlo Simulation, Types of Simulation, Elements of Discrete Event Simulation, Generation of Random Numbers, Applications to Queuing systems.
**Queueing Theory:** Characteristics of queueing systems, steady state MIMIt, MIIt/K and MIMIC queueing models, Markovian Queues - Steady state analysis of Single and Multi-server Models, Little's Formula, Finite and Infinite capacity models, Machine Interference Model, Self-service Queue.

**Replacement Theory:** Replacement of items that deteriorate, replacement of items that fail group replacement and individual replacement.

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

**PERT and CPM:** Arrow networks, time estimates, earliest expected time, latest allowable occurrence time and slack; critical path, probability of meeting scheduled date of completion of project, calculations on CPM network, various floats for activities, critical path, updating project, operation time cost trade off curve, project time cost trade off curve, selection of schedule based on cost analysis.

**References:**


**IT 41L: Web Design Lab**

Students are to practically implement the applications including the following and alike:

1. Web programming with HTML tags, ITS for styling, Page layout
2. Develop webpage using JavaScript for client side programming and HTML forms
3. Using The DOM and the JavaScript object models
4. Website optimization: crunching HTML, using ITS to replace HTML and light-weight graphiIT to speed up websites
5. Creating XML file with XML DTD and XML schema, SAX, XSL
6. Web site creation with PHP for server side programming for storing current date-time using cookies and for storing page views using sessions
7. Web application development using Servlet/ PHP/ JSP/ ASP.NET
8. Working with PHP and MySQL.
9. Constructing dynamic server-side web pages using JSF and integrate the Web application with any of the other Java2 Enterprise Edition application server methodologies such as Enterprise Java Beans, JavaMail, and SOAP.
10. Developing Java Enterprise Applications Using EJB3 Session beans, entity beans and message-driven beans.
11. Working with JNDI, JDBC and JMS.
12. Application development using J2ME.
15. Simple xml based applications using DOM, SAX and XSL.
16. Basic Java programming covering objects, inheritance, polymorphism, interfaces, packages and exception handling.
17. String handling programs and regular expression programs.
18. Creation of applet based GUIs.
19. Application involving applet based GUI, JDBC, Servlet, JSP/PHP, cookies and session tracking.
20. Designing typical website for different types of organizations

**IT 42L: DBMS Lab**

Study features of a commercial RDBMS package such as Oracle, Foxpro, MS Access and Structures Query Language (SQL) use with the RDBMS. Laboratory exercises should include defining scheme for applications, creation of a database, writing SQL queries to retrieve information from the database. Use of host language interface with embedded SQL. Students should learn to use the forms and report writer packages available with the chosen RDBMS product. Students are also to be exposed to front-end development tools, ODBC; Internet based access to databases and database administration.

Experiments in the Following Topics:

1. Data Definition - Manipulation of Tables and Views.
2. Database Querying Simple queries - Nested queries - Sub queries and Joins.
3. Triggers.
4. Transaction Control.
5. Embedded SQL.
6. Database Connectivity with Front End Tools.
7. Front End Tools / Programming Languages.
10. Database Design and Implementation i.e. Accounting for a shop, Database manager for a magazine agency or newspaper agency, Ticket booking for performances, Preparing greeting and birth day cards, Personal accounts - insurance, loans, mortgage payments etc., Doctor's diary, billing, Personal bank account, Class marks management, Hostel accounting, Video tape library, History of cricket scores, Cable transmission program manager, Personal library.
**IT 51: Parallel Computing**

**Review of Sequential Computing:** *Uniprocessor Architecture* - The CPU, Memory, I/O and Networking, Design Tradeoffs; *Enhancing Uniprocessor Performance* - Increasing Processor Clock Frequency, Parallelizing ALU Structure, Using Memory Hierarchy, Pipelining, Very Long Instruction Word (VLIW) Processors, Instruction-Level Parallelism (ILP) and Superscalar Processors, Multithreaded Processor, Performance bottlenecks of sequential computing.

**Introduction to Parallel Computing:** Motivation, What is Parallel Computing and Why to Use? Concurrent, Parallel, Distributed computing, interacting with hardware- Composite Capabilities, How Do Languages and Environments Assist with These Tasks? Applications of Parallel Computing, RAM and PRAM model, PRAM pseudo code, Data vs. Task parallelism.

**Parallel Computers Architectures:** Modifications to the Von-Neumann Model, Memory Barriers, Memory Hierarchy and organization, Different types of memory access-UMA and NUMA, Shared memory, distributed memory and distributed shared memory architectures, Cache Coherence and Memory Consistency, classification of parallel computers, Flynn's Classical Taxonomy, ILP, Multi-threaded architectures and TLP, Pipeline Parallelism, I/O Operations; Overheads- Hardware System Architecture, Costs of Operations; Parallel Architecture Design Tradeoffs and Future Directions, SIMD Processors, Systolic Processors, Cluster Computing, Grid and Cloud Computing, Multicore Systems, GPU computing, Synchronization and Mutual Exclusion; Scalability and Load Balance.

**Interconnection Networks:** Introduction, Communication between Parallel Processors, Classification of Interconnection Networks by Logical Topologies, Interconnection Network Switch Architecture, Routing Mechanisms for Interconnection Networks,


**References:**

2. Michael J. Quinn. Parallel Programming in C with MPI and OpenMP. TMH, 2004
4. M. Sasi Kumar, Dinesh Shikhare P. Raviprakash, Introduction to Parallel Processing, PHI
5. V. Rajaraman And C. Siva Ram Murthy, Parallel Computers – Architecture and Programming
6. Peter S. Pancheo, An Introduction to Parallel Programming, 2011

**IT 52: Application Development using .NET Framework**

.NET FRAMEWORK: *Introducing .NET-The Big Picture* - Characterize the .NET Paradigm, Describe Web Services; *Building .NET-The Framework Components* - Describe the .NET Framework, Describe the Common Language Runtime (CLR), Compare the .NET Class Framework to a Language-Specific Class Library, Decide When to Use .NET Windows Forms, Describe the Uses of Web Forms and Web Services, Identify When to Use Console Applications; *Managing .NET-The Common Language Runtime Components* - Identify the Components of the CLR, Describe Microsoft Intermediate Language (MSIL), Distinguish between the .NET Compilers, Describe How the CLR Manages Memory; *Taking Advantage of the Common Language Runtime* - Re-use Code, Describe Multiple Language Support in .NET, Explain Cross-Language Interoperability, Explain Garbage Collection, Describe Structured Handling; *Unifying .NET-The Class Framework* - Describe the .NET Class Framework, Describe the Purpose of Namespaces, To Use or Not to Use Inheritance, Differentiate Between Interface and Inheritance-Based Polymorphism

VB.NET: *Introduction* - VB.net, Elements, Types, Windows programming, Menus and Dialog Boxes, Using ADO.NET, Features of ADO.NET, Accessing Data with ADO.NET, Developing Components in Visual Basic .NET; *Deploying Applications* - Overview of XML, Introduction to web services, Describing Assemblies, Deploying Applications

C#.NET: *Introduction* - The Creation of C#, The Evolution of C#, Language and Syntax Enhancements, C# Language Fundamentals, ARRAYS, Decision making, Loops, Methods; *Using Object-Oriented Programming in C# .NET* - Object Oriented Concepts, Boxing 3.3 Delegates 3.4 Events 3.5 Interfaces; *Using Forms* - Windows Forms, Input, Output, and Serialization, Processes, App Domains, Contexts, Threading, Type Reflection, Late Binding, Attribute-based programming.

ASP.NET: *History of ASP.NET* - Getting Started with ASP.NET, ASP.NET Features, Building an ASP.NET Web Site, Creating Web Controls, Creating Web Forms; *Designing Web Site with Master Pages* - Server Controls, CSS for ASP.NET 3.5, Creating Consistent Looking Web Sites; *Introduction to Event Handlers* - Control Events and Event Handlers, Validation Controls, ADO.NET; *Accessing LINQ Controls* - LINQ, ASP.NET - Security, ASP.NET - Data Caching, ASP.NET - Multi Threading, ASP.NET - Configuration; *Introduction to ASP.NET MVC* - The MVC Pattern, Web Standards and REST, Architecture, Disadvantages, ASP.NET MVC vs. Web Forms; *Essential Language Features* - Automatically Implemented Properties, Using Object and Collection Initializes, Entity Framework, Lambda Expressions; *Building the Model* - Microsoft Data Access Options, Repository Pattern, Validation and Business Rule Logic, Familiarizing yourself with ASP.NET MVC classes(namespace); *Routes and URLs* - Introduction to Routing, Defining Routes, Constraints, Areas, Ignoring Routes; *Controllers* - Controller and ControllerBase, Action Methods, Working with Parameters, Action Result Types, HTTP Verbs, Asynchronous Actions, ViewData and TempData, Model Binders; *Views and View Templates* - Defining Views, ASP.NET View Engine, Razor View Engine, ViewData, Strongly-Typed Views, Using a ViewModel, Remote Validator; *HTML* - Helper Methods, Strongly-Typed Helpers, Html.ActionLink & HTML Forms, List Controls, WebGrid, Validation; *Partials and Master Pages* - Master Pages & User Controls, Partial and RenderPartial, Action and
Securing MVC applications - Securing your MVC Application, Walkthrough: Using Forms Authentication in ASP.NET MVC, Authorize Attribute class, Preventing JavaScript Injection (XSS) Attacks

References:
1. Introduction to Visual basic.NET - NIIT PHI, 2005
3. Introduction to Microsoft® ASP.NET Work Book, Microsoft Press
4. Developing XML Web Services Using Microsoft® ASP.NET, Microsoft Press
5. Douglas J. Reilly, Designing Microsoft ASP.NET Applications, Microsoft Press

IT 5E1: Elective -3
Select one from the list of IT5E1 electives and follow the specific syllabus.

IT 5E2: Elective -4
Select one from the list of IT5E2 electives and follow the specific syllabus.

IT 51L: Parallel Programming Lab
Students are to learn at least one parallel programming language/extensions suitable to different parallel programming models and should practice the implementation of programs like the followings:

Basic Applications: sending and receiving data to/from multiple processing nodes, Calculation the value of PI, Finding Partial Sum, Average, mean squared deviation, curve fitting, numerical integration, traveling salesman problem, Gaussian elimination, Discrete event time simulation


Sorting: Issues in Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quick sort

Dense Matrix Algorithms; Matrix-Vector Multiplication, Matrix-Matrix Multiplication, dense matrix algorithms, sparse matrix algorithms, Solving a System of Linear Equations


IT 52L: .NET Framework Lab
Students are to implement different suitable application based on the .NET technologies i.e. VB.NET/ASP.NET/C#.NET etc.
IT 51IL:
Industrial lecture will be delivered by the invited person from SW/IT industry. For Industrial lectures the sessional marks are based on participation and report.

IT 51 S:
Seminars are suggested to enable the students of MCA to appreciate the software developments which are going on in industries. These seminars will help the students to face interviews with some confidence. The students are to choose relevant topic and prepare the seminar report. The seminar is to be presented before the concern authority.

IT 51P:
The students are to take one minor academic project in parallel to the academic curriculum of the semester. The project to be implemented using suitable programming languages and tools/techniques. Focus should be given on using different CASE tools and to learn industrial practices and standards. The complete detail project report to be prepared and to be presented before the concerned authority.

Detailed Syllabus of Elective Papers

IT 3E1 Electives

E31: Automata Theory & Formal Languages

**Introduction to the theory of computation:** Symbol, alphabet, sets, relations and functions, strings and languages. **Finite state machines:** Finite automata definition & description, transition system, DFA, NFA, equivalence of DFA and NFA, Conversion of NFA to DFA, finite automata with outputs, Moore machine, Melay machine ,equivalence between Moore and Melay machines, Chomsky Hierarchy of languages,

**Regular expressions and regular grammars:** Regular expressions, equivalence of regular expressions and FA, Regular sets and properties: Regular set, Pumping lemma for regular sets, closure properties of regular sets, Regular grammars, Right linear and Left linear grammar, equivalence between Regular linear grammar and FA inter conversion between RE and RG.

**Context free languages:** Introduction, context free grammars, derivation trees, single ficatum of context free grammars, leftmost and rightmost derivations, ambiguity in CFG, simplification of CFG, normal forms-Chomsky normal form CNF, Greibach normal form GNF, Enumeration of properties of CFL.

**Pushdown automata:** Definition, model, acceptance of CFL, deterministic PDA, nondeterministic PDA, the pumping lemma for CFL’s, closure properties of CFL’s, A context Free Grammar corresponding to a given context free grammar, equivalence of CFL and PDA

**Turing machines:** Definition, model, representation of TM, design of TM, Computable Languages and Functions of Turing Machines, Techniques of turing machine construction, types of TM, Universal Turing machine, computable languages and function, Halting Problem, Modifications of Turing machine, Church’s Hypothesis, Linear bounded automata and context sensitive languages, Introduction of DCFL and DPDA, Decidability of problems.
Computability & Recursion: Basic definition of computable and non-computable functions, primitive Recursive, Recursive and partial Recursive functions, RICE theorem and Greibach theorem, PCP and undecidability, Properties of recursive & non recursive enumerable languages, post correspondence problem

References:

2. John C. Martin, Introduction to Languages and the theory of Computation, TMH
4. Peter Liz., An Introduction to Formal Languages and automata
5. V. Krishnamurthy, Introductory theory of Computer Science
6. Mannaz, Mathematical theory of computation
7. KLP Mishra & N. Chandra Sekharan, Theory of Computer Science, PHI

E32: Principles of Programming Languages


Syntax and Semantics: formal specifications, general Problem of describing Syntax and Semantics, formal methods of describing syntax - BNF, EBNF for common programming languages features, tokenizing versus parsing, recursive descent parsers; parse trees, one-token look ahead parsing, abstract syntax trees; ambiguous grammars, attribute grammars, denotational semantics and axiomatic semantics for common programming language features, attributes and binding; scope; symbol tables; allocation and storage classes; variables; pointers

Data types: Introduction, primitive, character, user defined, array, associative, record, union, pointer and reference types, design and implementation uses related to these types. Names, Variable, concept of binding, type checking, strong typing, type equivalence and compatibility, type systems; type inference; type coercion, named constants, variable initialization,

Expressions and Statements: Arithmetic relational and Boolean expressions, Short circuit evaluation mixed mode assignment, Assignment Statements, Control Structures – Statement Level, Compound Statements, Selection, Iteration, Unconditional Statements, guarded commands.

Control: expressions, selection, loops, go-to, parameters, activation records for function calls

Subprograms and Blocks: Fundamentals of sub-programs, Scope and lifetime of variable, static and dynamic scope, Design issues of subprograms and operations, local referencing environments, parameter passing methods, overloaded sub-programs, generic sub-programs, parameters that are sub-program names, design issues for functions user defined overloaded operators, co routines.

Abstract Data types: Abstractions and encapsulation, introductions to data abstraction, design issues, language examples, C++ parameterized ADT, object oriented programming in small talk, C++, Java, C#, Ada 95 Concurrency: Subprogram level concurrency, semaphores, monitors, massage passing, Java threads, C# threads.
Exception handling: Exceptions, exception Propagation, Exception handler in Ada, C++ and Java.

Functional Programming Languages: Introduction, functional algorithms; tail-recursion; fundamentals of FPL, LISP, ML, Haskell, application of Functional Programming Languages and comparison of functional and imperative Languages. Scripting Language: PragmatIT, Key Concepts, Case Study : Python – Values and Types, Variables , Storage and Control, Bindings and Scope, Procedural Abstraction, Data Abstraction, Separate Compilation, Module Library, lambda calculus -conversions, Church-Rosser theorem, fixed-points,

Object-oriented Programming: Polymorphism, Exceptions, Lazy evaluation, Reflection, Inheritance and subtyping, Concurrency and synchronization ("threads")

Logic Programming Language: Introduction and overview of logic programming, basic elements of prolog, application of logic programming, Horn clause logic, resolution and unification

References:

1. Doris Appleby, Julius J. Vandekopple, Programming Languages Paradigm and Practice, 2nd Ed., TMH.
6. Krishnamurthi, Programming Languages: Application and Interpretation.

E33: Real Time and Embedded Systems

Introduction: Embedded Systems, Challenges of Embedded Systems, fundamental components, examples of embedded systems, hardware fundamentals, gates, timing diagrams, memory, DMA, buses, interrupts, schematiIT, build process of embedded systems, examples.

Embedded System Design And Implementation: Requirements of an embedded system, Meeting real time constraints, Multi-state systems and function sequences, architecture styles and patterns, design methodologies and practices, implementation aspects and choices, 8051/89c51 and Advanced Processor Architectures, Memory Organization and Real world Interfacing, Memory access procedure, types of memory, memory management methods, Pointer related issues, polling versus interrupts, types of interrupts, interrupt latency, reentrancy, interrupt priority, programmable interrupt controllers, interrupt service routines.


Embedded Software Development Tools: Host and target machines, cross compilers, linker and locators for embedded software, Emulators and debuggers, address resolution, locating
program components, initialized data and constant strings, PROM programmers, ROM emulators, Flash memory.

References:
2. Raj Kamal, Microcontroller, 2nd Indian Print
7. Frank Vahid & Tony Givargus, Embedded System Design, Willey Publication

E34: Mobile and Pervasive Computing

Mobile Computing: Introduction, Differences between Mobile Communication and Mobile Computing, Contexts and Names; Functions, Applications and Services, Design Considerations, Integration of Wireless and Wired Networks Standards Bodies;


3g and 4g Cellular Networks: Migration to 3G Networks, IMT 2000 and UMTS, UMTS Architecture, User Equipment Radio Network Subsystem, UTRAN Node, B RNC functions, USIM Protocol Stack, IT and PS Domains, IMS Architecture, Handover 3.5G and 3.9G, a brief discussion 4G LAN and Cellular Networks, LTE Control Plane, NAS and RRC User Plane, PDCP, RLC and MAC WiMax IEEE 802.16d/e WiMax Internetworking with 3GPP

Context Aware Computing: Adaptability Mechanisms for Adaptation, Functionality and Data Transcoding, Location Aware Computing, Location Representation, Localization Techniques, Triangulation and Scene Analysis, De-launay Triangulation and Voronoi graphs, Types of Context, Role of Mobile Middleware, Adaptation and Agents, Service Discovery Middleware;

Mobile computing environment: Functions-architecture-design considerations, content architecture, CC/PP exchange protocol, context manager; Data management in WAECoda file system, caching schemes, Mobility QOS, Security in mobile computing.
Handoff in wireless mobile networks: reference model-handoff schemes, Location management in cellular networks, Mobility models, location and tracking management schemes, time, movement, profile and distance based update strategies, ALI technologies

Open protocols: Service discovery technologies- SDP, Jini, SLP, UpnP protocols, data synchronization, SyncML framework, Context aware mobile services, Context aware sensor networks, addressing and communications, Context aware security

Pervasive Computing: BasIT, Vision and Principles; CharacteristIT- interaction transparency, context aware, automated experience capture; Architecture for pervasive computing, Pervasive devices, Categories of Pervasive Devices, embedded controls, smart sensors and actuators, Context communication and access services

Application Development: Three tier architecture, MVC Architecture, Memory Management, Information Access Devices, PDAs and Smart Phones, Smart Cards and Embedded Controls, J2ME Programming for CLDC, GUI in MIDP Application Development ON Android and iPhone.

References:

3. Pei Zheng and Lionel M Li, Smart Phone & Next Generation Mobile Computing, Morgan Kaufmann, 2006
11. Asoke K Taukder,Roopa R Yavagal, Mobile Computing, TMH, 2005
IT 4E1 Electives

E41: Computer Graphics


Viewing in 3D: Stages in 3D viewing, Canonical View Volume (CVV), specifying an Arbitrary 3D View, Examples of 3D Viewing, The Mathematics of Planar Geometric Projections, Combined transformation matrices for projections and viewing, Coordinate Systems and matrices, camera model and viewing pyramid, Scan conversion-Lines, circles and Ellipses; Filling polygons and clipping algorithms, Scan Converting Lines, Mid-point criteria, Problems of Aliasing, end-point ordering and clipping lines, Scan Converting Circles, Scan Converting Ellipses, Filling Polygons, edge data structure, Clipping Lines algorithms Cyrus-Beck, Cohen Sutherland and Liang-Barsky, Clipping Polygons, problem with multiple components.

Solid Modeling: Representing Solids, Regularized Boolean Set Operations, Primitive Instancing, Sweep Representations, Spatial-Partitioning Representations, Octree representation, B-Rep, Constructive Solid Geometry, Comparison of Representations

Visible-Surface Determination: Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The z-Buffer Algorithm, Scan-line method, Painters algorithms (depth sorting), Area sub-division method, BSP trees, Visible-Surface Ray Tracing, comparison of the methods

Illumination and Shading: Illumination and Shading Models for Polygons, Reflectance properties of surfaces, Ambient, Specular and Diffuse reflections, Atmospheric attenuation, Phongs model, Gouraud shading, some examples.

Plane Curves and Surfaces: Curve Representation, Nonparametric Curves, Parametric Curves, Parametric Representation of a Circle, Parametric Representation of an Ellipse, Parametric Representation of a Parabola, Parametric Representation of a Hyperbola, A Procedure for using Conic Sections, The General Conic Equation; Representation of Space Curves, Cubic Splines,
Bezier Curves, B-spline Curves, B-spline Curve Fit, B-spline Curve Subdivision, Parametric Cubic Curves, Quadric Surfaces. Bezier Surfaces

**Graphics Programming using OPENGL:** Why OpenGL, Features in OpenGL, OpenGL operations, Abstractions in OpenGL GL, GLU & GLUT, 3D viewing pipeline, viewing matrix specifications, a few examples and demos of OpenGL programs.

**Miscellaneous topics:** Why Realism? Aliasing and Anti-aliasing, texture bump mapping, Animation methods, methods of controlling animation, soft modeling of objects, image based rendering, Fundamental Difficulties.

**Image Manipulation and Storage:** What is an Image? Digital image file formats, Image compression standard JPEG, Image Processing - Digital image enhancement, contrast stretching, Histogram Equalization, smoothing and median Filtering.

**References:**


**E42: Digital Image Processing and Steganography**

**Fundamentals of Image Processing:** Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels and distance measurement, connectivity, Image Geometry, Photographic film, Light, Brightness adaption and discrimination, Perspective Projection, Spatial Domain Filtering, Grayscale and Color fundamentals, color models (RGB, CMY, HIS), formulation, color complements, color slicing, tone and color corrections, image file formats

**Image Filtering:** *Spatial Domain Filtering*- Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian; *Frequency domain Filtering*- Hotelling Transform, Fourier Transforms and properties, FFT, Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering, Inverse filtering, Least squares filtering. Recursive filtering

**Image Compression:** Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding,

Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation; Wavelet based Image Compression- Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking; Fidelity criterion- MSE, PSNR, Compression ratio,

**Image Restoration:** Basic Framework and models, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization,

**Morphological Image Processing:** Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

**Image Segmentation:** Definition, Detection of Discontinuities, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Iterative and Multivariable thresholding, Otsu's method, Moving averages, Boundary detection based techniques; Characteristics of segmentation, Pixel based, Region based and histogram based segmentation methods, segmentation by sub region aggregation, split and merge technique, Watershed segmentation, Use of motion in segmentation (spatial domain technique only).

**Image Enhancement:** *Spatial Domain Methods*- Arithmetic and Analytical operations, pixel or point operations, size operations) Smoothing filters Mean, Median, Mode filters. Low pass filters, high pass filters, sharpening filters; *Frequency Domain Method*- Design of Low Pass, High Pass, Edge enhancement, Sharpening filters in frequency domain, Buffer Worth Filter, Homomorphic filters in frequency domain and spatial domain.

**Steganography:** Introduction, importance, steganography related issues and popular techniques- image authentication, watermarking and other applications

**References:**

2. Anil K Jain; Fundamentals of Digital Image Processing
3. Rafael C Gonzalez, Richard E Woods; Digital Image Processing, Pearson Education
5. B Chanda & D Dutta Majumder; Digital Image Processing and Analysis, PHI

**E43: Adhoc and Sensor Networks**

**Introduction of ad-hoc/sensor networks:** Key definitions of ad-hoc/sensor networks, Advantages of ad-hoc/sensor networks, Unique constraints and challenges, Driving Applications, Wireless Communications/Radio Characteristics, Ad-Hoc wireless networks

**Media Access Control (MAC) Protocols:** Issues in designing MAC protocols, Classifications of MAC protocols, MAC protocols

**Routing:** Cellular and Ad hoc wireless networks, Issues in designing routing protocols, Classification of routing protocols, Issues of MAC layer and Routing, Proactive, Reactive and Hybrid Routing protocols, Multicast Routing, Tree based and Mesh based protocols, Multicast with Quality of Service Provision, Routing protocols

**Quality of Service:** Real-time traffic support, Issues and challenges in providing QoS, Classification of QoS Solutions, MAC layer classifications, QoS Aware Routing Protocols, Ticket based and Predictive location based Qos Routing Protocols

**Energy Management Ad Hoc Networks:** Need for Energy Management, Classification of Energy Management Schemes, Battery Management and Transmission Power Management Schemes, Network Layer and Data Link Layer Solutions, System power Management schemes

**Mesh Networks:** Necessity for Mesh Networks, MAC enhancements, IEEE 802.11s Architecture, Opportunistic Routing, Self Configuration and Auto Configuration, Capacity Models, Fairness, Heterogeneous Mesh Networks, Vehicular Mesh Networks
**Sensor Networks:** Introduction, Unique features, Sensor Network architecture, Data Dissemination, Data Gathering, MAC Protocols for sensor Networks, Deployment of ad-hoc/sensor network, Sensor tasking and control, Transport layer and security protocols, Location discovery, Quality of Sensor Networks, Evolving Standards, Other Issues, Recent trends in Infrastructure less Networks

**Sensor Network Platforms and Tools:** Berkley Motes, Sensor network programming challenges, Embedded Operating System, Simulators

**Applications of Ad-Hoc/Sensor Network and Future Directions:** Ultra wide band radio communication, Wireless fidelity systems

**References:**

1. C. Siva Ram Murthy And B.S.Manoj, Ad Hoc Wireless Networks – Architectures And Protocols, Pearson Education, 2004

**E44: Human Computer Interaction**


References:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human Computer Interaction, 3rd Ed., PHI, 2004

IT 5E1 Electives

E51: System Software and Compiler Constructions

System Software: Introduction, Definition, Role and Functions, characteristics, types

Assembler: Introduction, functions, features, design of one pass and two pass assemblers;

Macroprocessors: Introduction, functions, features and design;

Loader and Linkers: Basic Concepts of Linkers and Loader Functions, Boot Loaders, Linking Loaders, Linkage Editors, Dynamic Linking

Compiler: Introduction to Compiler, Different phases and passes of compiler

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

Lexical Analysis: Role of Lexical Analyzer, Interface with input, parser and symbol table, Input Buffering, Specification of Tokens, lexeme and patterns; difficulties in lexical analysis; error reporting; Finite state machines and regular expressions and their applications to lexical analysis, regular definition, transition diagrams, Lex., Review of regular languages, design and implementation of a lexical analyzer,

Syntax Analysis: Role of the parser, Formal and context free grammars(CFGs) and their application to syntax analysis, ambiguity, associatively, precedence, Derivation and parse trees, Top Down parsing, LL(1) grammars, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, Shift Reduce Parsing, LR(0) grammars, operator precedence grammars, LR parsing algorithms and LR parsers, Yacc.

Syntax directed translation and Definitions: Syntax directed definitions, Construction of syntax trees, Top down and bottom up approaches, dependency graph, data types, mixed mode expression; subscripted variables, evaluation order and sequencing statement, Inherited and synthesized attributes, 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 Environments: Source Language issues, Storage organization, Storage Allocation strategies, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation, Access to non-local names, Parameter passing mechanism


Subroutines and functions: parameters called by address, by name and by value, subroutines with side effects.

References:
4. S. Chattopadhyay, Compiler Design, PHI, 2005
8. C. N. Fischer and R. J. LeBlanc, Crafting a compiler with C, Pearson Education.
12. D. M. Dhamdhere, Systems Programming and Operating Systems, TMH

E52: Information Security and Cyber Forensics


**Network Defense tools:** Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System

**Web Application Tools:** Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities, Curl, OpenSSL and Stunnel, Application Inspection tools, Zed Attack Proxy, Sqlmap, DVWA, Webgoat, Password Cracking and Brute-Force Tools, John the Ripper, L0htcrack, Pwdump, HTC-Hydra


**Cyber Security:** Introduction, Weak / Strong Passwords and Password Cracking, Web Browsers Security, Email Security: PGP and SMIME, Web Security: web authentication, SSL and SET, Firewall And Utm,

**Cyber Forensics:** Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks


**References:**

5. Mike Shema, Anti-Hacker Tool Kit (Indian Edition), TMH
10. Bernadette H Schell, Clemens Martin, Cybercrime, ABC – CLIO Inc, California, 2004
11. Understanding Forensics in IT, NIIT Ltd, 2005

**E53: Cryptography and Network Security**

**Introduction to Classical Cryptosystems:** Introduction, Need and importance of Cryptography, Classical Cryptosystems, Introduction to symmetric and asymmetric cryptography, Cryptanalysis of Classical Cryptosystems, Shannons Theory

Symmetric Key Ciphers and Cryptanalysis: Introduction, Symmetric Key Ciphers, Modern Block Ciphers- DES, AES; Linear Cryptanalysis, Differential Cryptanalysis, Other Cryptanalytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers, NIST recommendations.

Hash Functions and MACs: Hash functions, The Merkle Damgard Construction, Message Authentication Codes (MACs)

Asymmetric Key Ciphers and Cryptanalysis: Construction and Cryptanalysis, RSA Cryptosystem, Different Attacks & Remedies on RSA, Semantic Security of RSA, The Discrete Logarithm Problem (DLP), Diffie Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm, Massey-Omura; Construction and Cryptanalysis, Cryptanalysis of DLP


Digital Signatures: Introduction, Signature schemes, Authentication Protocols, Digital Signature Standards (DSS), Proxy Signatures

Network Security: Secret Sharing Schemes, Network Protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls

Primality Testing: Primality Testing, Quadratic Residues, Randomized Primality Test & Deterministic Polynomial Time Algorithm

References:

7. Wenbo Mao, Modern Cryptography, Theory & Practice, Pearson Education.
10. A. Joux,Algorithmic Cryptanalysis, CRC Press
11. S. G. Telang, Number Theory, TMH
E54: Cloud and Grid Computing

Introduction to Grid Computing: What is a grid? Infrastructure of hardware and software, Main Projects and Applications, The Open Grid Forum, International Grid Trust Federation; Grid Architecture, Overview of Resource Managers, Overview of Grid Systems; Application Management: Grid Application Description Languages, Application Partitioning, Meta-scheduling, Mapping, Monitoring; Web Services, Grid Portals,

Cloud Computing Overview: What is a cloud, Definition of cloud, Characteristics of cloud, Why use clouds, How clouds are changing, Driving factors towards cloud, Comparing grid with cloud, Public clouds (commercial), Cloud Computing and SOA, Enterprise Cloud drivers and adoption trends, Typical Cloud Enterprise workloads, Cloud service models/types, Cloud deployment models, Cloud ROI models, Cloud reference architectures, Cloud standards, Technology providers vs. Cloud providers vs. Cloud vendors, Planning Cloud transformations

Cloud service delivery: Cloud service, Cloud service model architectures, Infrastructure as a service (IaaS) architecture, Platform as a service (PaaS) architecture, Platform as a service (SaaS) architecture, Examples of SaaS applications, Business Process as a Service (BPaaS) Architecture, Trade-off in cost to install versus, Common cloud management platform reference architecture: Architecture overview diagram, Common cloud management platform

Cloud deployment scenarios: Cloud deployment models, Public clouds, Hybrid clouds, Community, Virtual private clouds, Vertical and special purpose, Migration paths for cloud, Selection criteria for cloud deployment, Case study example: IBM Smart Cloud

Security in cloud computing: Cloud security, Cloud security reference model, How security gets integrated, Cloud security challenges, Understanding security risks, Cloud security approaches: encryption, Digital signature, tokenization/obfuscation, cloud security alliance standards, cloud security models and related patterns; Virtualization and multitenancy, Internal security breaches, Data corruption or loss, User account and service hijacking, Steps to reduce cloud security breaches, Steps to reduce cloud security breaches; Identity detection, forensics and management, What is SSL? Cloud security in mainstream vendor solutions; Mainstream Cloud security offerings: security assessment, secure Cloud architecture design; Design a secure Cloud architecture to support the deployment of a secure version of the course project application.

References:


IT 5E2 Electives

E55: AI and Expert System
Scope of AI: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques-search knowledge, abstraction.

Problem solving: State space search- Production systems; Search space control-Depth first search, breadth first search, heuristic search – Hill climbing, best first search, branch and bound; Minimax search- Alpha-Beta cutoffs.


Rule Based Systems- Forward reasoning, Conflict resolution, Backward reasoning- Use of no backtrack.


Handling uncertainty: Probabilistic reasoning, Use of certainty factors, Fuzzy logic.


Expert Systems: Need and justification for expert systems, Knowledge acquisition

Case studies: MYCIN, RI.

References:


E56: Data Warehousing & Data Mining

Introduction to Data Mining: Definition of data mining, Data Mining functionalities, Classification of data mining systems, Data Mining Applications, Architectures of data mining systems, Data mining class comparison.

Data Mining Algorithms: Concept Description: Definition, Data Generalization and Summarization –Based Characterization, Mining Descriptive Statistical Measures in Large Databases; Mining Association Rules: Association Rule Mining, Market Basket Analysis, Association Rule Classification, The Apriori Algorithm, Mining Multilevel Association Rules, Constraint-Based Association Mining, Sequential mining

Classification and Prediction: What is Classification and Prediction? Data Classification Process, Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification Based on Association Rule Mining, Other Classification Methods Cluster Analysis: What is Cluster Analysis? Types of Data in Cluster Analysis, Categorization of Clustering Methods, Partitioning methods

Introduction to Data Warehousing: Introduction to Decision Support System: DSS Definition, History of DSS, Ingredients of DSS, Data and Model Management, DSS Knowledge base, User
Interfaces, The DSS Users, Categories and Classes of DSSs Need for data warehousing, Operational & informational data, Data Warehouse Definition and characteristics, Operational Data Stores

**Data warehouse Components:** Architectural components, Data Preprocessing: Why Preprocess Data? Data Cleaning Techniques, Data Integration and Transformation, Data Reduction Techniques, Discretization and Concept Hierarchy, Generation for numeric and categorical data, Significant role of metadata, Building a Data warehouse, Benefits of Data Warehousing.


**References:**
1. Jiawei Han, Micheline Kamber; Data Mining: Concepts and Techniques, Morgan Kaufmann, 2006
2. Paul Punnian, Data Warehousing Fundamentals, John Wiley
3. Alex Berson, S.J. Smith; Data Warehousing, Data Mining and OLAP, TMH
4. Margaret Dunham, Data Mining: Concepts and Techniques, Morgan Kaufmann
5. Ralph Kimball, The Data Warehouse Lifecycle toolkit, John Wiley

**E57: Soft Computing**

**Soft Computing:** Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing; Artificial Intelligence : Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies; Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.


**Artificial Neural Networks:** Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory; Propogation Networks- introduction, Counter propagation network, architecture, functioning & its characteristics, Back Propogation Networks -Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule coefficient; back propagation algorithm, factors affecting backpropagation training, applications; Hopfield/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations and applications; Hopfield v/s Boltzman machine; Adaptive Resonance Theory: Architecture, classifications, Implementation and training; Associative Memory.

**Fuzzy Logic:** Basic concepts of crisp and fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion; Fuzzy rule base system-Membership functions, features of membership functions,
fuzzy reasoning, interference in fuzzy logic, fuzzy decision making, fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Applications of fuzzy logic, Industrial applications.

**Genetic Algorithm (GA):** Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, fitness function, reproduction, Genetic modeling: Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator; Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method

**Hybrid Systems:** Integration of neural networks, fuzzy logic and genetic algorithms.

**References:**

2. Siman Haykin, Neural Networks, PHI
4. Kumar Satish, Neural Networks, TMH
5. J. Yen and R. Langari., Fuzzy Logic, Intelligence, Control and Information, Pearson Education

**E58: Software Project Management and SQA**

**Introduction to SW Project Management (SPM):** Introduction, Concept of Project, Need and importance of SW Project, concept of management, Evolution of Software Economics, Software Management Process Framework, Software Management Disciplines, Problem with SW projects, Modern Project Profiles, Project Evaluation- Strategic Assessment, Technical Assessment, Cost Benefit Analysis

**SW Project Planning:** Defining the problems, developing a solutions strategy, planning the development process, activity involved in SW project planning, Steps in SW project planning, planning an organizational structures.

**SPM Activities and Activity Planning:** Objectives, Project Schedule, Sequencing and Scheduling Activities, Umbrella Activities- Metrics, Configuration Management, Software Quality Assurance; In Stream Activities- Project Initiation, Project Planning, Execution and Tracking, Project Wind up, Concept of Process/Project Database, Network Planning Models i.e PERT and CPM, Shortening Project Duration


**Risk Management:** Definition, Categories, Nature and Types of SW project risk , Risk Assessment, Risk Management, Risk Control, Failure Mode and Effects Analysis (FMEA), Hazard Identification and Analysis, Risk Planning And Control.

**Metrics:** Need for Software Metrics, Classification of Software Metrics: Product Metrics (Size Metrics, Complexity Metrics, Halstead’s Product Metrics, Quality Metrics), and Process metrics (Empirical Models, Statistical Models, Theory-based Models, Composite Models, and Reliability Models)

**Managing People and Organizing Teams:** Introduction, Becoming a Team, Organizational and team Structures, Team Management, Client Relationship Management, Case Studies.

**SW Quality Fundamentals:** SW quality concept- what and why? Benefits and importance, SW Quality models i.e. McCall, Boehm, FURPS, Dromey, ISO 9001, 9126 etc., Cost of Poor quality, SQA: Introduction, roles and benefits, SQA and quality control, SQA planning and activities, SQA process framework i.e. ISO, CMM, Six-Sigma, TMMi, People CMM etc. and their relevance to Project Management

**Fundamentals of Software Quality Assurance:** Ethical Basis for Software Quality, Total Quality Management Principles, Software Processes and Methodologies.


**Quality Metric System:** Concepts, Measurement Theory, Software Quality Metrics, importance and categories of metrics, Metrics Program (GQM), Designing Software Measurement Programs, Complexity Metrics and Models, Organizational Learning, Improving Quality with Methodologies, Structured/Information Engineering, commonly used metrics i.e. Process, Product and Resource metrics.

**Test Management:** Recap of SW Testing fundamentals, Test Management and activities involved, Evaluation of Test Effectiveness, release management, Test management tools

**Tools for Quality Improvement:** Basic quality control tools, check sheet, C&E diagram, Pareto diagram, histogram, Scatter Plot, Run Chart, Control Chart, orthogonal defect classification,

**References:**

7. Ramesh, Gopalaswamy, Managing Global Projects, TMH, 2001