Computer Science & Engineering

Compulsory Subjects

IC 402 Engineering Management

CP 403 Data Structures

CP 404 Programming Languages

CP 405 Pulse and Digital Circuits

CP 406 Computer Architecture

CP 407 Systems Analysis and Design

Optional Subjects *(Any three from any one Group)*

Group I Computer Applications

CP 411 Graph Theory and Combinatorics

CP 412 Computer Networks

CP 413 Operating Systems

CP 414 Artificial Intelligence

CP 415 Database Management Systems

Group II Hardware Engineering

CP 421 Parallel Processing

CP 422 Computer Networks

CP 423 Operating Systems

CP 424 Computer Graphics

CP 425 Micro-processors and Micro-controllers

Group III Information Technology

CP 431 Pattern Recognition and Image Processing

CP 432 Theory of Computation

CP 433 Operating Systems

CP 434 Computer Graphics

CP 435 Software Engineering

ENGINEERING MANAGEMENT

Group A

Management and Organisations

Management process: Definition, planning organizing, directing, controlling, coordinating, types of management.

Organisation Definition, planning, design and development, types of organizations.

Management planning and control: Classical, new classical and modern principles. General Management, scientific management, engineering, management, systems management.

Planning: Procedures, resources and constraints, objectives, goals, policies and procedures.

Control: Setting of reference or standards, appraisal or evaluation, monitoring and controlling, types of control.

Human resource planning and management, selection, recruitment, training, retraining, skill development, competence development, promotion and career development, participative management, trade unions, and collective bargaining,

Management of Physical Resources

Plant: site selection procedures, factors affecting selection. Layout-types and relative merits and demerits, Maintenance-Objectives, different types of associated decisions, strategies for effective maintenance, computer applications.

Material : Functions, objectives, planning and control including inventory models with or without storage costs, price break (excluding dynamic and probabilistic considerations). Different classes of inventory. Material Requirement Planning (MRP).

Group B

Financial management: Introduction to standard forms of financial statements, ie., balance-sheet, profit and loss, and income statement. Fixed and current asset items. Fixed and current liability items. Linkage of two successive balance-sheets through income or profit and loss statement. Funds flow statement. Financial ratios and their implications.

Managerial economics: Concepts, theory of production, marginal productivity and cost. Introduction to theory of firm.

Quality management: Quality definition, quality planning, quality control and quality management, Total quality management, ISO 9000 systems, simple quality control techniques like control charts and acceptance sampling.

Marketing management consumer behavior, market research, product design and development pricing and promotion.

Project management: Introduction. Concept of a project, project management concepts, project simulation, cost or project and means of financing, economic evaluation criteria of the

project, project implementation, project planning, scheduling and monitoring, project control (PERT, CPM techniques including crashing). Project evaluation.

Information technology and management. Role of information, management information system and decision support system, Information technology-introduction to e-business, e-commerce and integration tools like enterprise resource planning (ERP).

DATA STRUCTURE

Group A

Time and space analysis of algorithms. Order notation.

Linear data structures: Sequential representations: Arrays and lists, stacks, queues and dequeues; strings and their applications.

Linked representations: Linear linked list, circular linked list, doubly linked list and their applications. Recursion: Design of recursive algorithms. Tail recursion, when not to use recursion, removal of recursion.

Group B

Nonlinear data structures: Trees, binary trees, traversals and threads, binary search trees, insertion and deletion algorithms, height-balanced and weight-balanced trees, B-trees, B+ trees, application of trees.

Graph representation. Breadth first search, depth first search. Hashing, hashing functions, collision resolving techniques. Sorting and searching algorithms, bubble sort, selection sort, insertion sort, quick sort, merge sort,

heapsort, radix sort.

File structures: Sequential and direct access, relative files, indexed files-B+tree as index, multi-indexed files, inverted files, hashed files.

PROGRAMMING LANGUAGE

Group A

Principles of high-level language programming, file structure and file handling, block structured languages, design principles, abstractions, control and data Structures, binding, parameter passing mechanism.

LISP. Overviews of LISP functions, conditions, arithmetic, recursion, iteration, application of LISP in, artificial intelligence problems.

C language: Fundamentals of C, types, operators and expressions, control flow, C-functions, recursion, pointers and arrays, structures, common line arguments, unions, Bitwise operators: file handling in C.

Group B

C++: Overview of C+ +, class and objects, arrays of objects, operator overloading, concepts of inheritance, base class, derived class, multilevel inheritance, nesting of classes, file concepts, library functions, streams, templates.

Java: Features of Java, Java arrays, two-dimensional array, multidimensional arrays, Java files, file I/O and streams, event-driven programming, events and applets, passing parameters to Applets. Examples.

PULSE AND DIGITAL CIRCUITS

Group A

Combinational Logic

Boolean algebra: Introduction, postulates of Boolean algebra, fundamental theorems, uniqueness properties, laws of Boolean algebra, De Morgan's theorem, the (inclusion) implication relation, bounds of Boolean algebra, duality in Boolean algebra, Boolean constants, variables and functions, two-valued Boolean algebra switching algebra, electronic gates and mechanical contacts.

Boolean functions and logic operations: Introduction, the normal form, the canonical form, fundamental products and sums, disjunctive and conjunctive normal forms, binary, octal and hexadecimal, designations, self-dual functions, logical operations, NAND and NOR operations, EXCLUSIVE-OR operation, functionally complete sets.

Minimization of switching functions: The Karnaugh map-introduction cubes and the Karnaugh map, prime cubes, maximum sum of products, minimum product of sums, don't care forms, five- and six-variable maps, multiple output minimization.

Tabular methods of minimization: Introduction, Quine-McCluskey algorithm, the dominance relation cyclic functions, the degree of adjacency and essential prime cubes.

Logic synthesis of switching functions: Introduction, AND, OR and inverter networks, NAND and NOR networks, EXCLUSIVE-OR networks, multiplexers, read only memories, programmable logic arrays (PLA), PLA minimization, essential prime cube theorems, PLA folding.

Reliable design and fault detection tests: Introduction, fault classes and models, fault diagnosis and testing, test generation, fault table method, path sensitization method, Boolean difference method, reliability through redundancy, hazards and hazard-free designs, quaded logic.

Group B

Sequential Circuits

Introduction to synchronous sequential circuits, the finite-state model-basic definitions, the memory elements and their excitation functions-S-R flip-flop, J-K flip-flop,D flip-flop, T flip-flop, synthesis of synchronous sequential circuits.

Capabilities, minimization and transformation of sequential machines, the finite-state model-further definitions, capabilities and limitations of finite-state machines, state equivalence and machine minimization, simplification of incompletely specified machines compatible states, the non-uniqueness of minimal machines, closed set of compatibles. The compatible graph and the merger table.

Asynchronous sequential circuits. Fundamental mode circuits, synthesis, state assignments in asynchronous sequential circuits, pulse mode circuits.

Finite state recognizers: Deterministic recognizers, transition graphs, converting non-deterministic into deterministic graphs, regular expressions, transition graphs recognizing regular sets, regular sets corresponding to transition graphs.

COMPUTER ARCHITECTURE

Group A

Introduction to basic structure and operational concepts, instruction formats, instruction execution process, addressing modes, stacks and subroutine handling, instruction sets and organisational features of some representative machines.

Control unit: Hardware control unit design, microprogramming and micro programmed control unit design, micro sequencer and bit sliced microprocessor (AMD 2900) based micro program control unit design, horizontal and vertical microprogramming, nanoprogramming, emulation.

Main memory organisation: Memory hierarchy, virtual memory, cache memory, interleaved memory and linear addressing techniques.

I/O organisation: Addressing of I/O devices, memory mapped I/O and I/O mapped I/O, data transfer techniques-programmed, interrupt driven, DMA, *I/O* channels programming, data transfer over synchronous and asynchronous buses, some standard. interface bus like VME/IEEE-488.

Group B

Introduction to RISC and CISC architecture and their comparison.

Pipelining: Classification, scalar and vector pipelining, instruction pipelining and execution pipelining, control strategy for pipeline scheduling and performance analysis.

Associative memory and its implementation with example algorithms to run on associative memory machines.

Flynn's classification of multiprocessor machines, SISD, SIMD, MIMD (both, loosely coupled and tightly coupled).

Introduction to some interconnection network (mesh, cube, cycle, hypercubes, pyramid and omega).

SYSTEMS ANALYSIS AND DESIGN

Group A

Systems Development Life Cycle, classic life cycle. Prototyping.

Feasibility study: Cost estimation, cost-benefit analysis.

Physical and logical data flow diagrams.

Requirement analysis: Entity-relationship diagrams. decision tables, CASE tools.

Systems design: Refinement. Software architecture, program design fundamentals.

Group B

Structured programming modularity-cohesion and coupling.

Design documentation.

System implementation: System simulation, planning for coding and testing, verification and validation.

Project review and walkthrough.

Input-output design, forms design, dialogue design.

File design, security and control.

Management Information System.

GRAPH THEORY AND COMBINATIONS

Group A

Graphs and digraphs, subgraphs, degree, walk path, cycle, trees, spanning trees, distance, connectivity, reactivity and reachability, adjacency matrix.

Eularian paths and circuits in graphs and diagraphs.

Hamiltonian paths and circuits in graphs and tournaments.

Matching, perfect matching, 4-colour theorem, vertex colouring, chromatic polynomial edge colouring.

Group B

Planar and non-planar graphs, Euler's formula, Kuratowgki's theorem. Network, Max flow-Min cut theorem. Graph enumeration-Polya's counting theorem. Graph algorithms-shortest path, minimal spanning tree, etc.

Basic combinatorial numbers, recurrence, generating functions, multinomials. Counting principles. Polya's theorem, inclusion and exclusion principles. Block design and error correcting codes. Hadamard matrix. Finite geometries.

COMPUTER NETWORKS

Group A

Introduction: Goals and applications of networks, WAN, MAN and LAN, computer networks and distributed computers.

Network architecture: ISO/OSI model, topology, connectivity analysis, queuing theory and delay analysis.

Physical layer: Theoretical basis of data communication, modems, FDM and TDM, X21, communication satellites, message and packet switching, terminal handling polling, multiplexing and concentration, error detection and correction techniques. Hamming codes and polynomial codes.

Group B

Data link layer and network layer: Framing techniques, network protocols—stop and wait protocol and its performance, sliding window protocol.

LANs: Ethernet and token ring. CCITT recommendation of X.25.

Introduction and overview of internet, TCP/IP, internet address. Introduction to web, web design and search engine. Mapping of internet address to physical address, ARP.

Routing, flow control and congestion analysis.

OPERATING SYSTEMS

Group A

Functions and features of OS. Different types of OS viz., single user, batch processing, multiprogramming, time sharing.

Single user system: Basic I/O system, ROM resident and disk based I/O system.

Command interpreter with reference to any available operating systems (like MSDOS).

File management and directory structures.

Memory management, partitioned, paging, segmentation and thrashing.

Processor management and different scheduling techniques.

Resource management, disk allocation and scheduling.-

Deadlock detection, recovery, prevention and avoidance.

Group B

Concurrent processor issues—functionality, mutual exclusion, synchronization, interprocess communication.

Primitives like semaphores and their implementation using machine primitives.

Concept of conditional critical region and monitors.

Interrupt handlers, device drivers and controllers, device independent I/O and piping.

Design issue of multiuser operating systems (with reference to UNIX).

Advanced concepts of program and data security and protection.

Distributed systems concepts and few basic results.

ARTIFICIAL INTELLIGENCE

Group A

Introduction. Cognitive science and perception problems. Problem solving paradigm, introduction to search techniques, problem representations through heuristics, search spaces and/or graphs.

Basic heuristic search procedures, specialized search techniques, decomposable search strategies.

Knowledge representation through propositional and predicate logic, fuzzy logic and some applications. Solutions of artificial intelligence problems by PROLOG.

Group B

Rule based deduction and expert systems with an example of MYCIN.

Knowledge engineering, inference engines and expert system shells.

Computer vision and natural language processing.

Concept of neural network.

DATABASE MANAGEMENT SYSTEMS

Group A

Introduction. Database concepts, architecture, physical data organization, entity relationship, data models-network, hierarchical and relational.

Relational model. Storage organization, relational algebra, relational calculus, query languages, functional dependencies, decomposition of relational schemes, query

optimisation.

Group B

Database Management System (DBMS): Typical DBMS based on relational model, DDL, creating, editing, searching, sorting, relational operations, formatted report, etc.

Features of a commercially available RDBMS as case study (ORACLE).

Data administration. Processing system life cycle, security and integrity, office automation system.

PARALLEL PROCESSING

Group A

Introducing to parallel processing, architectural classification and techniques.

Arithmetic and instruction pipelines, pipelining hazards and scheduling theory.

Super scalar architectures, asynchronous pipelines.

Interconnection networks—Hyper cubes, shuffle

exchange, Tree, Mesh and Butterfly networks.

Group B

Parallel algorithm for linear algebra, sorting, Fourier transform, systolic arrays, etc.

Vector processors, shared memory multiprocessor systems.

Data flow architectures-merits and demerits.

Operating systems for parallel processors.

Some case studies, namely, IBM 370, Cray X-MP, Cray 1, Cray 2, Cyber 205.

COMPUTER GRAPHICS

Group A

Various graphic display devices and interactive devices.

Line and curve drawing algorithms.

Area filling—Scan line algorithm, seed fill algorithm, half toning.

Two-dimensional transformation—translation, scaling, rotation.

Group B

Windowing and clipping techniques.

Three-dimensional graphics and transformations, reflections and viewing projections.

Hidden line and hidden surfaces removal algorithms.

Animation techniques.

MICROPROCESSOR AND MICRO CONTROLLERS

Group A

Microprocessor architecture and microcomputer systems, memory systems, input and output devices. Number systems-binary, hexadecimal and BCD numbers, 2s complement and arithmetic operations.

8085 microprocessor architecture. Memory interfacing address decoding techniques, memory read and write operations. Memory map. Interfacing I/O devices- Memory-mapped I/O and I/O mapped I/O. Polled and interrupt modes of data transfer. 8085 interrupts, direct memory access. Introduction to 16-bit microprocessor using 8086 as an example. Concept of debugger and MASM/T ASM for PC assembly language programming.

Peripheral devices. 8255 programmable peripheral interface, 8253 programmable counter timer, serial communication with SID and SOD, 8251 programmable communication interface, 8259 programmable interrupt controller, keyboard and display devices.

8085 assembly language programming: 8085 instructions-addressing modes. Stack and subroutines. 8085 programmer's model-CPU registers. Addition, subtraction and multiplication routines. Software delay and counting routines. Logical operations. Analog and digital I/O interface routines-ADC and DAC.

Software development systems: Assemblers and cross assemblers.

Microprocessor applications. Microprocessor based system design aids and trouble-shooting techniques.

Group B

Introduction to microcontroller: Comparison of various microcontrollers. 8051 microcontroller architecture. Bi-directional data ports, internal ROM and RAM, counters/timers. Oscillator and clock.

8051 registers. Memory organisations-program memory and data memory, internal RAM and bit addressable memory, special functions, registers, memory map.

External memory systems and I/O interface. Accessing external program memory, accessing external data memory, available I/O ports during external memory access. Alternate ports functions. Serial interface. 8051 interrupts. Power down modes.

8051 assembly language programming. 8051instruction sets, addressing modes, bit level operations. Arithmetic routines, counting and timing under interrupt control, keyboard and display interface routines, accessing lookup tables.

Software development systems. Assemblers and simulators. Microcontroller based system design and applications.

PATTERN RECOGNITION AND IMAGE PROCESSING

Group A

Hyperplane properties and decision functions. Minimum distance pattern classification with simple and multiple prototypes.

Clustering: K means and isodata algorithm, pattern classification by likelihood functions, bayes classifier, learning and estimation of mean vector and covariance matrix.

Trainable pattern classifier—Gradient technique, Robbins-Monre algorithm, potential functions and least mean square errors.

Feature selection by entropy minimization, Karhuner-Lucke expansion and divergence maximization.

Group B

Image representation, digitization, quantization, compression and coding.

Transform for image processing, restoration enhancement, segmentation, thinning.

Description of line and shape, statistical and syntactic models of image classification.

Morphological methods of image analysis.

THEORY OF COMPUTATION

Group A

Regular sets and regular expression, deterministic and non-deterministic and finite automata, equivalent finite automation of both. Minimization of states for deterministic finite automata.

Chomsky hierarchy of grammars, equivalent context-free grammars.

Chomsky normal form, recursiveness of context-sensitive grammar, syntax-directed translations.

Pushdown automata, pumping lemma for context-free languages, automata for syntax-directed translations.

Group B

Turing machines and its variants, universal luring machines, recursive functions and sets. Equivalence of recursive functions and computable functions.

Complexity theory. Space complexity, time complexity, simulation of RAM by TM and its complexity, NP-completeness concepts and some standard NP-complete problems.

SOFTWARE ENGINEERING

Group A

Software project planning and management: Basic concepts of life cycles models, milestone, cost models, successive versions model, project structure, team structure. Empirical and heuristic estimation techniques.

Requirement analysis. Specifications, algebraic axioms, regular expressions, decision tables, event tables, transition tables, FS mechanism, petri nets.

Software design: Architectural and detailed design, abstraction, information hiding, modularity, concurrency, etc, coupling and cohesion, data How diagrams, structure charts, pseudo code, stepwise refinement, top-down and bottom-up programming.

Test plan and implementation issues-structured coding, recursion, documentation.

Group B.

Modern programming language features: Typeless, strong type and pseudo strong type checking, user defined data types, data encapsulation, generic facilities,' concurrency mechanism, object oriented concepts.

Program verification and validation. Unit testing, integration testing, acceptance testing, formal verification.

Software maintenance: Source code metrics, Halstead's effort equation, cyclomatic metric.

Reliability and software quality assurance.

Software cost estimation.