

SYLLABUS OF B.SC.(H) COMPUTER SCIENCE I YEAR

101 – PROGRAMMING FUNDAMENTALS

Basic Computer Organization: Functional Units, basic I/O devices and storage devices; Representation of integers, real (fixed and floating point), characters (ASCII and Unicode); Basic operations of a programming environment.

Problem Solving Approaches: Notion of an algorithm, problem solving using top-down design and decomposition into sub-problems, stepwise methodology of developing an algorithm, methodology of developing an algorithmic solution from a mathematical specification of the problem, use of recursion for problems with inductive characterization.

Programming using a modern programming language such as Java, emphasizing the following notions: Building blocks: arithmetic and logical expressions, variables, assignment; Specifying the input-output interface (types); control structures including sequencing, conditionals, loops, procedural abstractions (procedures, methods); basic data structures—integers, reals, strings and arrays—and internal representation of scalar and vector data; data abstraction and encapsulation—objects, classes and packages; input/output of data.

Numerical and non-numerical applications using above concepts.

BOOKS RECOMMENDED

R.G. Dromey, **How to solve it by Computer**, Prentice Hall of India.

W.Savitch, **Java and introduction to computer science and programming**, Prentice Hall International

H.M. Deitel, P.J. Deitel, **JAVA: How to Program**, Pearson Education

H. Schildt, **Java 2: The Complete Reference Book**, Tata McGraw Hill

102 – DISCRETE STRUCTURES

Review of Sets, functions, relations including partial order

Counting, generating functions, recurrence relations: linear recurrence relations with constant coefficients, homogenous solutions, particular solutions, total solutions, solution by the method of generating functions.

Growth of Functions: Asymptotic notation, Θ , O , ω notations, monotonicity, standard functions: floors and ceilings, polynomials, exponentials, logarithms and factorials, summations: summation formulas and properties, bounding summations, approximation by integrals.

Graph Theory: Basic terminology, multigraphs and weighted graphs, paths and circuits, shortest paths in weighted graphs, Eulerian paths and circuits, Hamiltonian paths and circuits, Traveling Salesperson problem, planar graphs, trees and rooted trees, prefix codes, spanning trees and cut sets, directed graphs.

Propositional logic, predicate logic.

BOOKS RECOMMENDED

C.L. Liu, **Elements of Discrete Mathematics**, Tata McGraw-Hill,

J.Kelly, **The Essence of Logic**, Prentice Hall of India,

J.P. Trembley, R.Manohar, **Discrete Mathematical Structures with Applications to Computer Science**, Tata McGraw Hill,

T.H. Cormen, C.E. Leiserson, R.L. Rivest, **Introduction to Algorithms**, Prentices Hall of India,

D.E. Knuth, **The Art of Computer Programming Vol.I: Fundamental Algorithms**, Addison Wesley

103 – CALCULUS – I

Sequences and series: Infinite sequences, limit points, limit, convergence criteria, positive term series and their convergence, tests of convergence, absolute convergence and conditional convergence, Leibnitz test, rearrangement of series.

Review of limit, continuity, differentiation of real functions, successive differentiation, properties of continuous and differentiable functions, Taylor's series, McLaurin's series, indeterminate forms.

Points of Inflection, asymptotes, maxima and minima, singular points, curve tracing.

Functions of two and three variables, closed and open sets, limit, continuity and differentiation, partial derivatives, Euler's theorem, linearization of a function of two variables, chain rule, implicit function theorem, differentiation under integral sign, vector-valued functions and space curves, directional derivative, level surfaces, gradient vector and tangent planes, extreme values and saddle points, maxima and minima, Lagrange multipliers, Taylor's theorem.

BOOKS RECOMMENDED

G.B. Thomas, R.L. Finney, **Calculus and Analytic Geometry**, Addison Wesley,

P. Lax, S. Burstein, A. Lax, **Calculus with Applications and Computing Vol. I**, Springer Verlag

R.L. Wilson, **Much Ado About Calculus, a Modern Treatment with Applications Prepared for use with the Computer**, Springer Verlag

104 – DIGITAL ELECTRONICS

Fundamental Concepts: Digital signal, NAND, NOR and Exclusive–OR operation, Boolean Algebra, Basic Digital Circuits.

Number system and Codes: Primary, Octal, Hexadecimal, Signed numbers codes, hamming codes.

Combinational Logic Design: K-map representation of logical functions and simplification using K-map of 4 and 5 variables, Quine – McCluskey’s method.

Multiplexers, Demultiplexers, Adders and Subtractors, multipliers, Comparators, Parity generators and checkers, Code converters, Priority Encoders, Decoders.

Races, hazards, and asynchronous behaviour

Flip-Flops: Clocked RS flip flop, D-type flip flop, Excitation table of flip flop, Edge triggered flip flop, Clocked flip flop design.

Sequential Logic Designs: Registers, Shift registers, Asynchronous counters, synchronous counters, RAM, ROM.

BOOKS RECOMMENDED

Malvino, **Digital Principles and Applications**, Tata McGraw Hill, 4th Edition

M. Ercegovac, T. Lang, J.H. Moreno, **Introduction to Digital Systems**, John Wiley and Sons

105 – LANGUAGE: FORM AND FUNCTION

Natural and Computer Languages: Basic features of natural languages; structure of language at the levels of sounds, words and sentences; rule-governed behaviour and variability; features of formal languages; man-machine interface; computer languages

Language and Communication: Human and non-human communication systems; verbal and non-verbal communication; Language-dependent and language-independent systems of communication; speech and writing

Language Structure: The concept of linguistic sign; syntagmatic and paradigmatic relations; langue and parole; competence and performance; form and substance; human mind as a computing device, natural language processing.

Language Analysis: Study of rules at the levels of sounds (phonology), words (morphology) and sentences (syntax); computational applications in speech analysis; speech synthesis; grammatical parsers; phrase structure grammars and transformational generative grammars; basic semantic relations of synonymy, antonymy, homonymy, polysymy etc.

Social and Psychological Aspects: Language variation; use of computers in statistical analysis of language data; the role of person, place and topic in language choice; politeness; language and power; language and gender; multilingualism; corpus data and the use of computers to analyse large databases.

BOOKS RECOMMENDED

Akmajian, R. A. Demers, R. M. Harnish, Linguistics : **An Introduction to Language and Communication**, MIT Press, Cambridge, London

G. Yule, **The Study of Language**, Cambridge University Press

R. Grishman, **Computational Linguistics**, Cambridge University Press.

J. Aitchison, **The Articulate Mammal**, Hutchinson , London

J. Lyons, **Language and Linguistics : An Introduction**, Cambridge University Press

106 – PRACTICAL : LAB BASED ON PAPER 101 AND PC SOFTWARE TOOLS

PC SOFTWARE TOOLS

Exercises to familiarise the student with various tools and packages available in a Personal Computing environment: Editing tools, tools for preparation of technical documentation, e-mail, browsing and designing web pages using HTML, drawing tools, managing information using a spreadsheet, installing software, effective use of calendars, diaries etc for time and event management, presentation tools.

201 – DATA STRUCTURES

Introduction to the object- based and object- oriented programming paradigms; records, abstract data types and objects, data abstraction and internal representation; programming- in- the- large issues: modularity and code re-usability, classes and packages; graphical user interfaces; command-line arguments; interfacing with libraries and separate compilation; language support for OOP: Sub-typing, Inheritance, classes and subclasses, header files, function templates, overloading

Programming with Data structures: Stacks, queues, lists, trees and balanced binary trees, specification of exception conditions and exception handling, notion of efficient algorithmic solutions, efficient representations of data structures (e.g. sparse arrays), algorithms for searching and sorting.

BOOKS RECOMMENDED

M.A. Weiss, **Data Structures and Algorithm Analysis in Java**, Addison Wesley (3rd Indian Reprint)

S. Sahni, **Data Structures, Algorithms and Applications**, Tata McGraw Hill,

H.M. Deitel, P.J. Deitel, **JAVA: How to Program**, Pearson Education

S.B. Lippman, J. Lajoie, **C++ Primer, 3rd Edition**, Addison Wesley (2nd ISE Reprint)

R. Sedgewick, **Algorithms in C++**, Addison Wesley (3rd Edition 1st Indian Reprint)

A. Drozdek, **Data Structures and Algorithms in C++**, 2nd Edition, Vikas Publications

202 – COMPUTER SYSTEMS ARCHITECTURE

THE COMPUTER SYSTEM

System buses: Computer Components, Computer function, Interconnection Structures, Bus Interconnection, PCI.

Internal Memory: Computer Memory System Overview, Semiconductor Main memory, Cache Memory, Advanced DRAM Organization.

Input / Output: External Devices, I/O Modules, Programmed I/O, Interrupt-Driven I/O, Direct Memory Access, I/O Channels and Producers, The External Interface.

Operating System Overview.

THE CENTRAL PROCESSING UNIT

Computer Arithmetic: The Arithmetic and Logic Unit (ALU), Integer Arithmetic, Floating-Point Representation, Floating-Point Arithmetic.

Instruction Sets: Characteristics and Function, Machine Instruction Characteristics, Types of Operands, Types of Operations, Addressing Modes and Formats, Register Organization, The Instruction Cycle, Instruction Pipelining.

Assembly Language

The Control Unit: Micro-operations, control of the CPU, hardwired Implementation, Microprogram Controller, Basic Concepts, Microinstructions, Sequencing, Microinstruction Execution.

Reduced Instruction Set Computers: An Introduction.

BOOKS RECOMMENDED

M. Mano, **Computer System Architecture**, 3rd Edition, Prentice-Hall India,

W. Stallings, **Computer Organisation and Architecture**, 4th Edition, Prentice-Hall India,

Harry, Jordan, **Computer Systems Design & Architecture**, Edition, Addison Wesley

J.D. Carpinelli, **Computer Systems Organization & Architecture**, Addison Wesley,

J.P. Hayes, **Computer Architecture and Organisation**, McGraw Hill

M.M. Mano and Charles, **Logic and Computer Design Fundamentals**, 2nd Edition Updated, Pearson Education Asia

203 – CALCULUS II

Integration: Review of Estimating with finite Sums, Riemann sums and definite integrals, max min property & domination property, mean value theorem for definite integrals, fundamental theorem of calculus, volumes and surfaces of revolution, integrals of vector-valued functions of a real variable.

Fourier Series: Fourier Polynomials, Fourier Series and applications.

Multiple Integrals: Double and triple integrals, surface areas and volumes, Applications using Cartesian and polar forms, cylindrical and spherical coordinates, substitution in multiple integrals.

Complex analysis: Complex functions, continuous functions, analytic functions, linear fractional transformations, Cauchy Riemann equations, harmonic functions, complex integration, Cauchy's theorem and Cauchy's integral formula, Cauchy's integral formula for derivatives, Power series, Taylor series, Laurent's series, poles, residues, Cauchy's residue theorem and evaluation of integrals.

BOOKS RECOMMENDED

G. B. Thomas, R. L. Finney, **Calculus and Analytical Geometry**, Addison Wesley,

D. Hughes-Hallet, A.M. Gleason, **Calculus**, John Wiley & sons,

E. Kreyszig, **Advanced Engineering Mathematics**, John Wiley & Sons

S. Lang, **Complex Analysis**, Springer Verlag

P. Lax, S. Burstein, A. Lax, **Calculus with Application and Computing**, Vol I, Springer Verlag

S.V. Krantz, **Handbook of Complex Variables**, Birkhauser

T. Needham, **Visual Complex Analysis**, Clarendon Press

204 – PROBABILITY

Review of notion of probability, random experiment, classical and axiomatic definitions of probability, equally likely outcomes.

Conditional probability and Bayes Theorem, statistical independence of events.

Random variables: Concept of a RV, cumulative distribution function, pmf and pdf, discrete and continuous RV, functions of a RV, Expectation of function of a RV, conditional expectation.

Discrete Distributions: bernoulli, Binomial, Poisson, Geometric, negative binomial, Hypergeometric.

Continuous Distributions: Uniform, Exponential, Normal, Beta, Gamma.

Jointly Distributed RVs: Joint distribution of two RV's, bivariate normal distribution, independent RVs, covariance and variance of sums of RVs.

Moment generating functions, joint distribution of the sample mean and sample variance from a normal population.

Limit Theorems: Markov's inequality, Chebyshev's inequality, weak and strong laws of large numbers, Central Limit Theorem.

Markov Chains: Chapman-Kolmogorov Equations, classification of states, limiting probabilities.

Random Number Generation: Pseudo Random Numbers, Inverse transformation method, rejection method, generating random numbers from discrete (Binomial, Poisson, Geometric) and continuous (Exponential, Normal) distributions

Monte Carlo Integration: Hit Miss Monte Carlo Method, The Sample Mean Monte Carlo Method; Efficiency of Monte Carlo Method.

Information Theory: uncertainty, information and entropy; conditional E* mutual information, solution of logical problems by calculating information.

BOOKS RECOMMENDED

I.Blake, **An Introduction to Applied Probability**, John Wiley

S.M. Ross, **Introduction to Probability Models**, 6th edition

A M Yagolam, I.M. Yagolam **Probability and Information**, Hindustan Pub. Corp.

J. Jacob, P. Protter, **Probability Essentials**, Springer Verlag

D. Hankerson, G.A. Harris, P.D. Johnson Jr, **Introduction to Information Theory and Data Compression**, CRC Press,

R.L. Scheaffer, M. Gnanadeisikan, A. Watkins, J.A. Witmer, **Activity Based Statistics**.

205 (i) – ANALOG ELECTRONICS

Power Conversion: Review of Semiconductors, p-n junction characteristics, Basic rectifier circuits (H.W.F.R), Filter-inductor filter, capacitor filter, L and II – section filters, R.C. filter.

Wave Shaping: Differentiating, Integrating and Summation circuits, Application of wave shaping circuits; Generation of voltage step from ramp, square wave from a triangular wave, narrow pulses from square wave, clipping circuits, clamping circuits, voltage multipliers and peak-to-peak detector.

Amplification: Current-flow mechanism and current amplification in the function transistor, small signal amplifiers, positive and negative feed back, biasing and stabilization of operating point, performance measures of different configurations, High frequency consideration, Multistage principles.

Large Signal Amplifiers: Performance characteristics of class A amplifiers, Push-Pull operation of class A amplifier, Class B power amplifiers, Tuned class power amplifiers.

BOOKS RECOMMENDED

M.N. Millman, Halkias, **Integrated Electronics**, Tata McGraw Hill.

M.N. Millman, Grabel, **Micro Electronics**, Tata McGraw Hill.

205 (ii) – FINANCIAL MANAGEMENT

Introduction: Objectives and functions of financial management, time value of money, concept of risk and return.

Capital Budgeting: Data requirements; evaluation techniques – pay back, internal rate of return, net present value, capitalization & capital structure, computation of specific and weighted – cost of capital.

Working capital management: determination of working capital cash management, receivables management and inventory management.

Financial Decision: Relationship between dividend policy and value of a firm, dividend policy in practice, factors affecting dividend policy, legal and procedural aspects of dividend policy.

BOOKS RECOMMENDED

P. Chandra, **Financial Management**, Tata McGraw Hill,

M.Y. Khan, P.K. Jain, **Basic Financial Management**, Tata McGraw-Hill.

205 (iii) LOGIC

Definitions: Nature and classification, Classifications: nature and types of

Nature of logic, limitations of formal logic

Traditional logic: Connotation and denotation of terms, distribution of terms

Distinction between sentence and proposition, types of Aristotelian categorical propositions

Logical form; truth and validity

Laws of thought

Theory of the Square of opposition of categorical propositions, The problem of existential import

Laws of Conversion, Observation, and Contraposition of categorical propositions

Syllogism: Figures and Moods of valid syllogistic arguments. Rules governing different Figures, syllogism, fallacies, fallacies of syllogistic arguments, syllogistics and method of antilogism

Fluidity of ordinary logic, Philosophic problem of induction

Informal fallacies

Philosophy of logic

BOOKS RECOMMENDED

I.Copi, **Introduction to Logic**, 5th edition, Macmillan, New York,

W.V. Quine, **Methods of Logic**, 4th edition, Harvard University Press, Cambridge, Mass

Cohen, Nagel, **Introduction to logic and Scientific Method**, Allied Publishers

206 Practical Software Lab based on 201

207 Practical Digital Electronics lab based on 104 (of Sem I)

301 – ALGORITHMS

Mathematical Preliminaries: Review of growth of functions, summations and recurrences.

Sorting and Order Statistics: Heapsort, Quicksort, Mergesort, Lower bounds for sorting, radix sort, bucket sort, median and order statistics.

Advanced Data Structures: Review of binary search trees, dynamic set operation, randomly built binary trees, red black trees, order statistic tree binomial heaps, Fibonacci heaps, disjoint sets.

Dynamic Programming: Matrix chain multiplication, longest common subsequences and optional polygon triangulation problems.

Greedy Algorithms: Activity selection, Huffman coding, and task scheduling problem.

Amortized Analysis: Aggregate, accounting, potential methods, and dynamic tables.

Matrix Operations: Strassen's algorithm, system of equations – LU decompositions and matrix inversion.

Graph algorithms: Traversal connected components-biconnected and strongly connected components, minimal spanning trees.

BOOKS RECOMMENDED:

T.H. Cormen, C.E. Leiserson, R.L. Rivest, **Introduction to Algorithms**, Prentice Hall of India.

R.Sedgewick, **Algorithms in C++**, Third edition, Addison Wesley.

302 – SYSTEMS SOFTWARE

Scripting : Shell scripts, perl scripts, sed, awk

Configuration management : make and facilities

Version control : rcs, sccs or cvs

Archiving (tar), compression (zip), uuencode, rpm

Systems programs employed in runtime environment : linkers, loaders

Language front and software : Lex, Yacc

Installation of software and preparing software for installation

Representation, mark-up and processing of data

XML and associated translation tools (XSL etc.)

Interactive Web computing : Java-script, CGI

BOOKS RECOMMENDED:

O Reilly Series, **Programming Perl**.

B. Marchal, **XML by Example**, QUE Series, Prentice Hall of India.

B. Kernighan, R. Pike, **The Unix Programming Environment**, Prentice Hall of India.

W. Stallings, **Operating Systems**, Prentice Hall of India

Linux Manuals.

303 – ALGEBRA

Groups & Rings: Introduction to semi-groups, monoids, groups, generators, cosets, normal subgroups, Lagrange's Theorem, homomorphism, rings, polynomial rings, and fields.

Lattices: Introduction to partial orders, semi-lattices, and lattices.

Vector spaces : vector spaces, linear combinations, convex sets, linear independence, dimension, the column rank and row rank of a matrix.

Linear Mappings : linear mappings and vector space of linear maps, the kernel and the image of a linear map, orthogonal complement of a subspace, the vector space of homogeneous system of linear equations, set of solutions of a non-homogeneous system of linear equations, matrix associated with a linear map, change of bases, composition of linear maps, inverse of a linear map.

Scalar products on vector spaces, norm, Schwartz's inequality, Bessel's inequality, orthogonal bases, bilinear maps and matrices, determinants, the rank of a matrix and sub-determinant, Cramer's rule, determinants as areas and volumes, Eigen vectors and Eigen values, eigen space, The characteristic polynomial, Eigen values and Eigen vectors of a symmetric matrix, diagonalisation of a symmetric linear map.

Classification of conic sections and quadric surfaces.

Books Recommended:

A.M. Cohen, H. Cuypers, H. Sterk, **Algebra Interactive: Learning Algebra in an Exciting Way**, Springer Verlag

T. Banchoff, J. Werner, **Linear Algebra through Geometry**, Springer Verlag

S. Lang, **Introduction to Linear Algebra**, Springer Verlag.

304 – STATISTICS

Review of Population and sample, discrete and continuous data, presentation of data by table and diagram, frequency distribution of a variable and its graphical representation by histogram, frequency polygons and ogives

Measures of Locations and dispersions, moments, measures of skewness and kurtosis, absolute and factorial moments, shephard's connection, cumulants.

Bivariate Data : Scatter Diagram, principle of least square and fitting of polynomial and exponential curves, relation, regression, coefficient of determination, lines of regression, Spearman's Rank correlation, intra class correlation coefficient, correlation ration multiple and partial correlation

Sampling Distribution: Concept of Random Sample, parameter and statistic, sampling distribution of a statistic, standard errors of sample, mean and proportion, sampling distribution of sample mean and variance for a normal distribution.

Hypothesis testing: Simple, composite, null, and alternate hypotheses, level of significance, two types of errors, critical region and power of test, large sample test, tests of significance based on chi-square, t and F statistics, confidence intervals, confidence intervals for mean and variance of the normal population, confidence interval for proportions.

Theory of point estimation: Unbiasedness, consistency, efficiency, sufficiency, maximum likelihood estimate, interval estimation.

BOOKS RECOMMENDED:

J.E.Freund, R.E.Walpole, Mathematical Statistics, Prentice Hall of India.

R.B.Hogg, A.T.Craig, Introduction to Mathematical Statistics, fourth Edition, Macmillan Publishing Co.

P.L.Mayer, Intriductory Probability and Statistical Applications, Second Edition, Addison Wesley.

K.S.Trivedi, Probability abd Statistics with reliability, Queuing, and Computer Science Applications, Prentice Hall of India.

R.L.Scheaffer, M.Gnanadeisikan, A.Watkins, J.A.Witmer, Activity Based Statistics, Springer Verlag.

A.M.Mood, F.A.Graybill, D.C.Bose, Introduction to the Theory of Statistics, McGraw Hill.

V.K. Rohtagi: Introduction to Probability Theory and Mathematical Statistics, New Age Publishers.

S.Zacks, Parametris Statistical Inference, Pergamon Press.

305 – ORGANIZATIONAL BEHAVIOUR

Individual Differences at work: Personality, attitude and intelligence.

Motivation: Importance of motivation in work behaviour, approaches to motivation, content theories, process theories.

Job analysis and Design: Approaches, job rotation, job enlargement, job design models.

Communication: Types, transaction analysis, Johari windows.

Training and Development: Training need assessment, training techniques and training evaluation.

Organizational Power, Politics and Conflict: Types, sources, conflict coping strategies.

Leadership: Styles, theories and models.

Performance appraisal: Need, methods and applications.

Suggested References:

S.P. Robins, *Organizational Behaviour Concepts, Controversies and Applications*(8th ed.) 2000.

N.K. Chadha, **Human Resource Management 2000**, Sai New Delhi printographers.

F. Luthans, **Organizational Behaviour**, Tata McGraw Hill.

306 – Practical: Software Lab based on papers 301, 302

401- OPERATING SYSTEMS

Introduction: System software, resource abstraction, OS strategies; multiprogramming, batch, time sharing, personal computers & workstations, process control & real time systems, processes & threads using FORK, JOIN, QUIT.

Operating System Organization: Factors in operating system design, basic OS functions, implementation consideration: process modes, kernels, methods of requesting system services, device drivers.

Device Management: Service management approaches, buffering, device drivers, performance tuning.

Process Management: System view of the process and resources, initiating The OS, process address space, process abstraction, resource abstraction, process hierarchy.

Scheduling: Scheduling Mechanisms, Strategy selection, non-pre-emptive and pre-emptive strategies.

Synchronization Principles: Interactive processes, critical section, deadlock, co-ordinating processes, semaphores, shared memory, multiprocessors, events, monitors and the inter-process communication.

Deadlocks: System deadlock model, prevention strategies, hold and wait, circular wait, allowing pre-emptions, Banker's Algorithm, serially reusable resources, consumable resources, general resources system recovery.

Memory Management: Mapping address space to memory space, memory allocation strategies, fixed partition, variable partition, segmentation.

File Management: Directory structure, basic file operations and their implementation. Protection and Security: Policy mechanism, authentication, internal access authorization.

BOOKS RECOMMENDED

G. Nutt **Operating Systems: A Modern Perspective**, Pearson Education.

W. Stallings **Operating Systems**, Prentice Hall of India.

A.S Tanenbaum, **Modern Operating Systems**, 2nd Edition, Prentice Hall of India.

M. Milenkovic, **Operating Systems- Concepts and design**. Tata McGraw Hill.

C. Crowley, **Operating Systems: A Design Oriented Approach**. Tata McGraw Hill.

A Silberschatz. Galvin, **Operating Systems Concepts**, 5th Edition, John Wiley Publications.

402- SOFTWARE ENGINEERING

Evolving role of software, software characteristics; Systems and environment; system engineering hierarchy, information and knowledge engineering; Information strategy; Business Area analysis, modeling enterprise and business-level data modeling, system architecture and associated information flow; writing system specification.

Software Engineering as a layered technology: Software process, software process models.

Software configuration management: the SCM process, Identification of objects in software configuration, version control, change control, configuration audit, SCM standards.

Requirement analysis: communication techniques, Information gathering tools; organising and structuring information; analysis principles; Analysis modelling.

Software Specification:

Design process, principles and concepts: Abstraction, refinement, modularity, control hierarchy, structural partitioning, information hiding, functional independence, cohesion, coupling, design heuristics; Design methods: data design, architectural design, transform mapping, design optimisation, human computer interface design, procedural design and tools; Design documentation.

Software testing: Testing objectives, Testing principles, Testability, test case designing, white box testing; Basis path testing: flow graph notation and cyclomatic complexity, graph matrices; Condition testing, data flow testing, loop testing; Black box testing: graph based testing methods, equivalence partitioning, Boundary value analysis, comparison testing; Testing documentation and help facilities; Software testing strategy: unit testing, integration testing, validation testing, system testing.

Software project management techniques: project matrices, software measurement and metrics, software quality metrics; Software project planning: objectives of planning, resources, project estimation and estimation models, project decomposition techniques, make-buy decisions; automated estimation tools.

Risk management: software risks, risk identification, risk projection, risk mitigation, monitoring and management; Project Scheduling: people and effort relationships, defining tasks, defining task network, scheduling techniques; Software teams and intra-team relationships; role of project manager.

Software Quality Assurance: Concept of quality, quality control vs. quality assurance, cost of quality, factors that affect quality, quantitative view of quality, quality metrics, defect removal efficiency SQA activities, ISO standards and CMM practices, SEI levels, Software reviews, Formal approaches to SQA, Statistical Quality Assurance. Software reliability, reliability metrics, reliability models, meeting reliability requirements.

Effective metrics for software process: Measurement principles, attributes of software metrics, metrics for analysis model, metrics for design model, metrics for source code, metrics for maintenance.

Cleanroom software engineering: the cleanroom approach, cleanroom testing

Software reuse: difficulties in reuse, hardware reuse vs. software reuse, reusable artifacts, domain engineering approach, analysis design and construction of reusable components, classification and retrieval of components, economic impact of reuse and reuse metrics. Computer aided software engineering: CASE tools and application.

BOOKS RECOMMENDED:

J.F.Peters, W.Pedrycz, Software engineering: An Engineering approach, John Wiley.

R.S. Pressman, Software engineering: A Practitioner's Approach, 5th Edition, McGraw Hill.

I.Sommerville, Software engineering, 5th Edition, Addison Wesley, (ISE reprint).

D. Ghezzi, M. Jazayeri, D. Mandrioli, Fundamentals of software Engineering, Prentice Hall of India.

P.Jalote, Software Engineering, Narosa.

403-PROGRAMMING PARADIGMS

Overview of the declarative style programming versus the imperative style.

Functional paradigm: Introduction to value-oriented programming in the functional style in the context of a language such as ML, local definitions and scope, block structure, principle of qualification.

Functions, Principle of abstraction; Call-by-name and call-by-value parameter passing mechanisms; principles of correspondence, recursive functions and their implementation, type-checking, type constructions such as products, sums (tagged unions), function types (higher-order functions), lists and user defined data types, parametric polymorphism (ML-style) and simple programs using higher-order functions, lists and other user defined types.

Relational paradigm: Introduction to logic programming using a Language such as Prolog.

Pattern matching and Unification: SLD resolution, backtracking, generate-and-test solutions, simple exercises involving backtracking (8 queens, knight's tour).

Imperative Paradigm: Variable declarations and allocation of space, implementation of simple control constructs such as sequencing, conditionals and loops, block structure, parameter-passing mechanisms(call-by-value, call-by-name), implementation of recursive procedures in a block structured language (call stacks and display records).

Object-oriented paradigm; Data abstraction, classes, inheritance, dynamic dispatch, derived classes, friend classes, virtual functions, operator overloading, templates.

Object-oriented design Methodologies; object-oriented software architecture; Introduction to UML.

BOOKS RECOMMENDED;

C. Ghezzi, M. Jazayeri, **Programming Language Concepts**, John Wiley.

D. Appleby, J. Vandekopple, **Programming Languages: Paradigm and Practice**, Tata McGrawHill.

R. Sethi, **Programming Languages, Concepts and Constructs**, Addison Wesley.

404-DIFFERENTIAL EQUATIONS

Linear differential equations of second and higher orders, homogeneous linear equations with constant coefficients, characteristics equation, complementary solution, particular integral, general solution, differential operator.

Euler-Cauchy equation, Wronskian, variation of parameters, power series solution, Legendre's and Bessels functions.

System of differential equations.

Laplace transforms solution of differential equations using Laplace transforms.

BOOKS RECOMMENDED;

E.Kreyszig. **Advanced Engineering Mathematics**, John Wiley & Sons.

G.B. Gustafson, C.H. Wilcox, **Analytical and Computational Methods of Advanced Engineering Mathematics**, Springer Verlag.

C.C. Ross, **Differential equations; An Introduction with Mathematica**, Springer Verlag.

405 ENGLISH: TECHNICAL COMMUNICATION

Communication: Language and communication, differences between speech and writing, distinct features of speech, distinct features of writing.

Writing Skills; Selection of topic, limiting the topic, thesis statement, developing the thesis, introductory, developmental, transitional and concluding paragraphs, linguistic unity, coherence and cohesion, descriptive, narrative, expository and arguments writing.

Technical Writing: Scientific and technical subjects; formal and informal writings; formal writings reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided.

Oral Skills: Production skills: typical sounds, stress, intonation and rhythmic patterns; interactional skills: formal speech patterns, informal speech patterns, interpersonal communication on different occasions.

Oral interaction activity: Dialogue and conversation; sharing information; presentation of reports; public speaking; discussions, negotiating skills, rhetorical or expressive devices, conversation o verbal to non-verbal and of non-verbal to verbal forms.

BOOKS RECOMMENDED;

M.Bygate, **Speaking**, Oxford Univ. Press.

M.Frank, **Writing as thinking: A guided process approach**, Englewood Cliffs Prentice Hall Regents.

L.Hamp-Lyons and B.Heasley.**Study Writing; A Course in written English. For academic and professional purposes**, Cambridge Univ. Press.

R.Quirk, S.Greenbaum, G.Leech and J.Svartik, **A comprehensive grammar of the English language**, Longman, London.

406-PRACTICAL SOFTWARE LAB BASED ON 401,402,403

501 – FILE STRUCTURES AND DATABASE SYSTEMS

Introduction: Characteristics of database approach , data models, DBMS architecture and data independence.

E-R Modeling: Entity types, entity set, attribute and key, relation ships, relation types, roles and structural constraints, weak entities enhanced entity-relation and object modeling: Sub classes, super classes, inheritance, specialization and generalization, Modeling UNION type using categories, conceptual modeling using UML class diagram.

File organisation: Indexed sequential access files, implementation using B⁺ trees, Hashing, hashing functions, collision resolution, extendible hashing, dynamic hashing approach-implementation and performance.

Relation data model: Relational model concepts, relational constraints, relational algebra.

SQL: SQL queries, programming using SQL.

ER and EER- to relational mapping: Database design using EER to relational language.

Object Oriented Databases: Object identity, structure and type constructors, encapsulation, type hierarchies and inheritance object query language.

Data Normalisation: Functional dependencies, Normal forms up to fourth normal form.

Database Design and Tuning: Database design and database tuning.

Database System Architecture: Data dictionary and data repository systems.

Query Processing: Basic algorithms for query processing, approach to optimisation.

Case Study Oracle/ MS-SQL.

BOOKS RECOMMENDED:

R. Elmasri, S.B. Navathe, **Fundamentals of Database Systems**, Addison Wesley.

M.J. Flok, B. Zoellick, G. Riccardi, **File Structure: An Object Oriented Approach with C++**, Addison Wesley, 1998.

R. Ramakrishanan, J. Gehrke, **Database Management Systems**, McGraw-Hill.

A. Silberschatz, H. Lorth, S. Sudarshan, **Database System Concepts**, 3rd Edition, McGraw Hill.

502 – COMPUTER NETWORKS

Basic concepts: Components of data communication, distributed processing, standards and organizations. Line configuration, topology, transmission mode, categories of networks.

OSI and TCP/IP Models: Layers and their functions, comparison of models.

Digital transmission: Interfaces and modems: DTE-DCE interface, modems, cable modem.

Transmission media: Guided and unguided, attenuation, distortion, noise, throughput, propagation speed and time, wavelength, Shannon capacity, comparison of media.

Introduction to signals: Analogue and digital signals, Periodic and aperiodic signals, time and frequency domains, composite signals.

Encoding and modulation: Digital to digital conversion, analogue to digital conversion, analogue to analogue conversion.

Multiplexing, error detection and correction: Many to one, one to many, WDM, TDM, FDM, telephone system, DSL, CDMA, FTTC.

Datalink control protocols: Line discipline, flow control, error control, synchronous and asynchronous protocols, character and bit oriented protocols, Link access procedures.

LANs and MANs: IEEE802, Ethernet, Token Bus, token ring, FDDI, SMDS, comparisons.

Switching: Circuit switching, packet switching, message switching.

Point to point protocols: Transmission states, PPP layers, LCP, authentication, NCP.

ISDN: Services, historical outline, subscribers' access, ISDN layers, broadband ISDN.

Overview of Technologies: X.25, ATM and SONET/SDH – layers, design goals, architecture, services and applications.

Devices: Repeaters, bridges, gateways, routers, routing algorithms.

Transport and upper layers in OSI Model: Transport layers functions, connection management, Functions of Session layer, Presentation layer, Application Layer.

TCP/IP protocols: IP, Addressing, subnetting, ARP, IARP, ICMP, IGMP, UDP, TCP, Client-server model, BOOTP, DHCP, DNS, Telnet, FTP, TFTP, SMTP, SNMP, HTTP, WWW.

BOOKS RECOMMENDED:

B.A. Forouzan: **Data Communication and Networking**, 2nd Edition, Tata McGraw Hill.

A.S. Tanenbaum, **Computer Networks**, Prentice Hall of India.

J.F. Hayes, **Modelling and Analysis of Computer Communication Networks**, Plenum Press.

D. Bertsekas, R. Gallager, **Data Networks**, 2nd edition, Prentice Hall of India.

D.E. Comer, **Internetworking with TCP/IP, Vol. I**, Prentice Hall of India.

W. Stalling, **Data & Computer Communication**, Maxwell Macmillan International Edition.

503 – MICROPROCESSORS

Microprocessor architecture: Internal architecture, system bus architecture, memory and I/O interfaces.

Microprocessor programming: Register Organization, instruction formats, assembly language programming.

Interfacing: Memory address decoding, cache memory and cache controllers, I/O interface, keyboard, display, timer, interrupt controller, DMA controller, video controllers, communication interfaces.

BOOKS RECOMMENDED:

B. Brey, Microprocessor Programming and Interfacing, Prentice Hall of India.

504 – NUMERICAL ANALYSIS AND SCIENTIFIC COMPUTING

Errors: definitions, sources, examples, propagation of errors, summation.

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

Interpolation: Polynomial interpolation, Newton- Gregory Forward differences interpolation; Newton- Gregory Backward differences interpolation; Central differences interpolation, Stirling's and Bessel's central differences formulae, Derivatives of Tabulated functions; Lagrange's interpolation formula; Newton's divided differences interpolation formula; inverse interpolation- Lagrange's method and method of successive approximations, Cubic Splines.

Matrices and Linear System of equations: LU decomposition method for solving systems of equations and computing matrix inverse, Symmetric positive definite matrices and least square approximation, Matrix eigenvalues as a polynomial equation problem; Interactive algorithms for linear equations; Gauss-elimination and Gauss-Jordan methods; Gauss-seidel iterative method; Successive over-relaxation method

Curve fitting B-spline and approximation; Fitting linear and non-linear curves, Weighted least square approximation, method of least squares for continuous functions

Numerical differentiation and integration; Numerical differentiation and errors in Numerical differentiation.

Numerical integration; Newton-cotes formulae, Trapezoidal rule, Simpson's 1/3rd and 3/8th rule, Gaussian integration.

Numerical solutions of ordinary differential equations; Picard's method; Taylor's series method; Euler's method; Modified Euler's method; Runge-kutta methods; second and fourth order RK method; Predictor-corrector's method, Milne-Simpson's method, Adams-Bashford method, Adams-Moulton method.

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

BOOKS RECOMMENDED:

K. Atkinson, Elementary Numerical Analysis, John Wiley.

C.F. Gerald, P.O. Wheatley, Applied Numerical Analysis, Addison-Wesley.

M.K. Jain, S.R.K. Iyenger, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International.

S.S. sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India.

E. Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley

T.J. Akai, Applied Numerical Methods, John Wiley.

505 – ECONOMICS

Economic issues and concepts: concept of scarcity, production possibility frontier, market economy, and the modern mixed economy.

Market economy: concepts of demand and supply, price determination, elasticity concept, simple applications of price theory.

Consumer behaviour: utility theory of demand, consumer's consumer surplus; indifference theory approach.

Consumer's equilibrium , price effect , income effect and substitution effect.

Producer behavior : production , costs and profits , law of diminishing returns, costs in the long run, isoquants and factor substitution, profit maximization.

Market structure : the notion of perfect competition , short and long run equilibria of a firm under perfect competition and monopoly , introduction to notions of oligopoly , public policy towards monopoly, government failure.

Macroeconomic issue and measurement concepts of GDP, GNP and NDP basic model of determination of GDP, GDP in an open economy with government , GDP and the price level in the short run and in the long run.

Macro –policy in monetary economy , money and monetary forces and aggregate demand.

RECOMMENDED READINGS:

R.G.LIPSEY & K.A. CRYSTAL , **PRINCIPLES OF ECONOMICS , 9 TH EDITION** , OXFORD UNIVERSITY PRESS.

H.G.MANKIW , **PRINCIPLES OF ECONOMICS** , DRYDEN PRESS.

P.A.SAMUELSON AND W.D.NORDHAUS, **ECONOMICS** , 16TH EDITION , TATA MCGRAW HILL.

506-PRACTICAL: LAB BASED ON 503

507- PRACTICAL: LAB BASED ON 501, 502

PART I

All programs should be carried out in assembler available with the PC

1. 32 bit Binary Arithmetic (Addition, subtraction, division, Multiplication of 2 binary numbers, each 32 bit).
2. 8 digits BCD Arithmetic (Addition and Subtraction of BCD numbers each 8 digits).
3. Write an assembly language linear search, program to search a list.
4. Write an assembly language binary search, program to search a sorted list.
5. Write an assembly language program to sort a list.
6. Convert an ASCII coded decimal number into its binary equivalent.
7. Convert a binary number to ASCII character string
(Input & Output should be through external interface)

PART II

Interfacing experiments

- (i) DAC
- (ii) ADC
- (iii) Stepper motor controller
- (iv) Lift Simulator

Practical Examination will consist of one exercise from each part

601-THEORY OF COMPUTATION

Languages: Alphabet, string, language, basic operations on language; union intersection concatenation, Kleene star.

Regular languages: regular expressions, NFA,DFA, pumping theorem, design of Lex.
Context free languages: context free grammars, deterministic and non-deterministic push-down automata, pumping theorems, properties of context free languages.

Models of computation: RAM, Turing machine, universal Turing machine, language acceptability, decidability; unsolvability problems.

BOOKS RECOMMENDED;

P.Lewis, **Elements of the Theory of Computation**, Prentice Hall of India.

602-NETWORKS PROGRAMMING AND ADMINISTRATION

Network basics: processes, pipes, and signals.

Introduction to Berkeley sockets, TCP protocol, IO socket API and simple TCP applications, Developing clients for common services, FTP and Telnet, SMTP and sending mails, POP, IMAP, processing mail, HTTP and web.

LAN administration using Unix/Linux and Windows NT.

BOOKS RECOMMENDED:

R. Stevens, **Unix Network Programming**, Prentice Hall of India.

Linux Kernel Internals.

603-COMPUTER GRAPHICS

Introduction: Image Processing as Picture Analysis, Advantage of interactive graphics, representative uses of computer graphics, classification of applications, development of hardware and software for computer graphics, conceptual framework for interactive graphics.

Graphics Hardware: raster-scan display systems, Input Devices.

Raster Graphics: scan converting lines, scan converting circles, scan converting ellipses. Clipping: Sutherland-Cohen algorithm, Cyrus-Back algorithm.

Geometrical Transformations: 2D Transformations, Homogeneous Coordinates and matrix Representation of 2D Transformations, Composition of 2D Transformations, The Window-to-Viewport Transformations, Efficiency, Matrix Representations of 3D Transformations, Transformations as a change in coordinate system.

Viewing in 3D: Projections, Specifying an Arbitrary 3D View, Examples of 3D Viewing, The Mathematics of planar Geometric Projections, Implementing Planar Geometric Projections, coordinate systems.

Geometric Modelling: Representing curves & Surfaces: Polygon Meshes, Parametric Cubic Curves, Quadric Surfaces, Solid Modelling: Representing Solids, Regularized Boolean Set Operations, Primitive Instancing, Sweep Representations, Boundary Representations.

Hidden surfaces elimination: Z-buffer, list priority, area subdivision.

Shading: Illumination Models, shading Models for Polygons, Surface Detail, Shadows.

Animation: Conventional and Computer-Assisted Animation, animation languages, Methods of controlling Animation, Basic Rules of Animation.

BOOKS RECOMMENDED;

J.D.Foley, A.Van Dan, Feiner, Hughes **Computer Graphics Principles & Practice.**

D.Harm, Baker: **Computer Graphics**, Prentice Hall of India.

D.F.Rogers: **Procedural Elements for Computer Graphics**, McGraw Hill.

D.F.Rogers, Adams: **Mathematical Elements for Computer Graphics**, McGraw Hill.

E Angel, **Interactive Computer Graphic: a top-down approach with OpenGL**, Addison-Wesley.

604-OPERATIONAL RESEARCH TECHNIQUES

Introduction to Operational Research: Phases of an Operational Research study, various types of operational research models.

Linear Programming Models: Graphical solution, Simplex method, Charnes M-technique, Two-phase method, Revised simplex method, Duality and sensitivity in linear programming.

Transportation and Assignment problems.

Game Theory: Rectangular games, Methods of Solution(Graphical and algebraic techniques), solution by Linear Programming technique.

Concepts of PERT and CPM.

Basic concepts of Dynamic Programming, Bellman's Principle of Optimality and its applications.

Queuing Models: Basic structure of queuing models, Birth-Death queuing models and its steady state solution, M/M/1 and M/M/C models with infinite/finite waiting space.

Non-linear Programming: Wolf's Method, Kuhn-Tucker conditions.

BOOKS RECOMMENDED:

H.A.Taha, **Operations Research**, Sixth Edition, Macmillan.

R.L.Rardin, **Optimization in Operations Research**, Prentice Hall.

A.Racindran, D.T.Phillips, J.S.Solberg, Second edition, John Wiley.

605(I) MULTIMEDIA APPLICATIONS

Introduction to Multimedia Technology- Computers, communications and entertainment; Framework for multimedia systems; M/M devices; presentation devices and the user interface, M/M presentation and authoring.

Digital representation of sound and transmission; Brief survey of speech recognition and generation; Digital video and image compression; JPEG image compression standard; MPEG motion video compression; DVI technology; Time-based media representation and delivery.

M/M software environments; Limitations of workstation operating systems; M/M system OS support for continuous media application; Media stream protocol; M/M file systems and information representation; Data models for M/M and Hypermedia information.

Application of M/M intelligent M/M System.

Desktop VR; reality OS; Distributed virtual environment system; Virtual environment displays and orientation tracking; Visually coupled system requirements; Intelligent VR software systems.

Application of environments in various fields, such as medical, entertainment, manufacturing, business, education.

BOOKS RECOMMENDED;

T.Vaughan; **Multimedia; Making it work**, Tata McGraw Hill Publishing Company Limited, New Delhi.

S.J.Gibbs; **Multimedia Programming: objects, environments & Frameworks**, Dionysios C. Tschritzis, University of Geneva, GMD, Bonn.

J.Jeffcoate, **Multimedia in Practice: Technology & Applications**, Prentice Hall of India.

605(II) ARTIFICIAL INTELLIGENCE

Introduction to Artificial Intelligence: Simulation of so-called Intelligence behaviour, in different areas; Problem solving: games, natural language question answering, visual perception, learning; Aim-oriented (heuristic) algorithms versus solution-guaranteed algorithms.

Understanding Natural Languages: Parsing techniques, context-free and transformational grammars, transition nets, augmented transition nets, Fillmore's grammars, Shank's conceptual dependency, grammar-free analysers, sentence generation, translation.

Knowledge Representation: First-order predicate calculus: Horn's clauses; The language PROLOG; Semantic nets; partitioned nets; Minsky's frames; cases-grammar theory, Production rules; knowledge base, the inference system, forward and backward deduction.

Expert System: Existing systems (DENDRAL, MYCIN), Domain exploration; Meta-knowledge, expertise transfer, self-explaining systems.

Pattern Recognition Structured Descriptions: Symbolic description, machine perception, line finding, interpretation, semantics and models, object identification, speech recognition.

The language LISP is to be covered in this course.

BOOKS RECOMMENDED:

R.Duda, P.Hart, **Pattern Recognition and Scene Analysis**, Wiley.

E.A.Feigenbaum, J.Feldman; **Computers and Thoughts**, McGraw-Hill.

E.B.Hunt, **Artificial Intelligence**, Academic Press.

M.Minsky, **Semantic Information Processing**, MIT Press.

N.J. Jilsson, **Problem Solving Methods in Artificial Intelligence**, McGraw-Hill.

B.Somank, K.Colby, **Computer Models of Thought and Language**, Freeman.

J.Weizenbaum, **Computer Power and Human Reason**, Freeman.

J.Lloyd, **Foundation of Logic Programming**, Springer-Verlag.

606 PRACTICAL: SOFTWARE LAB BASED ON 602,603,605

607 PROJECT WORK-REPORT