B.Sc. (H) Computer Science
3-YEAR FULL TIME PROGRAMME

RULES, REGULATIONS AND COURSES CONTENTS

DEPARTMENT OF COMPUTER SCIENCE
FACULTY OF MATHEMATICAL SCIENCES
UNIVERSITY OF DELHI
DELHI – 110007
### Semester Systems at the undergraduate level

**Course of Study: B.Sc.(H) Computer Science**

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**Electives:**

1. Software Testing
2. Artificial Intelligence
3. Network Programming and Administration
4. Data Mining
5. Combinatorial Optimizations
### Semester I

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Syllabi of MAPT 101, MAPT 202, MAPT 404, MAPT 505 and ENPT 201 to be taken from B.Sc. (Physical Sciences) and ELHT 301 to be taken from B.Sc.(H) Electronics.


1) Duration of Theory Exam: 3 hrs.

   Duration of Practical Exam: 6hrs. for 4 credit papers

   4hrs. for 2 credit papers

   Internal Assessment as per University rules.

2) Infrastructure required: Networked lab with Internet facility on at least 20 nodes. LCD projection systems should be provided in class room/lab.

3) Batch size for practical exams: Every lab session should be supervised by a teacher and the batch size should be restricted to 20. For a class of more than 20 students, additional groups should be formed for every 20 students.
CSHT-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 Constructs basic data types; constants and variables, arithmetic and logical expressions, assignment; input-output interface; control structures in conditionals, loops; procedural abstractions; strings and arrays; command line arguments; file handling; error handling.

Introduction to the object-oriented programming paradigms; data abstraction and encapsulation — objects and classes; inheritance; polymorphism;

Recommended Books:


2. R.G. Dromey, How to solve it by Computer, Pearson Education 1982


CSHT 102 Discrete Structures

Introduction: Sets - finite and Infinite sets, uncountably Infinite Sets; functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion.
Growth of Functions: Asymptotic Notations, Summation formulas and properties, Bounding Summations, approximation by Integrals

Recurrences: Recurrence Relations, generating functions, Linear Recurrence Relations with constant coefficients and their solution, Substitution Method, Recurrence Trees, Master Theorem

Graph Theory: Basic Terminology, Models and Types, multigraphs and weighted graphs, Graph Representation, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Trees, Basic Terminology and properties of Trees, Introduction to Spanning Trees

Prepositional Logic: Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory

Recommended Books:


ELHT 301 Digital Electronics

Number System and Codes: Decimal, Binary, Hexadecimal, Octal, BCD, Conversions, Complements (1’s and 2’s), Signed and Unsigned numbers, Addition and Subtraction, Multiplication Gray and Hamming Codes

Logic Gates and Boolean Algebra: Truth Tables, OR, AND, NOT, EXOR, Universal (NOR and NAND) Gates, Boolean Theorems, DeMorgan’s Theorems.

Combinational Logic Analysis and Design: Standard representation of logic functions (SOP and POS), Minimization Techniques(Karnaugh Map Method: 4,5 variables). Multiplexers(2:1,4:1) and Demultiplexers (1:2,4:1), Adder (half and full) and their use as substractor, Encoder (8-line-to-3-line) and Decoder (3-line-to-8-line) , Code Converters( Binary to BCD and vice versa).
Sequential logic design: Latch, Flip flop, S-R FF, J-K FF, T and D type FFs, Clocked FFs, Registers, Counters (ripple, synchronous and asynchronous, ring, modulus), State Table, State Diagrams and Sequential Machines.

A/D and D/A Converters: Successive Approximation ADC, R/2R Ladder DAC.

Memories: General Memory Operation, ROM, RAM (Static and Dynamic), PROM, EPROM, EEPROM, EAROM.

Suggested Books:


CSHT 203 Data Structures

Introduction: Abstract Data Types, Arrays- Single and Multidimensional arrays, Sparse matrices.

Linear structures: Stacks, Queues (linear as well as circular implementation), singly-, doubly-, and circularly- linked lists -- Operations and applications.

Recursion: Problem solving using recursion, run time stack in recursion, tail recursion, and its removal.

Searching techniques: Linear search, Binary search and their efficiency, Skip Lists, Hashing.

Tree Structures: Trees, Binary Trees, Complete Binary trees and almost complete Binary trees, binary search trees, Insertion, Deletion, Tree traversal algorithms, Threaded trees (recursive as well as Non recursive), applications of trees. Multiway trees – B-Trees and introduction to B+ Trees.

Recommended Books:


**CSHT 204 Computer System Architecture**

**Basic Computer Organization and Design:** Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt, Interconnection Structures, Bus Interconnection design of basic computer.

**Central Processing Unit:** Register organization, arithmetic and logical micro-operations, stack organization, micro programmed control. Instruction formats, addressing modes, instruction codes, machine language, assembly language, input output programming, RISC, CISC architectures, pipelining and parallel architecture.

**Memory Organization:** Cache memory, Associative memory, mapping.


**Recommended Books:**


**CSHT 305 Design and Analysis of Algorithms**

**Introduction:** Basic Design and Analysis techniques of Algorithms, Correctness of Algorithm.

**Algorithm Design Techniques:** Iterative techniques, Divide and Conquer, Dynamic Programming, Greedy Algorithms.

**Sorting and Searching Techniques:** Elementary sorting techniques – Bubble Sort, Insertion Sort, Merge Sort, Advanced Sorting techniques - Heap Sort, Quick Sort, Sorting in Linear Time - Bucket Sort, Radix Sort and Count Sort, Searching Techniques, Medians & Order Statistics, complexity analysis;
Lower Bounding Techniques: Decision Trees

Balanced Trees - Red-Black Trees

Advanced Analysis Technique: Amortized analysis

Graphs: Graph Algorithms – Breadth First Search, Depth First Search and its Applications, Minimum Spanning Trees.

String Processing: String Matching, KMP Technique

Recommended Books:


CSHT 306 Systems Programming


Assemblers: Example of an assembly language, programming in assembly language, assembler features and functions, Load and Go assembler, One-pass and two pass assemblers, Macros and macro processors.

Compilers: Compiler functions and features, phases of compilation, optimization.

Loaders and Linkers: Basic Loader functions and features, Relocation, Program Linking, static and dynamic linking.

Recommended Books:

1. A. J. Dos Reis, Assembly language and computer architecture using C++ and JAVA, Course Technology, 2004


CSHT 307 Database Systems
Introduction: Characteristics of database approach, data models, database system architecture and data independence.

Entity Relationship(ER) Modeling: Entity types, relationships, constraints.

Relation data model: Relational model concepts, relational constraints, relational algebra, SQL queries, programming using embedded SQL.

Database design: mapping ER model to relational database, functional dependencies, normal forms.

Transaction Processing: ACID properties, concurrency control, recovery.

Web based databases: XML documents and databases.

Books Recommended:


CSHT 408 Operating Systems

Introduction: Basic OS functions, resource abstraction, types of operating systems – multiprogramming systems, batch systems, time sharing systems; operating systems for personal computers & workstations, process control & real time systems.

Operating System Organization: processor and user modes, kernels, system calls and system programs.

Process Management: System view of the process and resources, process abstraction, process hierarchy, threads, threading issues, thread libraries; Process Scheduling, non-pre-emptive and pre-emptive scheduling algorithms; concurrent and processes, critical section, semaphores, methods for inter-process communication; deadlocks.

Memory Management: Physical and virtual address space; memory allocation strategies -fixed and variable partitions, paging, segmentation, virtual memory

File and I/O Management: Directory structure, file operations, file allocation methods, device management.

Protection and Security: Policy mechanism, authentication, internal access authorization.
Recommended Books:


CSHT 409 Data Communication and Computer Networks

Introduction to Computer Networks: Network definition; network topologies; network classifications; network protocol; layered network architecture; overview of OSI reference model; overview of TCP/IP protocol suite.

Data Communication Fundamentals and Techniques: Analog and digital signal; data-rate limits; digital to digital line encoding schemes; pulse code modulation; parallel and serial transmission; digital to analog modulation-; multiplexing techniques- FDM, TDM; transmission media.

Networks Switching Techniques and Access mechanisms: Circuit switching; packet switching- connectionless datagram switching, connection-oriented virtual circuit switching; dial-up modems; digital subscriber line; cable TV for data transfer.

Data Link Layer Functions and Protocol: Error detection and error correction techniques; data-link control- framing and flow control; error recovery protocols- stop and wait ARQ, go-back-n ARQ; Point to Point Protocol on Internet.

Multiple Access Protocol and Networks: CSMA/CD protocols; Ethernet LANS; connecting LAN and back-bone networks- repeaters, hubs, switches, bridges, router and gateways;

Networks Layer Functions and Protocols: routing; routing algorithms; network layer protocol of Internet- IP protocol, Internet control protocols.

Transport Layer Functions and Protocols: Transport services- error and flow control, Connection establishment and release- three way handshake;

Overview of Application layer protocol: Overview of DNS protocol; overview of WWW & HTTP protocol.

Recommended Books:


CSHT 410 Software Engineering


**Software Project Management:** Estimation in Project Planning Process, Project Scheduling.

**Risk Management:** Software Risks, Risk Identification, Risk Projection and Risk Refinement, RMMM Plan.


**Recommended Books:**


CSHT 511 Theory of Computation

Languages: Alphabets, string, language, Basic Operations on language, Concatenation, Kleene Star

Finite Automata and Regular Languages: Regular Expressions, Transition Graphs, Deterministics and non-deterministic finite automata, NFA to DFA Conversion, Regular languages and their relationship with finite automata, Pumping lemma and closure properties of regular languages.

Context free languages: Context free grammars, parse trees, ambiguities in grammars and languages, Pushdown automata (Deterministic and Non-deterministic), Pumping Lemma, Properties of context free languages, normal forms.

Turing Machines and Models of Computations: RAM, Turing Machine as a model of computation, Universal Turing Machine, Language acceptability, decidability, halting problem, Recursively enumerable and recursive languages, unsolvability problems.

Recommended Books:


CSHT 512 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.
Recommended Books:


CSHT 513 Internet Technologies

JavaScript: Data types, operators, functions, control structures, events and event handling.

Java: Use of Objects, Array and ArrayList class, Designing classes, Inheritance, Input/Output, Exception Handling.


JSP: Introduction to JavaServer Pages, HTTP and Servlet Basics, The Problem with Servlets, The Anatomy of a JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP Environment, Implicit JSP Objects, Conditional Processing, Displaying Values, Using an expression to Set an Attribute, Declaring Variables and Methods, Error Handling and Debugging, Sharing Data Between JSP Pages, Requests, and Users, Database Access.

Java Beans: Java Beans Fundamentals, JAR files, Introspection, Developing a simple Bean, Connecting to DB

Recommended Books:


CSHT 614 Computer Graphics

Introduction to Graphics systems, Basic elements of Computer graphics, Applications of computer graphics.
**Graphics Hardware:** Architecture of Raster and Random scan display devices, input/output devices.

**Fundamental Techniques in Graphics:** Raster scan line, circle and ellipse drawing, thick primitives, Polygon filling, line and polygon clipping algorithms, 2D and 3D Geometric Transformations, 2D and 3D Viewing Transformations (Projections- Parallel and Perspective), Vanishing points.

**Geometric Modeling:** Representing curves & Surfaces.

**Visible Surface determination:** Hidden surface elimination.

**Surface rendering:** Illumination and shading models.

Basic color models and Computer Animation.

**Books Recommended:**


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**CSHT 615 Information Security**


**Cryptography:** Substitution ciphers, Transpositions Cipher, Confusion, diffusion, Symmetric, Asymmetric Encryption. DES Modes of DES.,Uses of Encryption.,Hash function,key exchange, digital signatures,Digital Certificates.

**Program Security:** Secure programs,Non malicious Program errors, Malicious codes virus,trap doors,salami attacks, covert channels,Control against program

**Threats.Protection in OS:** Memory and Address Protection, Access control, File Protection, User Authentication.

**Database Security:** Requirements, Reliability, Integrity, Sensitive data, Inference, Multilevel Security.

**Security in Networks:** Threats in Networks s Networks security Controls, firewalls, Intusion detection systems, Secure e-mails

**Administrating Security:** Security Planning, Risk Analysis, Organisational Security Policy, Physical Security. Ethical issues in Security:
Protecting Programs and data. Information and law.

**Recommended Books:**


**CSHT 616 (i) Software Testing**

**Fundamentals of testing:** Need for testing, General testing principles, Fundamental test process, The psychology of testing

**Testing throughout the software life cycle:** Software development models, Test levels (Unit, Integration, System Acceptance testing), Test types (functional, non-functional, regression testing), Maintenance testing

**Static techniques:** Static techniques and the test process, Review process (types of review, roles and responsibilities),

**Test design techniques:** The Test Development Process, Categories of test design techniques, Specification-based or black-box techniques (Equivalence partitioning, Boundary value analysis, Decision table testing, State transition testing, Use case testing), Structure-based or white-box techniques (Statement testing and coverage, Decision testing and coverage, other structure-based techniques), Experience-based techniques, Choosing test techniques

**Test management:** Test organization (test leader, tester), Test planning and estimation (Test planning, Test planning activities, Exit criteria, Test estimation, Test approaches), Test progress monitoring and control (Test progress monitoring, test reporting, test control), Configuration management, Risk and testing (Project risks, Product risks), Incident management

**Web Application Testing Foundation:** Basic test planning and testing methods for web applications, Introduction to gray-box testing and its application to testing web applications, Outline knowledge, methods and tools for testing web applications, Introduction to web testing tools and sources, Introduction to research tools on the Net.

**Tool support for testing:** Types of test tool, Test tool classification, Tool support for management of testing and tests, static testing, test specification, test execution and logging, performance and monitoring, specific application areas, using other tools, Effective use of tools: potential benefits and risks

**Recommended Books:**

2. Louise Tamres, “Software Testing”, Pearson Education
CSHT 616 (ii) Artificial Intelligence

Introduction:

Introduction to Artificial Intelligence, Background and Applications, Turing Test and Rational Agent approaches to AI, Introduction to Intelligent Agents, their structure, behavior and environment.

Problem Solving and Searching Techniques:


Knowledge Representation:


Programming in Logic (PROLOG).

Dealing with Uncertainty and Inconsistencies:

Truth Maintenance System, Default Reasoning, Probabilistic Reasoning, Bayesian Probabilistic Inference, Possible World Representations.

Understanding Natural Languages: Parsing Techniques, Context-Free and Transformational Grammars, Recursive and Augmented Transition Nets.

BOOKS RECOMMENDED:

CSHT 616 (iii) Network Programming and Administration

Transport Layer Protocols: TCP, UDP, SCTP protocol. Socket Programming: Socket Introduction; TCP Sockets; TCP Client/Server Example; signal handling; I/O multiplexing using sockets; Socket Options; UDP Sockets; UDP client server example; Address lookup using sockets. Network Applications: Remote logging; Email; WWW and HTTP. LAN administration: Linux and TCP/IP networking: Network Management and Debugging.

Books recommended:

2. B. A. Forouzan; Data Communications and Networking, Fourth edition, THM Publishing Company Ltd.
4. R. Stevens, Unix Network Programming, PHI 2nd Edition

CSHT 616 (iv) Data Mining

Overview: Predictive and descriptive data mining techniques, supervised and unsupervised learning techniques, process of knowledge discovery in databases, pre-processing methods

Data Mining Techniques: Association Rule Mining, classification and regression techniques, clustering, Scalability and data management issues in data mining algorithms, measures of interestingness

Books Recommended:

1. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education.
3. Introduction to Data Mining with Case Studies, G.K. Gupta, PHI,2006.
CSHT 616 (v) Combinatorial Optimization

**Introduction:** Optimization problems, neighborhoods, local and global optima, convex sets and functions, simplex method, degeneracy; duality and dual algorithm, computational considerations for the simplex and dual simplex algorithms-Dantzig-Wolfe algorithms.

**Integer Linear Programming:** Cutting plane algorithms, branch and bound technique.

**Graph Algorithms:** Primal-Dual algorithm and its application to shortest path, Math-flow problems Dijkstra’s algorithm, Max-flow problem, matching problem, bipartite matching algorithm, non-bipartite matching algorithms.

**Books recommended:**

2. K. Lange, Optimization, Springer, 2004