

HSST Computer Science Syllabus 2022

HSST 2022 Computer Science Syllabus Details:

Discrete Structures

Sets, Relations, Functions. Pigeonhole Principle, Inclusion-Exclusion principle, Equivalence and Partial Orderings. Elementary Counting Techniques.

Computability: Models of computation – Finite Automata, Pushdown Automata, Non-determinism and NFA, DPDA and PDA s and Languages accepted by these structures. Grammars – types of grammars – type 0 , type 1, type 2 and type 3. The relationship between types of grammars, Languages, Non-computability, Non-computable problems.

Groups: Finite fields and Error correcting / detecting codes.

Propositional logic. Predicate logic. Well-formed formulae (WFF). Satisfiability and Tautology.

Computer Arithmetic

Logic families: TTL, ECL and C-MOS gates. Boolean algebra and Minimization of Boolean functions, Flip-flops- types, race condition and comparison, Design of combinational and sequential circuits

Representation of Integers: Octal. Hex. Decimal and Binary 2's complement and 1's complement arithmetic. Floating point representation.

Programming in C and C++

Programming in C: Elements of C – Tokens, identifiers, data types in C, Control constructs in C, Sequence, selection and iteration. Structured data types in C – arrays, structs, unions, strings and pointers.

Object-Oriented programming Concepts: Class – object, instantiation, Inheritance -polymorphism and overloading, aggregation, abstract classes, generalization as extension and restriction. Object-oriented design. Multiple inheritances

C++ – programming: Elements of C++ – Tokens, Identifiers, Variables and constants. Data types, Operators. Control statements, Functions, parameter passing, Class and objects, Constructors and destructors, Overloading, Inheritance, Templates, Exception handling.

Relational Database Design and Query Languages

E-R diagrams, Transformation of E-R models to relational design, Normalization – 1NF, 2NF, 3NF, BCNF and 4NF.

SQL: Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (CDL) Commands. Database objects like- Views, indexes, sequences, synonyms, data dictionary, Embedded SQL, QBE

Query Processing and Optimization, Centralized and Distributed Database, Security, Concurrency and Recovery in Centralized and Distributed Database Systems, Object-Oriented Database Management Systems – Concepts, Composite objects, Integration with RDBMS applications.

Data Structures and Algorithms

Data, Information. Definition of data structure, Arrays, stacks, queues, linked lists, trees, graphs, priority queues and heaps.

File Structures: Fields, records and files. Sequential, direct, index-sequential and relative files.

Hashing, inverted list and multi-lists, B-trees and B+ trees.

Graphs: Definition, walks, paths, connected graphs, regular and bipartite graphs, cycles and circuits. Tree and rooted tree, Spanning trees, Eccentricity of a vertex radius and diameter of a graph, Hamiltonian and Eulerian graphs. Planar graphs.

Sorting and Searching Algorithms, Analysis of Algorithms, Interpolation and Binary Search.

Asymptotic notations – big oh. Omega and theta. Average case analysis of simple programs like the finding of a maximum of n elements. Recursion. Quicksort.

Design of Algorithms (Divide and Conquer. Greedy method. Dynamic programming.

Backtracking. Branch and Bound).

Data Communication and Computer Networks

Data Communication: Analog and Digital transmission. Asynchronous and Synchronous Transmission. Transmission media. Multiplexing and Concentration, Switching techniques.

Polling. Channel capacity. Transmission media – twisted pair, coaxial cables, fibre-optic Cables, wireless transmission- radio, microwave and infrared waves. Lightwave Transmission.

Telephones – local loop, trunks, multiplexing, switching, narrowband ISDN, Broadband ISDN.

ATM, High-speed LANs. Cellular Radio, Communication satellites-geosynchronous and low-orbit.

Reference Models: The OSI model, TCP/IP model.

Topologies, Networking Devices. Protocols for – (i) Data link layer (ii) Network layer, and (iii) The transport layer, TCP/IP protocols, Networks security and Network administration.

Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN).

Wireless Networks, InterNetworks.

Internetworking: Switch/Hub. Bridge. Router. Gateways. Concentrated virtual circuits.

Tunnelling, Fragmentation. Firewalls.

Routing: Virtual circuits and datagrams. Routing Algorithms. Congestion control.

Network Security: Cryptography – public key, secret key, Domain Name System (DNS) – Electronic Mail and World Wide Web (WWW). The DNS, Resource Records. Name servers.

E-mail architecture and E-mail Servers.

System Software and Compilers

Assembly language fundamentals (8085 and 8088 based assembly language programming).

Assemblers – 2-pass and single-pass. Macros and macro processors.

Loading, linking, relocation, program relocatability. Linkage editing.

Text editors, Programming Environments. Debuggers and program generators.

Compilation and Interpretation. Bootstrapping. Phases of compilation. Lexical analysis. LEX.

Context-free grammars. Parsing and parse trees. Representation of parse trees and rightmost and leftmost derivations, Bottom-up parsers – shift-reduce. operator precedence and LR. YACC.

Top-down parsers – left recursion and its removal. Recursive descent parser. Predictive parser.

Intermediate codes – Quadruples, Triples. Indirect Triples. Intermediate code generation, Code generation, Code optimization.

Operating Systems

Main functions of operating systems. Multiprogramming, multiprocessing and multitasking.

Memory management; Virtual memory, paging, fragmentation.

Concurrent processing: Mutual exclusion. Critical regions, lock and unlock.

Scheduling: CPU scheduling. I/O Scheduling. Resource scheduling. Deadlock and scheduling algorithms. Banker's algorithm for deadlock handling.

The Unix system: File system, process management. Bourne shell, shell variables, command line programming.

Systems Calls: Create, open, close, read, write. lseek, link, unlink, stat, fstat, umask, chmod, exec, fork, wait, system.

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Software Engineering

System Development Life Cycle (SDLC): Steps, Water fall model. Prototypes, Spiral model.

Software Metrics; Software Project Management.

Software Design: System design. Detailed design. Function oriented design, object-oriented design, user interface design. Design level metrics.

Coding and Testing: Testing level metrics. Software quality and reliability. Clean room approach, software engineering

Computer Graphics

Display systems. Input devices, 2D Geometry – Algorithms for drawing primitives, clipping and windowing, windows, view ports, Graphic operations for transformations, 3D Graphics.

Animation, Graphics standard. Applications.

Storage Devices, Input Tools. Authoring Tools, Application, Files.

Programming Language Theory

Programming language concepts, paradigms, models.

Data. Data types, Operators, Expressions. Assignment. Flow of Control – Control structures, I/O structures. I/O statements, User-Defined and built-in functions. Parameter passing.

Principles, classes, inheritance, class hierarchies, polymorphism, dynamic binding, reference semantics and their implementation.

Principles, functions, lists, types and polymorphism, higher order functions, lazy evaluation, equations and pattern matching.

Principles, horn clauses and their execution, logical variables, relations, data structures, controlling the search order, program development in Prolog, implementation of Prolog, example programs in Prolog.

Current Trends and Technologies

The topics of current interest in Computer Science and Computer Applications shall be covered.

The experts shall use their judgment from time to time to include the topics of popular interest which are expected to be known by an ardent follower of the field. Currently, they include:

Parallel computing– Parallel virtual Machine (PVM) and message passing interface (MPI) libraries and calls. Advanced architectures. Today's fastest computers

Mobile Computing- Mobile connectivity – Cells. Framework, wireless delivery technology and switching methods, mobile information access devices, mobile data internetworking standards, cellular data communication protocols, mobile computing applications. Mobile databases – protocols, scope, tools and technology.

E-Technologies- Electronic Commerce: Framework, Media convergence of Applications, Consumer Applications, Organisation applications.

Electronic Payment Systems: Digital Token, Smart Cards, Credit Cards. Risks in Electronic Payment System, Designing Electronic Payment Systems.

Electronic Data Interchange (EDI): Concepts, Applications, (Legal, Security and Privacy) issues. EDI and Electronic Commerce. Standardisation and EDI. EDI Software Implementation. EDI Envelope for Message Transport, internet-based EDI.

Data Warehousing: Data Warehouse environment, the architecture of a data warehouse methodology, analysis, design, construction, and administration.

Data Mining: Extracting models and patterns from large databases, data mining techniques, classification, regression, clustering, summarization, dependency modeling, link analysis, sequencing analysis, mining scientific and business data.

Principles of parallelism, coroutines, communication and execution, Parallel Virtual Machine (PVM), and Message Passing Interface (MPI) routines and calls. Parallel programs in PVM paradigm as well as MPI paradigm for simple problems like matrix multiplication.