

Computer Science

Syllabus for Higher Secondary Stage

(Class XI and XII)

विद्यया ऽ मृतमश्नुते



एन सी ई आर टी
NCERT

Department of Education in Science and Mathematics (DESM)

National Council of Educational Research and Training

Aurobindo Marg, New Delhi - 110 016

Syllabus of Computer Science

Higher Secondary Stage (Class XI and XII)

Rationale:

In the present education system of our country, specialised, discipline based courses are introduced at higher secondary stage. This stage is crucial and as well as challenging because of the transition from general to discipline-based curriculum and the pressure to perform better to get admission in a desired course. The National Curriculum Framework (NCF) 2005 recommends syllabus at this stage to have sufficient rigour and depth while being appropriate for comprehension of learners without being heavily loaded with contents at the same time.

Computer Science (CS) is offered as an optional subject at the higher secondary stage of school education. At this stage, students take up CS with the aim of pursuing a career in software development or related area after going through professional courses at higher levels. Courses offered in the name of Computer Science, Information and Communication Technology (ICT), Information Technology (IT) by various boards and schools up to secondary stage are often optional and focus largely on teaching office automation tools and other application software. Therefore, at higher secondary stage, there is a need to start from the basics so that learners who are going to study about computers for the first time are not left behind. Thrust is on making learners competent to meet the challenges of academic and professional courses after the higher secondary stage.

NCF 2005 advocates development of a comprehensive and coherent curriculum model covering the core elements of CS like the concepts of algorithms and iterative processes, problem-solving strategies, possibilities of computer usage, the role of computers in the modern world, and the societal issues that arise thereby.

This syllabus attempts to start with “how do computers work” and traverse the core areas of CS while covering the social context in which the technologies are used and their implications on security, privacy, ethics, values and our health. The primary focus is not just to train students to do programming or coding. Rather, the syllabus fosters the development of Computational Thinking and possibly more important, Problem Solving skills, in the learners. It reduces the importance of grasping programming language syntax and focuses on the need for developing algorithmic and

logical thinking skills. The syllabus has been developed based on the following broad areas which have been further classified into chapters:

Fundamentals of computers: Brief introduction to a computer system including functional components, memory, role and type of software. It includes data representation and covers the concepts of Boolean algebra. The idea is to create awareness about the emerging trends in IT and IT enabled applications and services.

Problem Solving, Algorithms and Data Structures: Principles of problem solving with their need and applications are covered. The concept of algorithmic thinking is the focus area here. The basic tenets of problem solving - formulating a problem, thinking for a solution, developing an algorithm, selection of a data structure, coding for the actual solution is covered with emphasis on problem solving with the help of examples. The core constructs of algorithms and their representation are given with examples and simulations for better understanding about algorithms and their efficiency.

Programming: The basic constructs of a structured programming approach that includes program structure, identifiers, variables, flow of control, lists and functions, files, exceptions and their handling are discussed. The aim is to empower learners to be confident of writing programs and small application projects.

Data Management: An introduction to Data and its purpose, its collection, and organization. Analyzing data through basic statistics and its interpretation are covered briefly. Concepts of database, relational data model and relational algebra are briefly introduced to make the learner aware of its importance and usage. Structured Query Language to define, manipulate and access data in a database is described using MySQL as an example.

Networking and Communication: The basic concept of networks, communication, their evolution and functioning are covered here. Various network devices and transmission media are discussed in addition to the introductory concepts of mobile networks. The concepts of network security, its need and different methods used to make a network secure are also included.

Societal Impact of IT: The focus here is on the challenges that come up with the expansion of the technology. Safety and security while traversing and communicating online, the importance of social values and ethics are highlighted. The rising issues

such as of cyber bullying, cyber crime and hacking are discussed to empower the learner to safeguard themselves and their peers. Issues like copyright, plagiarism, IPR, along with their ethical and legal aspects are explained. Environmental and health concerns of usage of digital devices are included to enable learners to make informed decisions while using technology.

After the completion of the course student will be able to:

- ★ identify the functional components of a computer system;
- ★ compare different number systems and convert from one system to other.
- ★ identify the emerging trends in the field of computer and information technology and elaborate how they influence modern society;
- ★ given a computational problem, solve it using problem solving steps;
- ★ develop an algorithm and represent it using a flowchart and pseudo-code;
- ★ distinguish between proprietary and open source software;
- ★ debug programs by identifying the cause of errors and correcting them;
- ★ write Python programs using appropriate data structures and control statements;
- ★ write Python programs on searching and sorting techniques;
- ★ recognise the importance of storing data for subsequent use;
- ★ create structured data using binary files and DBMS;
- ★ use SQL to define, manipulate and access data in a database;
- ★ identify the components of a computer network, its role in communication;
- ★ apply network security measures while using or creating a network;
- ★ exhibit responsibility while using digital resources and technologies;
- ★ enlist some of the preventive measures useful to safeguard against cyber crime;
- ★ recognise the impact of technology on health and wellbeing and understand importance of ergonomic aspects;
- ★ make efforts to prepare a project work on real life problem using Python.

Course Outline for Class XI

Total Periods 180 (including practical periods)

Chapter 1: Computer System 20 Periods

Introduction to computer and computing: evolution of computing devices, data and information, types of data, functional components of a computer system and their interconnections, I/O devices, data transfer through system bus.

Computer Memory: Units of memory, types of memory – primary and secondary; data deletion, its recovery and related security concerns.

Microprocessor: Evolution, features of microprocessor including memory size, word size, clock speed, introduction to microcontrollers.

Software: purpose and types – system and application software, operating system, language translators, device drivers, programming tools, generic and specific purpose software, classification of programming languages (high level language, machine language).

Operating System (OS): Need for operating system, brief introduction to functions of OS, user interface.

Chapter 2: Encoding Schemes and Number System 10 Periods

Encoding schemes: American Standard Code for Information Interchange (ASCII), UNICODE, Indian Script Code for Information Interchange (ISCII)

Number system: Decimal, Binary, Octal and Hexadecimal number system and converting a number from a number system to another, including its fractional part.

Chapter 3: Emerging Trends 10 Periods

Brief understanding of the following emerging trends:

Artificial Intelligence, Machine learning, Natural Language Processing, Immersive experience, Robotics, Big data and its characteristics, Internet of Things (IoT), Sensors, Smart cities, Cloud Computing and Cloud Services (SaaS, IaaS, PaaS); Grid Computing, Blockchain technology.

Chapter 4: Problem Solving

18 Periods

Introduction to Problem Solving: problem solving cycle - analyzing a problem, designing algorithm, implementation through coding, testing the solution

Algorithms : what is an algorithm, need of algorithm in problem solving, characteristics of algorithm, representation of algorithm using flowchart and pseudo-code

Programming: concept of a program, need for writing programs, process of conceptualizing a solution to a problem and moving from algorithm to programming.

Programming Constructs: Sequence, Selection and Iteration; Simulation (dry run) of program for better understanding of algorithm; Comparison and Analysis of Algorithms through simulations.

Decomposition: concept, need for decomposing a problem, examples of problem solving using decomposition.

Chapter 5: Getting started with Python

35 Periods

Basics of Python programming, working with Python interpreter in interactive mode and script mode, structure of a program, debugging-errors and exceptions, identifiers, keywords, constants, variables, types of operators, precedence of operators, data types, mutable and immutable data types, statements, expressions, evaluation and comments, input and output statements, data type conversion, debugging

Chapter 6 Flow of control

15 Periods

Control structures: Sequence, selection (decision) and repetition (iteration)

Selection: if, if-else, and nested if statement, indentation

Repetition: for, while, and nested loops, break, continue;

Chapter 7: Functions

20 Periods

Introduction to functions, need of functions

User defined functions: passing arguments to a function, returning values from functions, scope of variables,

Standard library: using built-in functions, importing modules-math, random, statistics, creating and importing user defined module

Chapter 8: Strings

10 Periods

Strings: initializing strings and accessing strings, string operations, built-in functions for string manipulation, string traversal, string as argument to function

Chapter 9: Lists

12 Periods

Lists: list operations - creating, initializing, traversing and manipulating lists, list methods and built-in functions, nested lists, list as argument to a function.

Chapter 10: Tuples and Dictionary

20 Periods

Tuples: Creating, initializing, accessing elements, tuple assignment, operations on tuples, tuple methods and built-in functions, nested tuples.

Dictionary: concept of key-value pair, mutability, creating, initializing, traversing, updating and deleting elements; dictionary methods and built-in functions.

Chapter 11: Societal Impacts

10 Periods

Digital footprint, Etiquettes for Net surfing and for communicating through social medias, data protection, Intellectual Property Rights (IPR) and their violation, plagiarism and copyrights, Free and Open Source Software (FOSS), Cyber crime and cyber laws, hacking, phishing, cyber bullying, Indian IT Act, preventing cyber crime.

Awareness about health concerns related to usage of technology like effect on eyesight, physiological issues and ergonomic aspects

Course Outline for Class XII

Total Periods 180 (including practical periods)

Chapter 1: Exception and File Handling in Python 20 Periods

Exception Handling: syntax errors, exceptions, need of exception handling, user-defined exceptions, raising exceptions, handling exceptions, catching exceptions, Try - except - else clause, Try - finally clause, recovering and continuing with finally, built-in exception classes.

File Handling: text file and binary file, file types, open and close files, reading and writing text files, reading and writing binary files using pickle module, file access modes.

Chapter 2: Stack 15 Periods

Stack (List Implementation): Introduction to stack (LIFO Operations), operations on stack (PUSH and POP) and its implementation in python. Expressions in Prefix, Infix and postfix notations, evaluating arithmetic expressions using stack, conversion of Infix expression to postfix expression

Chapter 3: Queue 15 Periods

Queue (List Implementation): Introduction to Queue (FIFO), Operations on Queue (INSERT and DELETE) and its implementation in Python.
Introduction to DQueue and its implementation in Python.

Chapter 4: Searching 20 Periods

Searching: Sequential search, Binary search, Analysis of Sequential and Binary Search. Dry run to identify best, worst and average cases. Implementation of searching techniques in Python.

Chapter 5: Sorting 20 Periods

Overview of sorting techniques, Bubble Sort, Selection Sort and Insertion Sort. Dry run to identify best, worst and average cases. Implementation of sorting techniques in Python.

Hashing: Hash Functions, Collision Resolution, Implementing the Map Abstract Data Type.

Chapter 6: Understanding Data 5 Periods

Data and its purpose, collection and organization; understanding data using statistical methods: mean, median, standard deviation, variance; data interpretation; visualization of data.

Chapter 7: Database Concepts

15 Periods

Introduction to database concepts, difference between database and file system, relational data model: concept of domain, tuple, relation, keys - candidate key, primary key, alternate key, foreign key;

Relational algebra: selection, projection, union, set difference and cartesian product;

Chapter 8: Structured Query Language

35 Periods

Advantages of using Structured Query Language, Data Definition Language, Data Query Language and Data Manipulation Language, Introduction to MySQL, Creating a database using MySQL, Data Types

Data Definition: CREATE TABLE, DROP TABLE, ALTER TABLE,

Data Query: SELECT, FROM, WHERE

Data Manipulation: INSERT, UPDATE, DELETE

Math functions: POWER (), ROUND (), MOD ().

Text functions: UCASE ()/UPPER (), LCASE ()/LOWER (), MID ()/SUBSTRING ()/SUBSTR (), LENGTH (), LEFT (), RIGHT (), INSTR (), LTRIM (), RTRIM (), TRIM ().

Date Functions: NOW (), DATE (), MONTH (), MONTHNAME (), YEAR (), DAY (), DAYNAME ().

Aggregate Functions: MAX (), MIN (), AVG (), SUM (), COUNT (); using COUNT (*).

Querying and manipulating data using Group by, Having, Order by.

Operations on Relations - Union, Intersection, Minus, Cartesian Product, JOIN

Chapter 9: Computer Networks

15 Periods

Introduction to computer networks, Evolution of networking,

Network types: LAN, WAN, MAN

Network devices: Modem, Ethernet Card, Repeater, Hub, Switch, Router, Gateway.

Network Topologies: Mesh, Ring, Bus, Star, and Tree topologies

Basic concept of MAC and IP Address

Difference between Internet and web

Chapter 10: Data Communication

12 Periods

Concept of communication, Types of Data Communication, switching techniques

Communication Media: Wired Technologies – Twisted pair cable, Co-axial cable, Ethernet Cable, Optical Fibre;

Introduction to mobile telecommunication technologies

Wireless Technologies – Bluetooth, WLAN, Infrared, Microwave

Network Protocol: Need for Protocol, Categorization and Examples of protocol, HTTP, FTP, IP, PPP; electronic mail protocol

Concept of Channel, Bandwidth (Hz, KHz, MHz) and Data Transfer rate (bps, Kbps, Mbps, Gbps, Tbps)

Chapter 11: Security Aspects

8 Periods

Threats and prevention: Viruses, Worms, Trojan horse, Spam, Cookies, Adware, Firewall, http vs https

Network Security Concepts: Firewall, Cookies, Hackers and Crackers

Antivirus and their workings

Network security threats: Denial of service, Intrusion problems, Snooping, Eavesdropping