



## **Course Outline for Entrance Exam**

### **Ph.D. in Computer Science**

All candidates will be tested on the basics in computer science, programming ability, and specific topics related to the intended areas of interest. The following basic topics will be examined at GATE level: Data Structures, Algorithms (including Graphs), Discrete Mathematics, Probability and Statistics, Linear algebra, Operating System, Computer Networks, Databases, Compilers. The students will also be tested for their programming ability. Every student is expected to be able to write simple 50-line programs (for example, performing simple linear algebra operations, implementing sorting algorithms, solving string-based problems).

In more detail, knowledge of the following topics:

#### **Course Titles:**

##### **Unit I. Data Structures and Algorithms:**

Basics of algorithms including sorting, searching, stacks, queues, linked lists, binary search trees.

Paradigms such as divide and conquer, dynamic programming.

Basic graph algorithms.

Proficiency in C/C++/Python.

##### **Unit II. Discrete Mathematics:**

Recurrence, induction, relations and functions, permutations and combinations including counting techniques, basics of graph theory.

##### **Unit III.**

Basics of probability and statistics.

Linear algebra, and continuous optimization.

Linear & logistic regression, overfitting / underfitting, decision trees.

Basics of Data Mining, Machine Learning, Deep Learning (eg. CNNs)

##### **Unit IV. Compilers:**

Finite State Automata, Regular Languages, Context Free Languages.

Lexical Analysis, LL and LR Parsing

**Unit V. Operating Systems:**

Processes/threads, multithreading, scheduling. Distributed Operating Systems

**Unit VI. Computer Networks:**

Networking protocols, network stacks (eg. TCP/IP), routing algorithms, delays/congestion control, basic network utilities like ping, traceroute, ssh. Adhoc and Sensor Networks

**Unit VII.**

Computer Architecture/Computer Organization. Parallel and High Performance Computing

**Unit VIII:**

DBMS: normal forms, serializability, fault tolerance

**Unit IX:**

Computer Systems Security, Cybersecurity, Privacy and Anonymity