Department of Computer Science & Engineering, IIT Guwahati.

Ph.D Admission (December 2018): Syllabus for the Written Test

Part A [Compulsory for all candidates]

(1) General Aptitude: Verbal Ability: English grammar, Sentence completion, Verbal analogies, Word groups, Instructions, Critical reasoning and verbal deduction.
Numerical Ability: Numerical computation, Numerical estimation, Numerical reasoning and data interpretation.

(2) Discrete Mathematics: Propositional Logic; Probability - Conditional Probability; Mean, Median, Mode and Standard Deviation; Random Variables; Distributions- Uniform, Normal, Exponential, Poisson, Binomial. Set Theory -Sets; Relations; Functions; Groups; Partial Orders; Lattice; Boolean algebra. Combinatorics - Permutations; Combinations; Counting; Summation; Generating functions; Recurrence relations; Graph Theory - Connectivity; Spanning trees; Cut vertices and edges; Covering; Matching; Independent sets; Coloring; Planarity; Isomorphism.

(3) Programming and Data Structures: Programming in C; Structures, Pointers, Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps, Graphs.

Part B [Candidate need to attempt only two sections out of the five below]

(1) Algorithms: Analysis of algorithms, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis of upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.

(2) Formal Languages and Automata Theory: Alphabets, languages, grammars; Finite automata; Regular languages, Regular expressions; Context-free languages: Pushdown automata, Context sensitive languages: Linear bounded automata; Turing machines: recursively enumerable languages; Undecidability; Operations on formal languages and their properties; Chomsky hierarchy; Decision questions on languages.

(3) Computer Organization and Architecture: Logic functions, Minimization, Combinational and sequential circuits; Representation of fixed and floating point numbers; Computer arithmetic. Machine instructions and addressing modes, RISC and CISC paradigms, Instruction pipelining; Memory interface; Memory hierarchy - Cache memory, main memory, secondary storage; I/O transfer techniques: Program controlled, Interrupt controlled, DMA transfer.

(4) Operating Systems: Processes, Threads, Inter-process communication, Concurrency: Mutual exclusion; Synchronization; Semaphores, Deadlock management, CPU scheduling, Memory Management: Allocation, Protection, Paging, Segmentation; Virtual Memory concepts. File Management, File Systems: Allocation, Free space management, Directory management, I/O Management: Device drivers, Disk scheduling algorithms.

(5) Computer Networks: Basics of digital communications, Guided and unguided media, ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IPv4 and IPv6, Interconnection devices - Hubs, Switches, Gateways, and Routers; Application layer protocols.