Ph.D.	Computer Science (Artificial Intelligence and Data Science)

Syllabus for Entrance Test

Artificial Intelligence

Search space control, Depth first search, Breadth First Search, Hill climbing, Branch and bound, Best First Search, A* algorithm, AND / OR Graphs, Problem Reduction, Means End Analysis.

Propositional & Predicate Logic; First Order Predicate Calculus; Skolemnisation; Resolution; Inference, Semantic Networks; Frame Systems; Scripts; Conceptual Dependency. Rule Based Systems: Inference Rules, Conflict Resolution, Forward & Backward Reasoning.

Data Science

Data Science Classification, Methodology, Exploration, Algorithms, Visualization, Data Analytics. Data Preprocessing, Model Planning, Model Building and evaluation, Time series forecasting.

Machine Learning

Supervised Learning: Supervised Learning: regression and classification problems, logistic regression, k-nearest neighbour, support vector machine, decision trees,

Unsupervised Learning: clustering algorithms, k-means/k-medoid, hierarchical clustering, top-down, bottom-up: single-linkage, dimensionality reduction, principal component analysis

Databases

ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions Processing and concurrencycontrol Techniques, Database Recovery Techniques, Distributed Databases.

Programming and Data Structures

Programming in Python, Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees,binary heaps, graphs.

Algorithms

Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph traversals,minimum spanning trees, shortest paths

Computer Organization and Architecture

Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage;I/O interface (interrupt and DMA mode).

Computer Networks

Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet, circuit and virtual circuit-switching; Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP,DHCP, ICMP), Network Address Translation (NAT); Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP,Email.

Cryptography and Network Security

Symmetric Block Encryption Algorithms (Data Encryption Standard, IDEA and Advanced Encryption Standard), Public-Key Cryptography Algorithms: RSA, Diffie-Hellman, Elliptic Curve, Digital Signature Standard Secure Sockets Layer (SSL), S/MIME, IP Security, Firewalls, Intrusion Detection Systems.

Theory of Computation

Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and contex-free languages, pumping lemma. Turing machines and undecidability.

Linear Algebra

Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.

Calculus

Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.

Probability and Statistics

Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability, Bayes theorem, correlation, and covariance, random variables, discrete random variables and probability mass functions, uniform, Bernoulli, binomial distribution, Continuous random variables and probability distribution function.

Discrete Mathematics

Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions.