**GATE Syllabus for CS and DA**

**1. Operating System**

○ System calls, processes, threads

○ Inter-process communication

○ Concurrency, and synchronization

○ Deadlock handling

○ CPU and I/O scheduling

○ Memory management, paging, segmentation, virtual memory

○ File systems

**2. Digital Logic**

○ Boolean algebra

○ Combinational and sequential circuits

○ Minimization techniques (K-map, Quine–McCluskey)

○ Number system and representations

○ Computer arithmetic (fixed and floating point)

**3. Theory of Computation**

○ Regular expressions and finite automata

○ Context-free grammars and push-down automata

○ Regular and context-free languages

○ Pumping lemma

○ Turing machines and undecidability

**4. Programming and Data Structures**

○ Programming in C and Python

○ Recursion, search algorithms (linear, binary)

○ Arrays, stacks, queues, linked lists, trees, hash tables

○ Binary search trees, binary heaps, graphs

**5. Algorithms**

○ Searching, sorting, hashing

○ Sorting algorithms: selection, bubble, insertion, merge, quicksort

○ Asymptotic time and space complexity

○ Algorithm design techniques: greedy, dynamic programming, divide-and-conquer

○ Graph theory: basic concepts, traversals, shortest path, minimum spanning trees

○ Hashing techniques

**6. Computer Organization and Architecture**

○ Machine instructions and addressing modes

○ ALU, data path, and control unit

○ Instruction pipelining and pipeline hazards

○ Memory hierarchy: cache, main memory, secondary storage

○ I/O interface (interrupt and DMA mode)

**7. Compiler Design**

○ Lexical analysis, parsing

○ Syntax-directed translation

○ Runtime environments

○ Intermediate code generation

○ Local optimization

○ Data flow analyses (constant propagation, liveness analysis, common

subexpression elimination)

**8. Databases & Data Warehousing**

○ ER-model

○ Relational model: relational algebra, tuple calculus, SQL

○ Integrity constraints, normalization (normal forms)

○ File organization, indexing (e.g., B and B+ trees)

○ Transactions and concurrency control

○ Data types and transformations: normalization, discretization, sampling

○ Data warehouse modeling: schemas, hierarchies, and measures

**9. Computer Networks**

○ Network models: OSI and TCP/IP Protocol Stacks

○ Switching techniques: packet, circuit, and virtual circuit switching

○ Data link layer: framing, error detection, MAC, Ethernet

○ Network layer: IP addressing (IPv4, CIDR), fragmentation, ARP, DHCP, ICMP, NAT

○ Routing algorithms: shortest path, flooding, distance vector, link state

○ Transport layer: TCP, UDP, sockets, flow & congestion control

○ Application protocols: DNS, SMTP, HTTP, FTP, Email

**10. Artificial Intelligence**

○ Search algorithms: uninformed, informed (A\*, greedy), adversarial (minimax, alpha-beta pruning)

○ Logic: propositional and predicate

○ Reasoning under uncertainty: conditional independence, exact inference (variable elimination), approximate inference (sampling)

**11. Machine Learning**

○ Supervised Learning

■ Regression: linear, multiple, logistic, ridge

■ Classification: k-NN, Naive Bayes, LDA, SVM, decision trees

■ Neural networks: MLP, feed-forward

■ Evaluation: bias-variance trade-off, cross-validation (k-fold, leave-one-out)

○ Unsupervised Learning

■ Clustering: k-means, k-medoids, hierarchical (top-down, bottom-up)

■ Dimensionality reduction: PCA

**12. Engineering Mathematics:**

○ Discrete Mathematics:

■ Propositional and first-order logic

■ Sets, relations, functions

■ Partial orders and lattices

■ Monoids and groups

■ Graphs: connectivity, matching, coloring, traversals, shortest path

■ Combinatorics: permutations, combinations, counting, recurrence relations, generating functions

○ Linear Algebra:

■ Vector spaces, subspaces

■ Linear dependence and independence

■ Matrices: projection, orthogonal, idempotent, partition

■ Determinant, rank, nullity

■ System of linear equations, Gaussian elimination

■ LU decomposition, SVD (Singular Value Decomposition)

■ Eigenvalues and eigenvectors

■ Projections, quadratic forms

○ Calculus and Optimization:

■ Functions of a single variable

■ Limits, continuity, and differentiability

■ Taylor series

■ Maxima and minima

■ Mean value theorem

■ Optimization with single variable

■ Integration

○ Probability and Statistics:

■ Sample space, events, axioms

■ Independent and mutually exclusive events

■ Random variables (discrete & continuous)

■ PMF, PDF, CDF

■ Conditional, marginal, and joint probabilities

■ Bayes’ theorem, conditional expectation and variance

■ Mean, median, mode, standard deviation

■ Correlation, covariance

■ Distributions: uniform, normal, standard normal, exponential, Poisson, binomial, t-distribution, chi-squared

■ Central Limit Theorem

■ Confidence intervals

■ Hypothesis testing: z-test, t-test, chi-squared test

**13. General Aptitude:** Verbal Aptitude, Quantitative Aptitude, Analytical Aptitude, Spatial Aptitude