JSPM University Pune

Faculty of Science and Technology

School of Computational Sciences

Department of Computer Science and Engineering



Syllabus

RPET 2026

Research Program Entrance Test

Director, SCOS

Dean, FST

PhD Entrance Syllabus (Computer Science and Engineering)

Section 1:	Engineering Mathematics
Discrete Mathematics: Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Graphs: connectivity, matching, colouring. Combinatorics: counting, recurrence relations, generating functions. 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 and Bayes theorem.	
Section 2:	**Digital Logic**
Boolean algebra and minimization – algebraic technique, Karnaugh map, tabular method. Design of combinational and sequential circuits. Number representation and arithmetic (fixed and floating point).	
Section 3:	**Computer Organization and Architecture**
Instruction set and addressing modes. Design of arithmetic and logic unit (ALU). Design of control unit – hardwired and microprogrammed. Memory interfacing and hierarchy: performance, cache memory mapping. I/O interface (interrupt and DMA). Instruction pipelining, pipeline hazards.	
Section 4:	**Programming and Data Structures**
Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.	
Section 5:	**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.	
Section 6:	**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.	
Section 7:	**Operating System**
System calls, processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU and I/O scheduling. Memory management and virtual memory. File systems.	
Section 8:	**Databases**
ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.	
Section 9:	**Computer Networks**
Principles of Layering; Basics of switching (circuit, packet and virtual circuit) and performance metrics; Data link layer: error detection, Medium Access Control, Ethernet; Distance vector and link state routing; IPv4 - Fragmentation, CIDR Notation, Network Address Translation; TCP- flow control and congestion control, socket API; DNS and HTTP.	
Section 10	**AI**
Search: informed, uninformed, adversarial; logic, propositional, predicate; reasoning under uncertainty topics — conditional independence representation, exact inference through variable elimination, and approximate inference through sampling.	

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Section 11:	Machine Learning
Supervised Learning: regression and classification problems, simple linear regression, multiple linear regression, ridge regression, logistic regression, k-nearest neighbour, naive Bayes classifier, linear discriminant analysis, support vector machine, decision trees, bias-variance trade-off, cross-validation methods such as leave-one-out (LOO) cross-validation, k-folds cross-validation, multi-layer perceptron, feed-forward neural network; Unsupervised Learning: clustering algorithms, k-means/k-medoid, hierarchical clustering, top-down, bottom-up: single-linkage, multiple-linkage, dimensionality reduction, principal component analysis.	

17/11/26

Chairman, BoS in CSE