Syllabus for Ph.D. Entrance Examination

I Research Methodology (50%)

A.

The literature review: Writing a survey and identifying the problem. Planning and writing a research proposal**:** Research projects, Major funding agencies. **Ethics and related issues in research**: Concepts in ethics, Intellectual Property Rights, Plagiarism, Fraud and misconduct in science, Unscientific practices in thesis work.

Collection and analysis of data: Designing experiments for the purpose of testing research hypotheses, and evaluating the results of those experiments, Analysis of data, Descriptive statistics, Inferential Statistics, Some common statistical tests and inferences. Tables, Illustrations, Graphs and visualization.

Information sources: Types of publications, Indexing and abstracting services, Online library, Search engines, Citation indexes, Citations analysis, Online searching methods, Initiatives for knowledge management.

References: How to cite and list correctly, Common documentation styles, Citation of sources in the text, Reference management softwares, Selecting a journal, conference.

Scientific writing: Preparation of thesis and research papers: Structure of a thesis/research article/ review article, including title, introduction, literature review, methods and materials, referencing. Editing and proofreading, Use of abbreviations.

B. Mathematical Tools for Research in Computer Science (part of Research Methodology)

Algebra: Groups and rings. De Moivre's theorem, relation between roots and coefficient of nth degree equation, solution to cubic and biquadratic equation, transformation of equations.

Linear Algebra: Scalars, Vectors and Matrices, Vector space, Matrix operations, Rank of a matrix, Determinants and their properties, Reduction to normal forms, Linear transformations, Linear Independence and Dependence, System of linear equations, Eigenvalues and Eigenvectors, Cayley-Hamilton theorem.

Calculus: Limit, continuity, differentiation and integration.

Geometry: System of circles, parabola, ellipse and hyperbola, classification and tracing of curves of second degree, sphere, cones, cylinders and their properties.

Vector Calculus: Differentiation, gradient, divergence and curl.

Differential Equations: Linear, homogenous and bi-homogenous equations, separable equations, first order higher degree equations.

Real Analysis: Neighborhoods, open and closed sets, limit points, continuous functions, sequences and their; properties, limit superior and limit inferior of a sequence, infinite series and their convergence. Rolle's Theorem, mean value theorem, Taylor's theorem, Taylor's series, Maclaurin's series, maxima and minima, indeterminate forms.

Probability and Statistics: Measures of dispersion and their properties, skewness and kurtosis, introduction to probability, theorems of total and compound probability, Bayes theorem random variables, and probability distributions and density functions, mathematical expectation, moment generating functions, cumulants and their relation with moments, binomial Poisson and normal distributions and their properties, correlation and regression, method of least squares, introduction to sampling and sampling distributions like Chi-square, t and F distributions, test of significance based on t, Chi-square and F distributions.

C   English Comprehension

Correct usage of English language and reading Comprehension.

II Computer Science (Subject Specific) (50%)

Discrete Structures: Sets, functions, relations, counting; generating functions, recurrence relations and their solutions; algorithmic complexity, growth of functions and asymptotic notations.

Programming, Data Structures and Algorithms: Data types, control structures, functions/modules, object-oriented programming concepts: sub-typing, inheritance, classes and subclasses, etc. Basic data structures like stacks, linked list, queues, trees, binary search tree, AVL and B+ trees; sorting, searching, order statistics, graph algorithms, greedy algorithms and dynamic programming

Computer System Architecture: Boolean algebra and computer arithmetic, flipflops, design of combinational and sequential circuits, instruction formats, addressing modes, interfacing peripheral devices, types of memory and their organization, interrupts and exceptions.

Operating Systems: Basic functionalities, multiprogramming, multiprocessing, multithreading, timesharing, real-time operating system; processor management, process synchronization, memory management, device management, File management, security and protection; case study: Linux. **Software Engineering:** Software process models, requirement analysis, software specification, software testing, software project management techniques, quality assurance.

DBMS and File Structures: File organization techniques, database approach, data models, DBMS architecture; data independence, E-R model, relational data models, SQL, normalization and functional dependencies.

Computer Networks: ISO-OSI and TCP/IP models, basic concepts like transmission media, signal encoding, modulation techniques, multiplexing, error detection and correction; overview of LAN/MAN/ WAN; data link, MAC, network, transport and application layer protocol features; network security.