

University of Kalyani
Department of Computer Science & Engineering

Research Eligibility Test (RET) Syllabus as per Ph.D. regulation 2021

RET Syllabus on Research Methodology Component

Research Formulation: Objectives and motivation of Research – Research Methodology vs methods. Types of research – Descriptive, Analytical, Applied, Fundamental, Quantitative, Qualitative, Conceptual, Empirical etc; Approaches to Research: Preparation of Schedule, Case study approach, Comparison approach, Definition approach, Descriptive approach, Evaluative approach, Exploratory approach, Interpretive approach, Narrative approach, Persuasive approach, Policy memorandum approach. Definition and formulation of the research problem – Selection of the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Development of working hypothesis.

Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Generalization and Interpretation.

Reporting and thesis writing: Structure and components of reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables – Bibliography, referencing and footnotes.

Intellectual Property Rights: Intellectual property rights (IPR): kinds of property, nature of IP, basic principle, major IP, moral rights & economic rights; Copyright, Patent, Industrial Design, Trademark, Geographical Indication, Farmers' Right, IPR licensing & Technology Transfer; Reproducibility of IP and Accountability.

Philosophy and Ethics: Introduction to Philosophy: definition, nature and scope, concept, branches – Ethics: definition, moral philosophy, nature of moral judgments and reactions.

Scientific Conduct: Ethics with respect to science and research – Intellectual honesty and research integrity – Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) – Redundant Publications: Duplicate and overlapping publications, salami slicing – Selective reporting and misinterpretation of data.

Publication Ethics: definition, introduction and importance – Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. - Conflicts of interest – Publication misconduct: definition, concept, problems that lead to unethical behavior and vice-versa, types – Violation of publication ethics, authorship and Contributorship – Identification of publication misconduct, complaints and appeals – Predatory publishers and journals.

Open access publishing: Open access publications and initiatives – SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies – Software tool to identify predatory publications developed by SPPU – Journal finder / journal suggestion tools viz., JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Publication Misconduct: A) Group Discussions: Subject specific ethical issues, FFP, authorship – conflicts of interest – Complaints and appeals: examples and fraud from India and abroad. - **B) Software tools:** Use of plagiarism software like Turnitin, Urkund and other open source software tools, Smart referencing (open source reference management (RM) software, RM as SEO (Search Optimization Tool), Retraction (Databases & services, Inclusion in RM).

Databases & Research Metrics: A) Databases: Indexing databases – Citation databases: Web of Science, Scopus, etc. - **B) Research Metrics:** Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score – Metrics: h-index, g index, i10 index, altmetrics.

RET Syllabus for Subject-Specific Component

Same as GATE syllabus for Computer Science and Information Technology (CS)

Section 1: Engineering Mathematics

Discrete Mathematics: Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Groups. Graphs: connectivity, matching, coloring. 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: 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

Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Section 3: Computer Organization and Architecture

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

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 search, 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: Compiler Design

Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.

Section 8: Operating System

Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Section 9: 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 10: Computer Networks

Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls