

Mumbai University

Syllabus for PET 2020 Examination

Computer Engineering

Section A: Research Methodology and General Awareness

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific methods, understanding the language of research, Concept, Construct, definition, Variable. Research Process

Problem Identification & Formulation: Research Question–Investigation Question Measurement Issues. Hypothesis–Qualities of a good Hypothesis–Null hypothesis & Alternative Hypothesis. Hypothesis Testing–Logic & Importance–Logic & Importance

Research Design: Concept and Importance in Research, Features of a good research Design: Exploratory Research Design, concept, types and uses, Descriptive Research Designs: concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

Qualitative and Quantitative Research: Qualitative research, Quantitative research, concept of measurement, causality, generalization, replication. Merging the two approaches. Types of data and data collection techniques

Measurement: Concept of measurement -what is measured? Problems in measurement in research –Validity and Reliability. Levels of measurement –Nominal, Ordinal, Interval, Ratio.

Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample –Practical considerations in sampling and sample size.

Data Analysis: Data Preparation –Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis –Cross tabulations and Chi square test including testing hypothesis of association, Analysis of Variance (ANOVA)

Interpretation of Data and Report writing: Types of publication, Paper Writing, Layout of a Research Paper, Journals in Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self Plagiarism.

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Section B: Computer Engineering

Mathematics: (Weightage 10%)

- 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.

Digital Logic: (Weightage 10%)

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

Computer Organization and Architecture: (Weightage 10%)

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).

Data Structures: (Weightage 10%)

Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Algorithms: (Weightage 10%)

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.

Theory of Computation: (Weightage 10%)

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

Compiler Design: (Weightage 10%)

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

Operating System: (Weightage 10%)

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

Databases: (Weightage 10%)

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.

Computer Networks:

(Weightage 10%)

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.