

Syllabus for PET Examination - PhD (Computer Science and Engineering)

Research Methodology

1. **Foundation of Research:** Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive, and inductive theory. Characteristics of scientific method - understanding the language of research - Concept, Construct, definition, Variable. Research Process.
2. **Problem Identification & Formulation:** definition and formulating the research problem, Necessity of defining the problem, Importance of literature review in defining a problem, Research Question - Investigation Question - Measurement Issues - Hypothesis - Qualities of a good hypothesis - Null hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & importance.
3. **Research Design:** Concept and Importance in Research - Features of a good research design - Exploratory Research Design - Concept, Types and uses, Descriptive Research Design - concept, types and uses. Experimental Design - Concept of Independent & Dependent variables.
4. **Qualitative and Quantitative Research:** Qualitative - Quantitative Research - Concept of measurement, causality, generalization, replication. Merging the two approaches.
5. **Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection, hypothesis-testing - Generalization and Interpretation.
6. **Measurement:** Concept of measurement - what is measured? Problem in measurement in research - Validity and Reliability. Levels of measurement - Nominal, Ordinal, Interval, Ratio.
7. **Sampling:** Concept 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.
8. **Data Analysis:** data Preparation - Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis - Cross tabulations and Chi-square test, including testing the hypothesis of association.
9. **Interpretation of Data and Paper Writing:** Layout of a Research Paper, Journals in Computer Science, Impact factor of journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbooks, etc., and academic databases for the discipline concerned.
10. **Use of tools/techniques for Research:** methods to search for required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MSOffice, software for detection of Plagiarism.
11. **Reporting and Thesis writing:** Structure and components of scientific 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 - Oral presentation - Planning - Preparation - Practice - Making presentation - Use of visual aids - Importance of effective communication

12. **Application of results and ethics:** Environmental impacts - Ethical issues - ethical committees - Commercialization - Copy right - royalty - Intellectual property rights and patent law - Trade related aspects of intellectual property Rights - Reproduction of published material - Plagiarism - citation and acknowledgement - citation and acknowledgement - Reproducibility and accountability.
13. **Reasoning and Mentalability:** Analogy, Classification, Series, Coding-Decoding, Direction Sense, Representation Through Venn Diagrams, Mathematical Operations, Arithmetical Reasoning, Inserting the Missing Character, Number, Ranking and Time Sequence Test, Eligibility Test, Representation through Venn-diagrams, Number & symbols ordering, Comprehension questions, Statement & assumptions, Statement & conclusions.