

# Department of Computer Science and Engineering

## Part A Research Methodology Syllabus for admission in CSE

- 1 Foundations 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 – 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 Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
4. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.
5. Measurement: Concept of measurement – what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio
6. 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.
7. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages)

## Part-B Syllabus of Subject

### Section 1: Digital Logic

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

### Section 2: 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 3: Programming and Data Structures

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

#### **Section 4: 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 5: 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 undesirability.

#### **Section 6: Compiler Design**

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

#### **Section 7: Operating System**

Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU 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** 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.

## **REFERENCES**

**Algorithms:** Introduction to Algorithms by Rivest, Cormen, Stein, Leiserson, MIT Press

**Operating System:** "Operating System Concepts" by Galvin, Silberschatz.  
WILEY Publishers

**Theory of Computation:** "Introduction to Automata Theory, Languages and Computation"  
by Hopcroft, Ullman. Pearson Education

**Computer Networks:** "Computer Networking: A top-down approach" by Kurose-  
Ross. Pearson Education

"Computer Networks" by Tanenbaum, Prentice Hall

**Computer Organisation:** "Computer Organisation" by Carl Hamacher. McGraw Hill

**Programming:**

"Computer Systems: A Programmer's Perspective", Randal E. Prentice Hall

“Java: The Complete Reference, 8<sup>th</sup> Edition”, Herbert Schildt. McGraw Hill

**Database Systems:** "Database System Concepts" by Korth. McGraw Hill

**Compiler Design:** "Principles of Compiler Design" by Aho and Ullman. Narosa Publishing House

**Digital Logic:** "Digital Logic and Design" by Morris Mano. Pearson Education, Prentice Hall

**Software Engineering:** "Software Engineering: A Practitioner's Approach" by Pressman. Prentice Hall