

410

1/3

Ph.D. (Computer Science) Entrance Syllabus from Session 2020 -21 and onwards
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(A Central University)

Part A: Research Methodology

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.

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. Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample.

6. 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.

Part B: Computer Science

1. Discrete Structure

Sets, relation, Functions, Pigeonhole Principle, inclusion -Exclusion Principle, Equivalence and Partial orderings, elementary counting techniques Probability, Measures for Information and total information

Compatibility: Model of computation-Finite Automata, Pushdown Automata, Non-determinism and NFS, DPDA and PDAs and languages accepted by these structure, Grammars languages, non compatibility and example of non computable problems

Graph-definitions walks paths, trails, connected graphs, regular and bipartite graphs, cycles and circuits, tree and rooted tree, spanning trees, eccentricity of a vertex radius and diameter of a graph, central graphs, centers of a tree, Hamiltonian and Eulerian graphs, planar graphs

Group: Finite field and error correcting / detecting codes

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2. Computer Arithmetic

Proportional (Boolean Logic), Predicate Logic, Well formed formula (WFF), Satisfactory and tautology

Logic Families: TTL, ECL and C-MOS sates, Boolean algebra and minimization of Boolean functions, Flip-Flop types race conditions and comparison, Design of combinational and sequential circuits

Representation of Integer: Octal, Hex, Decimal and Binary, 2's Complement and 1's complement arithmetic, Floating point representation

3. Programming in C and C++

Programming in C: Element of C-Tokens, Identifiers, Data types in C, Control structure in C, Sequence selection and iteration, Structured data types in C-arrays, structure, union, string and pointers

Object Oriented Programming concepts: Classes, Object, installation, Inheritance, Polymorphism and overloading

C++ Programming: Element of C++ Tokens, identifiers, Variable and constants, Data types, Operator, Control Statement, Function parameter passing, Class and object, Constructor and destructor, overloading inheritance templates, exception handling

4. Relational database design and SQL

E-R Diagram and their transformation to relation design, normalization -1NF, 2NF and BCNF

SQL: Data definition language (DDL) Data manipulation language (DML), Data control language (DCL) commands database objects like. Views, data dictionary

5. Data Structure and Algorithms

Data information, definition of data structure, arrays, stacks, queues, linked lists, trees, graphs, priority queues, and heaps

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.

6. Computer Network

Network Fundaments: Local area Network (LAN), metropolitan Area Network *(MKAN), Wide area Network (WAN)m, Wireless Network, Inter Network

Reference Model: The OSI model, TCP/IP model

Data Communication: channel capacity. Transmission media. Twisted pair Coaxial cables, Fiber optic cables, Wireless transmission -radio, microwave infrared and millimeter waves Light wave transmission, telephones-local loop, trunks, multiplexing switching, Internetworking: Switch/Hub. Bridge, router, Gateways.

Network Security: Cryptography-Public key, Secret Key, domain Name System (DNS), electronic mail and worldwide web (WWW),

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7. System Software

Assemble language fundamental (8085 based assembly language programming), Assembler-2pass and single pass, Macros and Microprocessor Loading, linking, program recordable, linkage editing text editor programming environments debugger and program generator

Compilation and interpretation, Bootstrap compiler. Phase of Compilation process, Lexical analysis, Lex package on UNIX System

context free grammar, Parsing and parse trees, representation of parse (derivation) trees as nightmare and leftmost derivation, Bottom up parsers--Shift reduce, operator, precedence, and LR. YACC package on UNIX system

Top down parses-Left recursion and its removal, recursive descend parses. Predictive parses, Intermediate codes, Quadruples, Triples, Intermediate code generation, Code generation, Code optimization

8. Operating System

Main function of operating system, Multiprogramming multiprocessing and multitasking

Memory management: Virtual memory, Paging, fragmentation

Concurrent processing: mutual exclusion, critical regions, locks and unlock

Scheduling: CPU Scheduling, I/o Scheduling, resource scheduling, Banker's Algorithm for deadlock handling

9. Software engineering

System development cycle(SDCL) : Steps, water fall model, Prototypes, Spiral model

Software Metrics : Software Project Management

Software Design: System Design, Detailed design., function oriented design, Object oriented design, user interface design, Design level metrics

Coding and Testing : testing level metrics, Software quality and reliability, clean room approach, Software reengineering

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