Rani Durgavati University, Jabalpur
Department of Mathematics & Computer Science

Entrance examination syllabus for Ph.D./ M.Phil. (Computer Science) 2018 onwards

Maximum marks = 100

Instructions to Paper setter/ Examiner :

(i) Entrance test question paper will have two sections A & B, each consisting of 50 objective type compulsory questions. In all there will be total 100 questions.
(ii) Section-A will represent "**Research Methodology**", whereas Section-B will represent "**Computer Science**".
(iii) Each question will carry 1 mark.
(iv) Each objective type question has to be framed with four optional answers viz. a), b), c), d) with single choice.
(v) No negative marking has to be done.
(vi) The paper setter is requested to please submit the key along with the question paper.

(Section – A)
Subject -- Research Methodology

Scientific Process : Meaning and Definition, a brief history of scientific process

Introduction of Research Methodology : Meaning of research, objectives of research, types of research, significance of research, problems encountered by researchers in India.

Research Problems : Definition, necessity and techniques of defining research problems. Formulation of research problem, Objectives of research problem.

Research Design : Meaning, need and features of good research design. Types of Research Designs. Basic principles of Experimental Designs, Design of experiments.

Sampling Techniques : Census and sample surveys, characteristics of good sample design. Different types of sampling techniques, Simple Random, Stratified and systematic sampling.

(Dr. S. Kurariya)
10/07/2018

Dr Nidhi Chouhey (Rajni Jain)

Data Collection : Primary and secondary data. Methods of collecting primary and secondary data. Various of measures of characterization of data. Distributions.

PhD / M.Phil

SYLLABUS FOR COMPUTER SCIENCE

1.

Computer Organisation and Architecture

Computer Urganization: Digital and Analog computers, CPU, Hardware, Software and Firmware. Number Systems: Binary Numbers, Number Base Conversions, Octal and Hexadecimal Numbers, Complements, Signed Binary Numbers, Binary Codes: BCD code, Gray Code, ASCII code. Excess 3 Code, Error detecting Code.

Computer Arithmetic, Logic gates, Integrated Circuits, K-Map, AND. OR, NAND and NOR implementations. Exclusive-OR function.

Combinational Logic: Combinational Circuits, Binary adder, subtracter, multiplier, Decoders, Encoders, Multiplexes, and Demultiplexers.

Sequential circuits. Latches, Flip Flops: SR, D, JK, T. Master Slave JK Flip flop. Characteristic equations and Excitation tables of flip-flops. Shift Registers, Counters.

Computer organization: The memory unit, the input and output subsystem, the bus structures, ALU. Program development tools: Compiler, interpreter, and assembler.

8085/86 micro processor architecture, Instruction set. Integer division. BCD arithmetic, Design of ALU. Memory address and addressing modes. RISC and CISC processors. Instruction pipelining, Parallel processing and pipelining, pipelining in RISC and CISC processors. Super scalar processors. VLIW processors. Cache memory and its types. Input Output organization, accessing I/O devices, Interrupts. Memory mapped I/O and I/O mapped I/O. Programmed I/O.

2.

Operating System

Operating system concepts, Processor Management: Concepts, Algorithms for batch processing Memory Management, Concurrent Processes: Mutual exclusion and synchronization, Techniques of inter process communication, Deadlock handling

File Management: Operations on a file, structure of a file system

Free block list, directory structure, sharing and protection of files, file system Reliability, Unix file system.

Device Management: Goals of input/output software design, Structure of device hardware and software. Layers of I/O software, structure of device drivers, Disk driver, disk arm scheduling algorithms, terminal driver, clock driver etc.

I/O devices. Introduction to network and distributed operating systems Case Studies: Unix/Linux, Windows operating system, Unix/Linux commands.

File system and process management commands. Shell, Pattern matching, Navigating the File Systems. Unix editor: VI editor, Creating new files. Shell programming: Features of shell. Shell variables. Control statements. Unix system administration: Adding and removing users. User accounting. Adding and removing hardware. Performing backups and restore. Disk space management.

Introduction To Embedded Systems : Definition and Classification — Overview of Processors and an embedded system - Software embed. into the system — Exemplary

Embedded Systems — Embedded Systems on a Chip (SoC) and the use of VLSI designed Circuits. Serial Devices - Examples of Internal Serial-Communication Devices - UART - Parallel Port Devices - 'I2C', 'USB', 'CAN'. Real Time Operating Systems: Definitions of process, task and threads —RTOS Services- RTOS:- Kernel, Process Management. Memory Management. Device Management, File System Organisation, I/O Subsystems, Interrupt Routines Handling. Inter Process Communications, Study of Micro C/OS-II and Vx Works, Memory Allocation Related Functions, Semaphore Related Functions, Mailbox Related Functions, Queue Related Functions, Windows CE.

3.

Computer Networks

Computer Network, Goals and Applications, Reference models — OSI and TCP/IP. LAN, MAN and WAN and topologies, LAN components — File server, Workstations, Network Adapter Cards. Connection Oriented and Connection less services, Switching Techniques — Circuit Switching, Packet Switching. Transmission media.

Data Link Layer: Design Issues, Framing, Error Detection: Parity Check, Check Sum and Cyclic Redundancy Check (CRC); Correction Technique: Hamming code. Flow Control: Elementary Data Link Protocols, Data link layer in the Internet: SLIP and PPP.

Aloha, CSMA Protocols; Collision-Free Protocols; IEEE MAC Sub layer protocols: 802.3 802.4, 802.5 and their management. High speed LANs — Fast Ethernet, FDDI, Wireless LANs Network Layer: Routing Algorithms, Internet addressing and Internet Control protocols Transport Layer: Connection Establishment, Connection Release, Multiplexing. UDP, TCP. Application layer: Client Server Architecture, DNS, WWW and HTTP. Cookies. Proxy Server. E-mail Protocols. Network Security: Cryptography, Symmetric- key Algorithms, Public- key Algorithms, Digital Signatures.

Characteristic of Cellular Systems, Mobility support in cellular telephone networks, Personal Communications Systems/Personal Communications Networks. Mobile applications. Limitations, Health Concerns, Cordless phone.

Wireless Personal Area Network, Wireless Local Area Network and Internet Access. Mobility management, Security. Cellular telephony, Mobile communication, Satellite Systems, Mobile IP. goals, assumptions requirements, entities & terminology, IP packet delivery, tunnelling and encapsulation, Feature & format IPv6, DHCP, TCP over Wireless. Ad Hoc networks, CODA. HTTP versus HTML.WML, XML application for wireless handheld devices.UWB systems Characteristics, Signal propagations, technology, Mobility management for integrated systems. Current approaches for security. Network management in Unix.

4.

Programming Languages

Classification of programming languages, Programming Environment {Assemblers, compilers. interpreters, linkers, and loaders}.

Programming Concepts with Flowcharting and algorithms, Developing and debugging flowcharts for Programming Problem.

Introduction to C: Data types, Constants and Variables, Expressions and Operators and Decision Control Structures in C. Loop Control Structures, Case Control Structures. One dimensional and multidimensional array. Pointers and their Applications, String Handling.

Functions: Standard and User defined Function, Parameter passing, Scope Rule, Recursion, Structures and Union, Arguments to main, Enumerations and bit fields.

Pre-Processors: {clef, include, macro's, ifdef etc.}, File Handling.

Introduction to C++: Structures, Variables in C++, References, Functions, Function Overloading, Default Values for Formal Arguments of Function s, Inline Functions.).

Class and Objects: Introduction to Classes and Objects

Constructors, destructors, friend function, dynamic memory allocation, Inheritance, Overloading, Polymorphism, Templates.

Introduction to Java: Features of Java, Object-oriented programming overview, Introduction of Java Technologies, How to write simple Java programs, Data Types, Variables, Memory concepts, decision making operators, Naming Conventions

Introduction to Class, Objects, Methods and Instance Variables, Primitive type Vs Reference Type, Initializing Objects with Constructors.

Static Method, static field, String Handling in JAVA, Arrays, Using Command-line Arguments, final Instance Variables, this reference, static import, overloaded Constructors, Garbage collection and method finalize , Overloading methods, Parameter passing.

Inheritance, Polymorphism, Packages and Interfaces, Exception Handling, Streams and Files, Multithreading, GUI in JAVA, Applets, Generic and Collection API, Database connectivity: JDBC

Programming concepts and Embedded programming in C, C++: Programming Assembly language (ALP) vs High Level Language - C Program Elements, Macros and functions -Use of Pointers - NULL Pointers - Use of Function Calls — Multiple function calls in a Cyclic Order in the Main Function Pointers.

Concepts of EMBEDDED PROGRAMMING in C++ Objected Oriented Programming — Embedded Programming in Java.

5.

Database Technologies

Various views of data, data independence, schema & sub-schema, primary concept of data models, database languages, transaction management, database administrator & user, data dictionary, database architectures. ER model, Reduction of ER Schema to tables, candidate,

primary, alternate & foreign keys, attributes, relationships, degree, unary, binary, ternary, n-ary, cardinalities constraints, ER modeling examples.

Enhanced ER modeling: super type, subtypes, specialization, generalization, specifying constraints in EER models, Disjointness, discriminators, defining super/sub type hierarchies Relational Algebra, SQL: DDL, DML, DCL Queries, Relational Database, Programming concepts- of PL/SQL, Stored procedure, Database connectivity with ODBC/JDBC, SQL Extensions. Functional dependencies, Normalization, basic normal forms, definition of first, second, third normal form and removing anomalies from the relations. De-normalization and merging relations. Database Integrity, Transaction Management, Concurrency & Recovery, Query processing, Query optimization, File Organization: File organization, Organization of records in files, basic concept of Indexing, ordered indices: B+ tree & B tree index files. RAID, Object Oriented Databases, Spatial Databases.

6.

Data Mining & Warehousing

Data Warehouse, Warehouse Schema, Data Warehouse Architecture, Data Warehouse Server, Data Warehouse Implementation, Metadata, OLAP operations.

Fundamentals of data mining, Data Mining Query Languages, Data Mining applications, Association Rule, clustering, classification, Genetic Algorithm, Web Mining , Web content mining, Web Structure mining, Text mining, Temporal Data Mining, Spatial Data Mining.

Object Oriented Databases, Spatial Databases. Fundamentals of data mining, Data Mining applications, Data Mining. Techniques: Association Rule, clustering, classification etc. Neural Network, Genetic Algorithm. Web Mining, Text Mining, Image mining, Spatial data mining, Temporal Data Mining, Emotion based Mining, Multimedia mining, Aspect Mining.

7.

Data Structures and Algorithms

Data Structures: Definition, Arrays, Stacks, Queues, Dequeues, Linked Lists, Singly and Doubly linked list., Trees : Definition, Tree types and their and Implementation, Preorder, post order, inorder traversal, Graphs: Definition and implementation.

Hashing, Hash function, Collision Resolution Techniques, Hashing Applications, Standard Template Libraries

Time Complexity, Big — Oh - notation, Running Times, Best Case, Worst Case, Average Case, Factors depends on running time, Introduction to Recursion, Divide and Conquer Algorithm, Evaluating time Complexity.

Straight Sequential Search, Binary Search, Interpolation Search.

Sorting: Introduction, Sorting by exchange, selection, insertions, Bubble sort, Selection sort, Insertion sort, Efficiency of above algorithms, Merge sort, Quick sort Algorithm, Heap sort, Radix sort,

Order Analysis: Objectives of time analysis of algorithms; Big-oh and Theta notations, Master Theorem and its proof, solution of divide and conquer recurrence relations, Dynamic Programming: methodology and examples. Graph Algorithms: Basics of graphs and their representations. BFS. DFS. Topological sorting.

Minimum spanning trees (Kruskal and Prim's algorithms and brief discussions of disjoint set and Fibonacci heap data structures). Shortest Paths (Dijkstra, Bellman-Ford, Floyd-Warshall). Hard problems and approximation algorithms. Problem classes P, NP, NP-hard and NP-complete. deterministic and nondeterministic polynomial-time algorithms. Approximation algorithms for some NP-complete problems. Backtracking, Branch and Bound technique, String Matching. Knave algorithm. KMP algorithm, Parallel Algorithms.

8.

Theory of Computation

The Theory of Automata: String, Alphabets and Languages, Finite Automata, Finite State Machine, Basic Definition. Description of a Finite Automaton.

Deterministic Finite Accepters- Transition Graphs, Languages, Non-Deterministic Finite Acceptors- Definition, Finite Automata with e-moves

Equivalence of Deterministic and Nondeterministic Finite Accepters. Mealy and Moore models- Definitions, Transformation of Mealy Machine into Moore Machine and vice-versa Conversion of NDFA to DFA Removal of e transition from e — NDFA.

The Myhill-Nerode theorem and Minimization of Finite Automata — Definition and Construction. Properties of Regular Sets: Pumping lemma for regular set, Closure properties of regular set.

Formal Language: Basic Definition, Chomsky Classification of languages, Initialization of Finite Automata Regular Expression and Language Regular Expressions, Connection between Regular Expressions and Regular Languages

Regular Grammars — Right and Left Linear Grammars, Equivalence between Regular Languages and Regular Grammars

Context-Free Grammars: Leftmost and Rightmost Derivations, Derivation Trees, Parsing and Ambiguity, Simplification of CFGs Chomsky Normal Form, Greibach Normal Form, Cocke-Kasami-Younger Algorithm, Properties of Context-Free Languages Pushdown Automata: Definition, Non deterministic Pushdown Automata, Pushdown Automata for Context Free Languages. Context-Free Grammars for Pushdown Automata. Deterministic Pushdown Automata and Deterministic Context-Free Languages.

Turing Machine: Definition of Standard Turing Machine Turing Machine as Language Accepters and Transducers.

9.

Compiler Desing

Compiler, Translator, Interpreter definition, Phase of compiler introduction to one pass & Multi pass compilers. Analysis of sqiike program.

Review of Finite automata lexical analyzer, Input, buffering, Recognition of tokens, Idea about LEX: A lexical analyzer generator, Error handling.

Introduction to parsing. Bottom up parsing Top down parsing techniques. Shift reduce parsing, Operator precedence parsing, Recursive descent parsing predictive parsers. LL grammars & passers error handling of LL parser, LR parsers, Construction of

SLR. Conical I R & LALR parsing tables, parsing with ambiguous grammar. Syntax directed definitions; Construction of syntax trees, L—attributed definitions. Top down translation.

Intermediate code forms using postfix notation and three address code. Representing TAC using triples and quadruples. Translation of assignment statement. Boolean expression and control structures. Definition of basic block control flow graphs, DAG representation of basic block. Advantages of DAG, Sources of optimization, Loop optimization, Idea about global data flow analysis, Loop invariant computation, Peephole optimization, Issues in design of code geneiatoi, A simple code generator, Code generation from DAG. Code Optimization.

10.

Discrete Structures

The Foundations: Logic, Sets and Functions: Introduction, logic, prepositional equivalences, predicates and quantifiers.

The Foundations: Logic, Sets and Functions: Sets, set operations, fuzzy sets, functions.

functions for computer science, sequences and summations.

Mathematical reasoning: Methods of proof, mathematical induction.

Mathematical reasoning: Recursive definitions, recursive algorithms.

Combinatorics: The basics of counting, The Pigeonhole Principle,

Permutations and Combinations.

Combinatorics : Advanced counting techniques, recurrence relations, solving recurrence relations, algorithm design, complexity of algorithms.

Relations: Relations and their properties, n-ary relations and their applications.

representing relations, closures of relations, equivalence relations, partial ordering.

Relations: Representing relations, closures of a relation.

Relations : Equivalence relations , partial orderings and lattices,chains and antichains.

Graphs: Introduction to Graphs, Graph terminology, representing graphs and graph isomorphism. Graphs: Connectivity, Euler and Hamiltonian Paths, shortest path problems, planar graphs, graph colouring, chromatic number, Euler's formula, kuratowski's theorem.

Graphs: The four colour problem, Applications of Graph Colouring, Introduction to Trees, applications of trees, tree traversal, trees and sorting, Spanning trees, minimum spanning trees. Languages and Grammars :Introduction to Languages and Grammars, Phrase-Structure Grammars, types of Phrase structure grammars.