KUVEMPU UNIVERSITY

DEPARTMENT OF P.G. STUDIES & RESEARCH IN COMPUTER SCIENCE & M.C.A.

INTIMATION

Sub: Entrance Test for Ph.D. in Computer Science 2022-23

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The Entrance Examination for Ph.D. in Computer Science will be held on **5th August 2023 (Saturday)** at Department of Computer Science & M.C.A., Kuvempu University, Shankaraghatta.

Instructions to candidates:

- Entrance Examination time : **11.00am to 2.00pm**. Duration of entrance test is **03 hrs**
- Maximum Marks for entrance test : **90 marks**
- The candidates should bring all original documents along with a photocopy of each
- The candidates should report at 10:00 AM on 05-08-2023 along with 2 stamp sized photographs, any personal ID card and a photocopy of the same.
- The Admission Tickets will be issued before the commencement of examination on the same day.
- Entrance Test is Compulsory for all the candidates including candidates who have passed M.Phil., or have cleared NET/SLET/JRF.

Scheme of Question Paper for Ph.D. Entrance Examination

Part-A   Maximum Marks: 20   (20X1=20)
   20 objective type /multiple choice questions. Each question carries 01 mark.

Part-B   Maximum Marks: 30   (5X6=30)
   05 questions shall be answered out of 08 questions. Each question carries 06 marks (Question may contain sub questions).

Part-C   Maximum Marks: 40   (4X10=40)
   04 questions shall be answered out of 06 questions. Each question carries 10 marks (Question may contain sub questions).

NOTE:

- **Syllabus for entrance examination** :
   Research methodology and Cognate Subjects of Computer Science,
   (50% of the questions will be from Research methodology).

Sd/-
(Dr. Yogish Naik G.R.)
Chairman

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Register Number for Ph.D. Entrance Examination 2022-23

SL.NO.	CANDIDATE NAME	REG.NO.
01	ABHISHEK S	PHDCS2301
02	BASAWARAJ	PHDCS2302
03	CHANDANA DEV D	PHDCS2304
04	CHITRA LEKHA N C	PHDCS2305
05	GAGANA G R NAYAKA	PHDCS2306
06	INDRA KUMAR K	PHDCS2307
07	KAVYA SHREE N S	PHDCS2308
08	KRISHNAMURTHY K	PHDCS2309
09	MANJUNATHA C P	PHDCS2310
10	POORNIMA B H	PHDCS2311
11	RABIYA BASREE	PHDCS2312
12	RAMESH K N	PHDCS2313
13	SAJEETH A G	PHDCS2314
14	SHRUTHI M R	PHDCS2315
15	SHRUTHI P	PHDCS2316
16	SUJATHA SHEKHAWAT	PHDCS2317
17	VIKASA V	PHDCS2318
18	VISHNU K M	PHDCS2319

Sd/-
(Dr. Yogish Naik G.R.)
Chairman

Department of P.G Studies and Research in Computer Science
Ph.D. Entrance Examination Syllabus

Subject: COMPUTER SCIENCE

Research Methodology

Unit 1: Introduction, Meaning of research, Objective of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Criteria of good research.

Unit 2: Definition of Research problems, What is research problem? Selecting the problem, Necessity of defining the problem, Technique involved in defining a problem, an illustration, Conclusion.

Unit 3: Research Design, Meaning of research design, features of a good design, Important concepts relating to research design, different research designs, Developing a research plan.

Unit 4: Methods of Data collection and Analysis of Data Collection of primary data, Collection of secondary data, Selection of appropriate method for data collection, Difference between survey and experiment. Problems in processing elements/types of analysis.

Unit 5: How to study a scientific paper, Summarizing paper – Reading abstracts and finding ideas, conclusion, Advantages of their approach, the drawbacks of the papers (What is lacking– can be found in the sections such as future work) Generalize results from a research paper to related research problems Comparing the approach - Identify weaknesses and strengths in recent research articles in the subject. Meaning of Interpretation, why Interpretation? Technique of Interpretation, Precaution in Interpretation.

Unit 6: Publishing a paper, How to write scientific paper - Structure of a conference and journal paper, how (and How Not) to write a Good Systems Paper: Abstract writing, chapter writing, discussion, conclusion, references, bibliography, and In-class discussion of technical writing examples, Poster papers, review papers, how to organize thesis/ Project report, How to write a research proposal? How research is funded? Research ethics – Legal issues, copyright, plagiarism General advice about writing technical papers in English - Tips for writing correct English.

Unit 7: Report writing, Significance of Report writing, Different steps in writing Report, Layout of the Research Report, Types of Report, Oral Presentation, Precautions for writing Research Reports, conclusion. Format of research proposal, Individual research proposal, Institutional proposal.

Unit 8: How to present scientific paper, Talk structure, basic presentations skills Documentation and presentation tools – LATEX, Microsoft office, PowerPoint.

Cognate Subjects of Computer Science

Unit 1: Discrete Structures and Optimization

Mathematical Logic: Propositional and Predicate Logic, Propositional Equivalences, NormalForms, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference.

Sets and Relations: Set Operations, Representation and Properties of Relations, Equivalence Relations, Partially Ordering.

Counting, Mathematical Induction and Discrete Probability: Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Inclusion- Exclusion Principle, Mathematical Induction, Probability, Bayes' Theorem.

Group Theory: Groups, Subgroups, Semi Groups, Product and Quotients of Algebraic Structures, Isomorphism, Homomorphism, Automorphism, Rings, Integral Domains, Fields, Applications of Group Theory.

Graph Theory: Simple Graph, Multigraph, Weighted Graph, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Bipartite Graphs, Trees and Rooted Trees, Prefix Codes, TreeTraversals, Spanning Trees and Cut-Sets.

Boolean Algebra: Boolean Functions and its Representation, Simplifications of Boolean Functions. **Optimization:** Linear Programming - Mathematical Model, Graphical Solution, Simplex and Dual Simplex Method, Sensitive Analysis; Integer Programming, Transportation and Assignment Models, PERT-CPM: Diagram Representation, Critical Path Calculations, Resource Levelling, Cost Consideration in Project Scheduling.

Unit - 2 : Computer System Architecture

Digital Logic Circuits and Components: Digital Computers, Logic Gates, Boolean Algebra, Map Simplifications, Combinational Circuits, Flip-Flops, Sequential Circuits, Integrated Circuits, Decoders, Multiplexers, Registers and Counters, Memory Unit.

Data Representation: Data Types, Number Systems and Conversion, Complements, Fixed Point Representation, Floating Point Representation, Error Detection Codes, Computer Arithmetic - Addition, Subtraction, Multiplication and Division Algorithms.

Register Transfer and Microoperations: Register Transfer Language, Bus and Memory Transfers, Arithmetic, Logic and Shift Microoperations.

Basic Computer Organization and Design: Stored Program Organization and Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output, Interrupt.

Programming the Basic Computer: Machine Language, Assembly Language, Assembler, Program Loops, Subroutines, Input-Output Programming.

Microprogrammed Control: Control Memory, Address Sequencing, Design of Control Unit.

Central Processing Unit: General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, RISC Computer, CISC Computer.

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing Array Processors.

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous DataTransfer, Modes of Transfer, Priority Interrupt, DMA, Serial Communication.

Memory Hierarchy: Main Memory, Auxillary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Multiprocessors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Arbitration, Interprocessor Communication and Synchronization, Cache Coherence, Multicore Processors.

Unit - 3 : Programming Languages and Computer Graphics

Language Design and Translation Issues: Programming Language Concepts, Paradigms and Models, Programming Environments, Virtual Computers and Binding Times, Programming Language Syntax, Stages in Translation, Formal Transition Models.

Elementary Data Types: Properties of Types and Objects; Scalar and Composite Data Types.

Programming in C: Tokens, Identifiers, Data Types, Sequence Control, Subprogram Control, Arrays, Structures, Union, String, Pointers, Functions, File Handling, Command Line Argumaents, Preprocessors.

Object Oriented Programming: Class, Object, Instantiation, Inheritance, Encapsulation, Abstract Class, Polymorphism.

Programming in C++: Tokens, Identifiers, Variables and Constants; Data types, Operators, Control statements, Functions Parameter Passing, Virtual Functions, Class and Objects; Constructors and Destructors; Overloading, Inheritance, Templates, Exception and EventHandling; Streams and Files; Multifile Programs.

Web Programming: HTML, DHTML, XML, Scripting, Java, Servlets, Applets.

Computer Graphics: Video-Display Devices, Raster-Scan and Random-Scan Systems; Graphics Monitors, Input Devices, Points and Lines; Line Drawing Algorithms, Mid-Point Circle and Ellipse Algorithms; Scan Line Polygon Fill Algorithm, Boundary-Fill and FloodFill.

2-D Geometrical Transforms and Viewing: Translation, Scaling, Rotation, Reflection and Shear Transformations; Matrix Representations and Homogeneous Coordinates; Composite Transforms, Transformations Between Coordinate Systems, Viewing Pipeline, Viewing Coordinate Reference Frame, Window to View-Port Coordinate Transformation, Viewing Functions, Line and Polygon Clipping Algorithms.

3-D Object Representation, Geometric Transformations and Viewing: Polygon Surfaces, Quadric Surfaces, Spline Representation, Bezier and B-Spline Curves; Bezier and B-Spline Surfaces; Illumination Models, Polygon Rendering Methods, Viewing Pipeline and Coordinates; General Projection Transforms and Cipping.

Unit – 4 : Database Management Systems

Database System Concepts and Architecture: Data Models, Schemas, and Instances; ThreeSchema Architecture and Data Independence; Database Languages and Interfaces; Centralized and Client/Server Architectures for DBMS.

Data Modeling: Entity-Relationship Diagram, Relational Model - Constraints, Languages, Design, and Programming, Relational Database Schemas, Update Operations and Dealing withConstraint Violations; Relational Algebra and Relational Calculus; Codd Rules.

SQL: Data Definition and Data Types; Constraints, Queries, Insert, Delete, and Update Statements; Views, Stored Procedures and Functions; Database Triggers, SQL Injection.

Normalization for Relational Databases: Functional Dependencies and Normalization; Algorithms for Query Processing and Optimization; Transaction Processing, Concurrency Control Techniques, Database Recovery Techniques, Object and Object-Relational Databases;Database Security and Authorization.

Enhanced Data Models: Temporal Database Concepts, Multimedia Databases, Deductive Databases, XML and Internet Databases; Mobile Databases, Geographic Information Systems,Genome Data Management, Distributed Databases and Client-Server Architectures.

Data Warehousing and Data Mining: Data Modeling for Data Warehouses, Concept Hierarchy, OLAP and OLTP; Association Rules, Classification, Clustering, Regression, Support Vector Machine, K-Nearest Neighbour, Hidden Markov Model, Summarization, Dependency Modeling, Link Analysis, Sequencing Analysis, Social Network Analysis.

Unit – 5 : System Software and Operating System

System Software: Machine, Assembly and High-Level Languages; Compilers and Interpreters; Loading, Linking and Relocation; Macros, Debuggers.

Basics of Operating Systems: Operating System Structure, Operations and Services; SystemCalls, Operating-System Design and Implementation; System Boot.

Process Management: Process Scheduling and Operations; Interprocess Communication, Communication in Client–Server Systems, Process Synchronization, Critical-Section Problem,Peterson's Solution, Semaphores, Synchronization.

Threads: Multicore Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues.

CPU Scheduling: Scheduling Criteria and Algorithms; Thread Scheduling, MultipleProcessorScheduling, Real-Time CPU Scheduling.

Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance and Detection; Recovery from Deadlock.

Memory Management: Contiguous Memory Allocation, Swapping, Paging, Segmentation, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files.

Storage Management: Mass-Storage Structure, Disk Structure, Scheduling and Management, RAID Structure.

File and Input/Output Systems: Access Methods, Directory and Disk Structure; FileSystem Mounting, File Sharing, File-System Structure and Implementation; Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance; Recovery, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Requests to Hardware Operations.

Virtual Machines: Types of Virtual Machines and Implementations; Virtualization.

Linux Operating Systems: Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Input and Output; Interprocess Communication, Network Structure.

Unit – 6 : Digital Image Processing

Introduction: Origins of digital image processing, Electromagnetic spectrum, Applications, Components of image processing system, Image sensing and acquisition, Digitization, Sampling and Quantization. Basic relationships: Neighbors, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations.

Image Enhancement: Basic gray level transformations, histogram processing, enhancement using arithmetic/ logic operations, basics of spatial filtering, smoothing and sharpening spatial filters, Frequency domain: introduction to the Fourier transform and the Frequency domain, smoothing and sharpening frequency domain filters, Discrete Fourier transforms, Properties of DFT, FFT.

Image Restoration and Color image processing: A model of the image degradation/restoration process, noise models, Spatial Filtering- mean filters, order static filters, adaptive filters, Color models, pseudo color image processing, smoothing and sharpening.

Morphological image processing: introduction, structuring elements, dilation and erosion, opening and closing, Hit-or-Miss transformation, basic morphological algorithms.

Image segmentation: detection of discontinuities, edge linking and boundary detection, thresholding, Region based approach, segmentation by morphological watersheds.

Unit – 7 : Software Engineering

Software Process Models: Software Process, Generic Process Model – Framework Activity, Task Set and Process Patterns; Process Lifecycle, Prescriptive Process Models, Project Management, Component Based Development, Aspect-Oriented Software Development, Formal Methods, Agile Process Models – Extreme Programming (XP), Adptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal, Web Engineering.

Software Requirements: Functional and Non-Functional Requirements; Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modelling; Requirements Review, Software Requirment and Specification (SRS) Document.

Software Design: Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling; Object-Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level Design.

Software Quality: McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management (RMMM); Software Reliability.

Estimation and Scheduling of Software Projects: Software Sizing, LOC and FP based Estimations; Estimating Cost and Effort; Estimation Models, Constructive Cost Model (COCOMO), Project Scheduling and Staffing; Time-line Charts.

Unit – 8 : Data Structures and Algorithms

Data Structures: Arrays and their Applications; Sparse Matrix, Stacks, Queues, Priority Queues, Linked Lists, Trees, Forest, Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, B Tree, B+ Tree, B* Tree, Data Structure for Sets, Graphs, Sorting and Searching Algorithms; Hashing.

Performance Analysis of Algorithms and Recurrences: Time and Space Complexities;Asymptotic Notation, Recurrence Relations.

Design Techniques: Divide and Conquer; Dynamic Programming, Greedy Algorithms, Backtracking, Branch and Bound.

Lower Bound Theory: Comparison Trees, Lower Bounds through Reductions.

Graph Algorithms: Breadth-First Search, Depth-First Search, Shortest Paths, Maximum Flow, Minimum Spanning Trees.

Complexity Theory: P and NP Class Problems; NP-completeness and Reducibility. **Selected Topics:** Number Theoretic Algorithms, Polynomial Arithmetic, Fast Fourier Transform, StringMatching Algorithms.

Advanced Algorithms: Parallel Algorithms for Sorting, Searching and Merging, Approximation Algorithms, Randomized Algorithms.

Unit – 9 : Theory of Computation and Compilers

Theory of Computation: Formal Language, Non-Computational Problems, Diagonal Argument, Russels's Paradox.

Regular Language Models: Deterministic Finite Automaton (DFA), Non-Deterministic Finite Automaton (NDFA), Equivalence of DFA and NDFA, Regular Languages, Regular Grammars, Regular Expressions, Properties of Regular Language, Pumping Lemma, NonRegular Languages, Lexical Analysis.

Context Free Language: Pushdown Automaton (PDA), Non-Deterministic Pushdown Automaton (NPDA), Context Free Grammar, Chomsky Normal Form, Greibach Normal Form, Ambiguity, Parse Tree Representation of Derivation Trees, Equivalence of PDA's and ContextFree Grammars; Properties of Context Free Language.

Turing Machines (TM): Standard Turing Machine and its Variations; Universal Turing Machines, Models of Computation and Church-Turing Thesis; Recursive and Recursively Enumerable Languages; Context-Sensitive Languages, Unrestricted Grammars, Chomsky Hierarchy of Languages, Construction of TM for Simple Problems.

Unsolvable Problems and Computational Complexity: Unsolvable Problem, Halting Problem, Post Correspondence Problem, Unsolvable Problems for Context-Free Languages, Measuring and Classifying Complexity, Tractable and Intractable Problems.

Syntax Analysis: Associativity, Precedence, Grammar Transformations, Top Down Parsing, Recursive Descent Predictive Parsing, LL(1) Parsing, Bottom up Parsing, LR Parser, LALR(1)Parser.

Semantic Analysis: Attribute Grammar, Syntax Directed Definitions, Inherited and Synthesized Attributes; Dependency Graph, Evaluation Order, S-attributed and L-attributed Definitions; Type-Checking.

Run Time System: Storage Organization, Activation Tree, Activation Record, Stack Allocation of Activation Records, Parameter Passing Mechanisms, Symbol Table.

Intermediate Code Generation: Intermediate Representations, Translation of Declarations, Assignments, Control Flow, Boolean Expressions and Procedure Calls.

Code Generation and Code Optimization: Control-flow, Data-flow Analysis, Local Optimization, Global Optimization, Loop Optimization, Peep-Hole Optimization, Instruction Scheduling.

Unit – 10 : Data Communication and Computer Networks

Data Communication: Components of a Data Communication System, Simplex, Half Duplex and Duplex Modes of Communication; Analog and Digital Signals; Noiseless and Noisy Channels; Bandwidth, Throughput and Latency; Digital and Analog Transmission; Data Encoding and Modulation Techniques; Broadband and Baseband Transmission; Multiplexing,Transmission Media, Transmission Errors, Error Handling Mechanisms.

Computer Networks: Network Topologies, Local Area Networks, Metropolitan Area Networks, Wide Area Network, Wireless Networks, Internet.

Network Models: Layered Architecture, OSI Reference Model and its Protocols; TCP/IP Protocol Suite, Physical, Logical, Port and Specific Addresses; Switching Techniques.

Functions of OSI and TCP/IP Layers: Framing, Error Detection and Correction; Flow and Error Control; Sliding Window Protocol, HDLC, Multiple Access – CSMA/CD, CSMA/CA, Reservation, Polling, Token Passing, FDMA, CDMA, TDMA, Network Devices, Backbone Networks, Virtual LANs. IPv4 Structure and Address Space; Classful and Classless Addressing; Datagram, Fragmentation and Checksum; IPv6 Packet Format, Mapping Logical to Physical Address (ARP), Direct and Indirect Network Layer Delivery; Routing Algorithms, TCP, UDP and SCTP Protocols; Flow Control, Error Control and Congestion Control in TCP and SCTP.

World Wide Web (WWW): Uniform Resource Locator (URL), Domain Name Service (DNS), Resolution - Mapping Names to Addresses and Addresses to Names; Electronic Mail Architecture, SMTP, POP and IMAP; TELNET and FTP.

Network Security: Malwares, Cryptography and Steganography; Secret-Key Algorithms, Public-Key Algorithms, Digital Signature, Virtual Private Networks, Firewalls.

Mobile Technology: GSM and CDMA; Services and Architecture of GSM and Mobile Computing; Middleware and Gateway for Mobile Computing; Mobile IP and Mobile Communication Protocol; Communication Satellites, Wireless Networks and Topologies; Cellular Topology, Mobile Adhoc Networks, Wireless Transmission and Wireless LANs; Wireless Geolocation Systems, GPRS and SMS.

Cloud Computing and IoT: SaaS, PaaS, IaaS, Public and Private Cloud; Virtualization, Virtual Server, Cloud Storage, Database Storage, Resource Management, Service Level Agreement, Basics of IoT.

Unit – 11 : Artificial Intelligence (AI)

Approaches to AI: Turing Test and Rational Agent Approaches; State Space Representation of Problems, Heuristic Search Techniques, Game Playing, Min-Max Search, Alpha Beta CutoffProcedures.

Knowledge Representation: Logic, Semantic Networks, Frames, Rules, Scripts, Conceptual Dependency and Ontologies; Expert Systems, Handling Uncertainty in Knowledge. **Planning:** Components of a Planning System, Linear and Non Linear Planning; Goal Stack Planning, Hierarchical Planning, STRIPS, Partial Order Planning.

Natural Language Processing: Grammar and Language; Parsing Techniques, Semantic Analysis and Prgamatics.

Multi Agent Systems: Agents and Objects; Agents and Expert Systems; Generic Structure of Multiagent System, Semantic Web, Agent Communication, Knowledge Sharing using Ontologies, Agent Development Tools.

Fuzzy Sets: Notion of Fuzziness, Membership Functions, Fuzzification and Defuzzification; Operations on Fuzzy Sets, Fuzzy Functions and Linguistic Variables; Fuzzy Relations, Fuzzy Rules and Fuzzy Inference; Fuzzy Control System and Fuzzy Rule Based Systems.

Genetic Algorithms (GA): Encoding Strategies, Genetic Operators, Fitness Functions and GACycle; Problem Solving using GA.

Artificial Neural Networks (ANN): Supervised, Unsupervised and Reinforcement Learning; Single Perceptron, Multi Layer Perceptron, Self Organizing Maps, Hopfield Network.