Ph.D. COMMON ENTRANCE EXAM - JANUARY 2025

SUBJECT – Computer Science and Engineering

PART-B

Roll No:

Duration: 60 minutes **Maximum Marks: 50**

Instructions:

1. **This entrance test question paper is not to be taken out of the examination hall**
2. **Question paper consists of Section A and Section B**
3. **Section A consists of 30 MCQs carrying 1 Mark each. Write the Alphabet of the correct answer in the space given.**
4. **Section B consists of Descriptive questions carrying 5 marks each. Restrict your answer to 500 words. Additional plain sheets have been attached to the question paper to answer Section B**

SECTION – A

Answer the following questions by writing the Alphabet of the correct answer in the box given: **30 x 1 = 30 Marks**

1. Which of the following is NOT a stage in the research process?
   A. Problem Formulation
   B. Data Collection
   C. Data Analysis
   D. Publication of the Research Results

2. What is the primary ethical concern regarding plagiarism in research?
   A. It undermines the original author's work.
   B. It increases the length of the research paper.
   C. It ensures proper citation.
   D. It encourages data collection.

3. Which of the following types of data is continuous?
   A. Nominal
   B. Discrete
   C. Interval
   D. Ordinal

4. Which of the following is NOT a type of graph used in statistical graphics?
   A. Histogram
   B. Frequency Polygon
   C. Scatterplot
   D. Trend Line

5. In the context of scientific writing, what is the main purpose of referencing?
   A. To provide a detailed description of methodology
   B. To give credit to the original authors and sources
   C. To explain the research findings in depth
   D. To summarize the research objectives

6. Which of the following statements about sets is correct?
   A. The union of two sets always results in a subset of one of the original sets.
   B. The intersection of two sets can never be an empty set.
   C. A set can contain multiple instances of the same element.
   D. The power set of a set with n elements has 2^n elements.

7. In linear algebra, the LU decomposition of a matrix is a factorization of the matrix into which of the following?
   A. A product of a diagonal matrix and an orthogonal matrix
   B. A product of a lower triangular matrix and an upper triangular matrix
   C. A product of two diagonal matrices
   D. A product of a symmetric matrix and an identity matrix

8. Which of the following is a characteristic property of the Poisson distribution?
   A. It has a mean equal to its variance.
   B. It is defined for only continuous random variables.
   C. It has a skewed distribution that is symmetric around its mean.
   D. It is used to model the number of successes in a fixed number of trials.

9. Which of the following best describes the concept of an eigen-value and eigen-vector in linear algebra?
   A. Eigenvalues and eigenvectors represent the scaling and direction of a transformation when applied to a matrix.
   B. Eigenvalues correspond to the sum of all the elements in the matrix, and eigenvectors are orthogonal vectors to the matrix.
   C. Eigenvectors are the solutions to the system of linear equations formed by the matrix, and eigenvalues represent the magnitude of the solutions.
   D. Eigenvalues are always positive, and eigenvectors are always unit vectors.

10. Which of the following is the correct definition of conditional probability?
   A. The probability that two independent events will occur.
   B. The probability of an event given that another event has already occurred.
   C. The probability that a random variable falls within a given range.
   D. The probability of events that are mutually exclusive.

11. Find the 2's complement of the binary number 1101
   A. 0010
   B. 0101
   C. 1110
   D. 1011

12. A circuit that decodes binary input into decimal output is called as a:
    A. Decoder
    B. Encoder
    C. Multiplexer
    D. Demultiplexer

13. What type of hazard arises due to dependencies between instructions in a pipeline?
    A. Structural hazard
    B. Data hazard
    C. Control hazard
    D. None of the above

14. Identify the fastest memory in the hierarchy of computer storage.
    A. Main memory
    B.Cache memory
    C.Registers
    D. Secondary storage

15. Recursion primarily depends on which data structure for execution?
    A. Queue
    B. Stack
    C. Linked list
    D. Array

16. Traversal in which order guarantees sorted output from a binary search tree?
    A. Pre-order
    B. Post-order
    C. In-order
    D. Level-order

17. What is the asymptotic time complexity of merge sort in the worst case?
    A. O(n)
    B. O(n2)O(n^2)O(n2)
    C. O(nlogn)O(n \log n)O(nlogn)
    D. O(logn)O(\log n)O(logn)

18. Kruskal's algorithm uses which technique to find the minimum spanning tree?
    A. Divide and conquer
    B. Dynamic programming
    C. Greedy approach
    D. Backtracking

19. Finite automata are used to recognize which type of language?
    A. Regular language
    B. Context-free language
    C. Recursive language
    D. All of the above

20. What is the primary purpose of the pumping lemma in formal language theory?
    A. To prove a language is regular
    B. To prove a language is context-free
    C. To design finite automata
    D. To validate recursion properties

21. During which phase of a compiler is a symbol table most heavily used?
    A. Lexical analysis
    B. Syntax analysis
    C. Semantic analysis
    D. Intermediate code generation

22. What type of parser operates using a stack for its parsing mechanism?
    A. Top-down parser
    B. Bottom-up parser
    C. Recursive-descent parser
    D. Predictive parser

23. Semaphores are primarily used for what purpose in an operating system?
    A. Memory management
    B. Synchronization
    C. Process scheduling
    D. File access

24. Starvation is most likely to occur in which scheduling algorithm?
    A. Round-robin
    B. First-come-first-serve
    C. Shortest job next
    D. Priority scheduling

25. Removing partial dependencies in a database is achieved in:
    A. First normal form
    B. Second normal form
    C. Third normal form
    D. Boyce-Codd normal form

26. How is atomicity maintained in a database transaction?
    A. Through a COMMIT statement
    B. Using a ROLLBACK statement
    C. By defining constraints
    D. With a save point

27. ARP is used for resolving which two types of addresses?
    A. IPv4 and IPv6
    B. Logical and physical addresses
    C. TCP and UDP addresses
    D. IP and MAC addresses

28. Identify the layer not included in the OSI model:
    A. Transport layer
    B. Application layer
    C. Internet layer
    D. Physical layer

29. Identify graph traversal algorithm uses a Stack data structure?
    A. Depth-First Search (DFS)
    B. Breadth-First Search (BFS)
    C. Dijkstra's algorithm
    D. Prim's algorithm

30. B+ trees are primarily used for what purpose in databases?
    A. Data sorting
    B. Query optimization
    C. Indexing
    D. Transaction control

SECTION – B

ANSWER ANY FOUR QUESTIONS

(Each question carries 5 marks) 4*5 = 20

1. Explain the key differences between exploratory, descriptive, and experimental research designs. Provide an example for each.

2. What are Intellectual Property Rights (IPR), and why are they important in research? Discuss the implications of plagiarism on the credibility of scientific work.

3. What is Recursion? How does recursion differ from iteration in terms of implementation and memory usage?

4. Explain the differences between linear search and binary search in terms of:
    - Time complexity in the best, worst cases
    - Applicability to sorted and unsorted arrays
    - When would you prefer one over the other?

5. What are integrity constraints in relational databases? Explain the following types of integrity constraints:
    - Domain Integrity
    - Entity Integrity
    - Referential Integrity

    Provide an example for each of these constraints in a sample database.

6. Compare the functionalities of TCP and UDP. Highlight scenarios where each protocol is best suited, with specific application examples.