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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S,FE) (FT/WP/PT) Examination December 2025 (2019 Scheme)

Course Code: CST 308

Course name: COMPREHENSIVE COURSE WORK

Max. Marks: 50 **Duration: 1Hour**

Instructions: *(1) Each question carries one mark. No negative marks for wrong answers*
(2) Total number of questions: 50
(3) All questions are to be answered. Each question will be followed by 4 possible answers of which only ONE is correct.
(4) If more than one option is chosen, it will not be considered for valuation.

1. What is the time complexity of searching for an element in a balanced binary search tree (BST)?

a) O(log n) b) O(n) c) O(n log n) d) O(1)

2. Which of the following data structures is used for implementing recursion?

a) Queue b) Stack c) Linked List d) Binary Tree

3. What is the time complexity of finding the kth smallest element in an unsorted array using a min-heap of size k?

a) O(n log k) b) O(k log n) c) O(n + k log n) d) O(n^2)

4. In an AVL tree, what is the maximum difference in heights between the left and right subtrees?

a) 0 b) 1 c) 2 d) 3

5. What is the time complexity of Quick Sort in the worst case?

a) O(n log n) b) O(n^2) c) O(n) d) O(log n)

6. How many distinct binary search trees can be formed with 4 distinct keys?

a) 16 b) 14 c) 24 d) 42

7. In a graph represented by an adjacency list, the time complexity of detecting a cycle using Depth First Search is:

a) O(V + E) b) O(V^2) c) O(E^2) d) O(V log E)

8. What is the minimum number of stacks required to implement a queue?

a) 1 b) 2 c) 3 d) 4

9. What is the time complexity of heap sort for n elements?

a) O(1) b) O(n log n) c) O(n) d) O(log n)

10. If a graph has V vertices and no edges, how many connected components does it have?

a) V b) V-1 c) 1 d) 0

11 Which of the following is a function of an operating system?

a) Compiling code b) Managing system resources c) Designing applications d) Debugging software

12 Consider a system with three processes P1, P2, and P3 sharing four resources. The maximum demand, allocation, and available resources are given. What algorithm determines if the system is in a safe state?

a) Round Robin Scheduling b) Banker's Algorithm c) Peterson's Algorithm d) First-Come-First-Serve

13 A system uses a paging scheme with a page size of 4 KB and a 32-bit logical address space. How many pages are in the logical address space?

a) 1024 b) 2048 c) 4096 d) 1,048,576

14 In a preemptive priority scheduling algorithm, which process gets the CPU if multiple processes are ready?

a) The process with the smallest burst time b) The process that arrived first c) The process with the highest priority d) The process with the largest burst time

15 A system uses a paging scheme with 64-bit virtual addresses and a page size of 4 KB. The page table entry size is 8 bytes. What is the total size of the page table for a process that uses 2 GB of virtual memory?

a) 16 MB b) 32 MB c) 64 MB d) 128 MB

16 Consider the following set of processes with arrival times and burst times:

Process	Arrival Time	Burst Time
P1	0 ms	5 ms
P2	1 ms	3 ms
P3	2 ms	8 ms
P4	3 ms	6 ms

Using the Shortest Remaining Time First (SRTF) scheduling algorithm, what is the average waiting time?

a) 3.25 ms b) 4.25 ms c) 5 ms d) 6 ms

17 A disk has 200 cylinders (0–199). The disk head is currently at cylinder 50 and moves as per the SSTF scheduling algorithm. If the requests are for cylinders [55, 58, 18, 90, 160], in what order are the requests processed?

a) 55, 58, 90, 160, 18 b) 55, 58, 18, 90, 160 c) 55, 58, 18, 160, 90 d) 55, 58, 18, 90, 160

18 A producer-consumer problem is implemented with a bounded buffer of size 5. If the producer and consumer use a semaphore implementation, which semaphore conditions prevent deadlock?

a) mutex = 1, full = 0, empty = 5 b) mutex = 0, full = 5, empty = 0 c) mutex = 1, full = 5, empty = 0 d) mutex = 0, full = 0, empty = 5

19 A multilevel queue scheduling algorithm classifies processes based on

a) Burst time b) Priority c) Arrival time d) Type of processes

20 Which one of the following CPU scheduling algorithms can NOT potentially cause starvation?

a) First-in-First-Out b) Round Robin c) Priority Scheduling d) Shortest Job First

21 Which of the following is a register that holds the address of the next instruction to be executed?

a) Accumulator b) Program Counter c) Instruction Register d) Stack Pointer

22 What is the main purpose of a control unit in a computer?

a) To perform arithmetic operations b) To direct the operations of the processor c) To store data temporarily d) To act as an interface to peripheral devices

23 If a CPU has a clock cycle time of 2ns and a pipeline with 5 stages, what is the theoretical instruction throughput?

a) 2 instructions per nanosecond b) 0.5 instructions per nanosecond c) 1 instruction per 2 nanoseconds d) 1 instruction per nanosecond

24 What is the effective address when the following instruction is executed: LOAD A, where A is the address in memory? Assume direct addressing mode.

a) The value stored at address A b) The value of A itself c) The instruction address d) None of the above

25 A processor uses a TLB with 64 entries and each entry maps 4 KB. What is the total memory coverage of the TLB?

a) 256 KB b) 128 KB c) 512 KB d) 1 MB

26 In a microprogrammed control unit, what is stored in the Control Store?

a) Data to be executed b) Opcodes c) Microinstructions d) Machine Instructions

27 Which of the following is true about Harvard Architecture?

a) It uses a single memory for data and instructions b) It has separate memories for data and instructions c) It is less expensive than von Neumann Architecture d) It does not use instruction pipelining

28 A shift-left logical operation in a CPU does what to the binary number?

a) Divides the number by 2 b) Multiplies the number by 2 c) Shifts the least significant bit out d) Preserves the MSB

29 The time required to access one word is called

a) Latency b) throughput c) Seek time d) Memory access time

30 In a bus system, the number of address lines determines:

a) Number of registers b) Number of I/O devices c) Size of memory addressable d) Data transfer rate

31 Which of the following is a characteristic of a foreign key in a relational database?

a) It uniquely identifies each record in a table b) It establishes a relationship between two tables c) It allows null values only d) It is used for indexing

32 Consider a relation R(A, B, C) with the following functional dependencies: {A → B, B → C}. Which decomposition of R is dependency preserving and lossless?

a) {A, B} and {B, C} b) {A, C} and {B, C} c) {A, B} and {A, C} d) {A, B, C}

33 What is the purpose of the `GROUP BY` clause in SQL?

a) To filter rows based on a condition b) To group rows that have the same values in specified columns c) To sort the data in ascending or descending order d) To join multiple tables

34 Consider the following SQL query:

```
sql
Copy code
SELECT DISTINCT A
FROM R
WHERE A IN (SELECT B FROM S WHERE B > 10);
```

What does this query return?

a) All unique values of A in R b) All distinct values of A from table R that match values in column B of table S where B>10B. c) Values of B in S greater than 10 d) All rows from R and S where A = B

35 Which of the following database models organizes data in a tree-like structure?

a) Relational model b) Hierarchical model c) Network model d) Object-oriented model

36 A relation is in Boyce-Codd Normal Form (BCNF) if:

a) Every attribute is functionally dependent on a candidate key b) Every determinant is a candidate key c) There are no transitive dependencies d) It is in 2NF and 3NF

37 A systematic procedure for moving the CPU to new process is known as-

a) Synchronization b) Deadlock c) Interrupt handling d) Context Switching

38 Given a B+ tree with order 5, what is the maximum number of child pointers that an internal node can have?

a) 5 b) 6 c) 4 d) 3

39 Consider the following ER diagram: An entity "Student" is related to the entity "Course" with a "Many-to-Many" relationship. How is this implemented in a relational database?

a) By creating a single table for both entities b) By creating two tables, one for each entity, with foreign keys c) By creating three tables, one for each entity and one for the relationship d) By using a composite primary key in one table

40 Let E1 and E2 be two entities in an E/Rdiagram with simple single-valued attributes. R1 and R2 are two relationships between E1 and E2, where R1 is one-to-many and R2 is many-to-many. R1 and R2 do not have any attributes of their own. What is the minimum number of tables required to represent this

situation in the relational model?

a) 1 b) 2 c) 3 d) 4

41 Which of the following languages is context-free?

a) {a^n b^n c^n | n >= 0} b) {a^n b^n | n >= 0} c) {a^n b^n c^m | n != m} d) {a^n b^n c^n d^n | n >= 0}

42 Which of the following is true for a deterministic pushdown automaton (DPDA)?

a) It can accept all context-free languages b) It can accept all regular languages c) It can accept only deterministic context-free languages. d) It can accept only some regular languages.

43 Which of the following is NOT a characteristic of a finite automaton?

a) It can only store finite information. b) It has a finite number of states. c) It can accept infinite languages d) It can perform operations on a stack.

44 In a Turing machine, which of the following statements is true?

a) A Turing machine has finite memory b) A Turing machine can simulate any finite automaton c) A Turing machine can only compute regular languages. d) A Turing machine cannot simulate a pushdown automaton.

45 Which of the following languages is regular?

a) {a^n b^n | n >= 0} b) {a^n b^m | n != m} c) {a^n b^n c^n | n >= 0} d) {a^n b^n | n >= 0}

46 The pumping lemma is used to prove that which type of languages are not regular?

a) Context-free languages b) Regular languages c) Context-sensitive languages d) Recursively enumerable languages

47 Which of the following is a characteristic of a finite automaton?

a) Infinite memory b) A finite number of states c) Infinite states d) It can perform stack operations

48 A context-free grammar can generate?

a) Only regular languages b) Only context-free languages c) Only recursive language d) Both context-free and regular languages

49 Which of the following can be used to accept all regular languages?

a) Pushdown automaton b) Turing machine c) Finite automaton d) Context-free grammar

50 The language accepted by a deterministic finite automaton is?

a) Context-free language b) Regular language c) Context-sensitive language d) Recursively enumerable language

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