

**SREEPATHY INSTITUTE OF MANAGEMENT & TECHNOLOGY, Vavanoor**  
 DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING  
 VIth Semester - B.Tech.  
 Second Internal Examination – April 2024

**Course: CST308 - COMPREHENSIVE COURSE WORK**

Total Mark: 50

Total Time: 1 Hrs : 30 Mins

CO1	Comprehend the concepts and applications of data structures	Understanding(U)
CO2	Comprehend the concepts, functions and algorithms in Operating System	Understanding(U)
CO3	Comprehend the organization and architecture of computer systems	Understanding(U)
CO4	Comprehend the fundamental principles of database design and manipulation	Understanding(U)
CO5	Comprehend the concepts in formal languages and automata theory.	Understanding(U)

General Instructions

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

CO BL MARK

- Ackerman's function is defined recursively on the non-negative integers as:
 

$A(m,n) = n+1$  if  $(m = 0)$   
 $A(m,n) = A(m-1, 1)$  if  $(m \neq 0 \ \&\& \ n = 0)$   
 $A(m,n) = A(m-1, A(m, n-1))$  if  $(m \neq 0 \ \&\& \ n \neq 0)$

 Using the above definition  $A(2, 2)$  equals  
 A) 6                                      B) 7                                      C) 9                                      D) 10
 

CO1 2(1)
- Convert the following expression from reverse polish notation to infix notation  $ABCDE + \times - /$ 

A)  $A / (B - C \times D + E)$                                       B)  $A / (B \times C) - (D + E)$   
 C)  $A / (B - C \times (D + E))$                                       D)  $A / (B - C) \times (D+E)$

CO1 2(1)
- Insert keys 4, 12, 8, 16, 6, 18, 24, 7 into an initially empty Binary search tree. Delete the node having the key 6. The Inorder traversal after deletion is
 

A) 4, 12, 7, 8, 24, 18, 16                                      B) 4, 12, 8, 7, 16, 18, 24  
 C) 4, 7, 8, 12, 16, 18, 24                                      D) 4, 12, 7, 8, 16, 24

CO1 2(1)
- In which of the following order any given set of numbers should be inserted into a BST to get inorder and post order traversals as same?
 

A) Increasing order                                      B) Decreasing Order  
 C) Not possible                                      D) Any Order

CO1 2(1)
- A full -array tree is a tree with all the internal nodes has degree  $m$ . The height of a tree is the maximum distance (number of edges) from the root to the farthest child. If an  $m$ -array tree with height  $h$  has  $L$  leaves, then which of the following statement is true ?
 

A)  $L < m^h$                                       B)  $L \leq m^h$                                       C)  $L > m^h$                                       D)  $L \geq m^h$

CO1 2(1)
- The minimum complexity to compute is  $3^n$  is
 

A)  $O(n)$                                       B)  $O(\log n)$                                       C)  $O(\sqrt{n})$                                       D)  $O(\log^2 n)$

CO1 2(1)
- Possible number of trees with 4 unlabeled vertices is
 

A) 7                                      B) 8                                      C) 12                                      D) 14

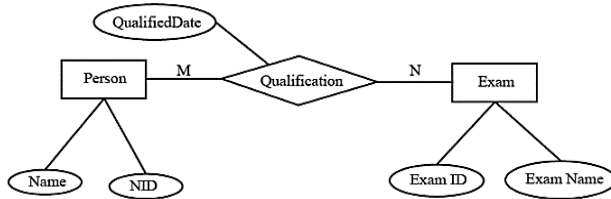
CO1 2(1)

8. A Binary search tree is used to locate the number 43. Which of the following probe sequences is not possible? CO1 2(1)  
A) 61, 52, 14, 17, 40, 43 B) 2, 3, 50, 40, 60, 43  
C) 10, 65, 31, 48, 37, 43 D) 81, 61, 52, 14, 41, 43
9. Which one of the following algorithm design technique is used to find all pairs of shortest distance in a graph? CO1 2(1)  
A) Dynamic Programming B) Backtracking  
C) Greedy D) Divide and conquer
10. A sorting method is said to be stable if the relative order of keys is the same after the sort as it was before the sort. In which of the following pairs both sorting algorithms are stable? CO1 2(1)  
A) Quicksort and Insertion sort B) Insertion sort and MergeSort  
C) Quicksort and Heapsort D) Quicksort and Bubble sort
11. Concurrent access to shared data may result in \_\_\_\_\_ CO2 2(1)  
A) Data Consistency B) Data Insecurity C) Data Inconsistency D) None of These
12. A situation where several processes access and manipulate the same data concurrently and the outcome of the execution depends on the particular order in which access takes place is called CO2 2(1)  
A) Data Consistency B) Race Condition C) Aging D) Starvation
13. The segment of code in which the process may change common variables, update tables, write into files is known as \_\_\_\_\_ CO2 2(1)  
A) Program B) Critical Section C) Non-Critical Section D) Synchronizing
14. A memory management system has 64 pages with 512 bytes page size. Physical memory consists of 32 page frames. Number of bits required in logical and physical address are respectively: CO2 2(1)  
A) 14 and 15 B) 14 and 29 C) 15 and 14 D) 16 and 32
15. Mutual exclusion implies that \_\_\_\_\_ CO2 2(1)  
A) if a process is executing in its critical section, then no other process must be executing in their critical sections  
B) if a process is executing in its critical section, then other processes must be executing in their critical sections  
C) if a process is executing in its critical section, then all the resources of the system must be blocked until it finishes execution  
D) None of the mentioned
16. Bounded waiting implies that there exists a bound on the number of times a process is allowed to enter its critical section \_\_\_\_\_ CO2 2(1)  
A) After a process has made a request to enter its critical section and before the request is granted  
B) When another process is in its critical section  
C) Before a process has made a request to enter its critical section  
D) None of the mentioned
17. What are the two kinds of semaphores? CO2 2(1)  
A) Mutex & Counting B) Binary & Counting C) Counting & Decimal D) Decimal & Binary
18. For which of the following purposes, Banker's algorithm is used? CO2 2(1)  
A) Preventing deadlock B) Solving deadlock C) Recover from deadlock D) None of these
19. At a particular time of computation, the value of a counting semaphore is 7. Then 20 P operations and x V operations were completed on this semaphore. If the new value of semaphore is 5, x will be CO2 2(1)  
A) 18 B) 22 C) 15 D) 13

20. A counting semaphore is initialized to 4. Then 8 P(wait) and 3 V (signal) operations are performed on the semaphore. The final value of the semaphore is CO2 2(1)  
 A) 1                      B) -1                      C) 2                      D) -2
21. The number of full and half-adders required to add 16-bit numbers is: CO3 2(1)  
 A) 8 half-adders, 8 full-adders      B) 1 half-adder, 15 full-adders      C) 16 half-adders, 0 full-adders      D) 4 half-adders, 12 full-adders
22. More than one word are put in one cache block to CO3 2(1)  
 A) Exploit the spatial locality of reference in a program      B) Exploit the temporal locality of reference in a program  
 C) Reduce the miss penalty      D) None of these
23. Increasing the RAM of a computer typically improves performance because CO3 2(1)  
 A) Virtual memory increases      B) Larger RAMs are faster  
 C) Fewer page faults occur      D) Fewer segmentation faults occur
24. A CPU has 24-bit instructions. A program starts at address 300 (in decimal). Which one of the following is a legal program counter (all values in decimal)? CO3 2(1)  
 A) 400                      B) 500                      C) 600                      D) 700
25. Booth's algorithm for integer multiplication gives worst performance when the multiplier pattern is CO3 2(1)  
 A) 101010 ..... 1010      B) 100000 ..... 0001      C) 111111 ..... 1111      D) 011111 ..... 1110
26. How many 8-bit characters can be transmitted per second over a 9600 baud serial communication link using asynchronous mode of transmission with one start bit, eight data bits, two stop bits and one parity bit? CO3 2(1)  
 A) 600                      B) 800                      C) 876                      D) 1200
27. Consider the following processors (ns stands for nanoseconds). Assume that the pipeline registers have zero latency. P1: Four-stage pipeline with stage latencies 1 ns, 2 ns, 2 ns, 1 ns. P2: Four-stage pipeline with stage latencies 1 ns, 1.5 ns, 1.5 ns, 1.5 ns. P3: Five-stage pipeline with stage latencies 0.5 ns, 1 ns, 1 ns, 0.6 ns, 1 ns. P4: Five-stage pipeline with stage latencies 0.5 ns, 0.5 ns, 1 ns, 1 ns, 1.1 ns. Which processor has the highest peak clock frequency? CO3 2(1)  
 A) 1                      B) 2                      C) 3                      D) 4
28. Consider a machine with a byte addressable main memory of 216 bytes. Assume that a direct mapped data cache consisting of 32 lines of 64 bytes each is used in the system. A 50 \* 50 two-dimensional array of bytes is stored in the main memory starting from memory location 1100H. Assume that the data cache is initially empty. The complete array is accessed twice. Assume that the contents of the data cache do not change in between the two accesses. How many data cache misses will occur in total? CO3 2(1)  
 A) 40                      B) 50                      C) 56                      D) 59
29. Consider a machine with a byte addressable main memory of 216 bytes. Assume that a direct mapped data cache consisting of 32 lines of 64 bytes each is used in the system. A 50 \* 50 two-dimensional array of bytes is stored in the main memory starting from memory location 1100H. Assume that the data cache is initially empty. The complete array is accessed twice. Assume that the contents of the data cache do not change in between the two accesses. Which of the following lines of the data cache will be replaced by new blocks in accessing the array for the second time? CO3 2(1)  
 A) line 4 to line 11      B) line 4 to line 12      C) line 0 to line 7      D) line 0 to line 8
30. Consider a direct mapped cache of size 32 KB with block size 32 bytes. The CPU generates 32 bit addresses. The number of bits needed for cache indexing and the number of tag bits are respectively. CO3 2(1)  
 A) 10, 17                      B) 10, 22                      C) 15, 17                      D) 5, 17

31. Consider the following Relationship Entity Dia-gram(ERD)

CO4 2(1)



Which of the following possible relations will not hold if the above ERD is mapped into a relation model?

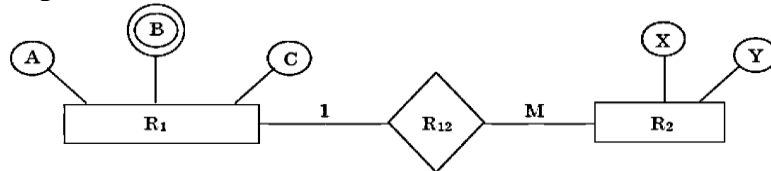
- A) Person (NID, Name)                      B) Qualification(NID, ExamID, QualifiedDate)  
 C) Exam (ExamID, NID, ExamName)        D) Exam (ExamID, ExamName)
32. Let M and N be two entities in an E-R diagram with simple single value attributes. R1 and R2 are two relationships between M and N, where as R1 is one-to-many and R2 is many-to-many. The minimum number of tables required to represent M, N, R1 and R2 in the relational model are \_\_\_\_\_
- A) 4                      B) 6                      C) 7                      D) 3
33. The E-R model is expressed in term of
- I. Entities  
 II. The relationship among entities.  
 III. The attributes of the entities.  
 IV. Functional relationship.
- A) I, II                      B) I, II, IV                      C) II, II, IV                      D) I, II, II
34. Consider the following transaction involving two bank account x and y. read(x); x:= x-50; write(x); read(y); y:= y+50; write(y) The constraint that the sum of the accounts x and y should remain constant is that of
- A) Atomicity                      B) Consistency                      C) Isolation                      D) Durability
35. The best normal form of relation scheme R(A, B, C, D) along with the set of functional dependencies F = {AB → C, AB → D, C → A, D → B} is
- A) Boyce-Codd Normal form                      B) Third Normal form  
 C) Second Normal form                      D) First Normal form
36. Consider the following schedules involving two transactions.
- S1: r1(X) ; r1(Y) ; r2(X) ; r2(Y) ; w2(Y) ; w1(X)  
 S2 : r1(X) ; r2(X) ; r2(Y) ; w2(Y) ; r1(Y) ; w1(X)
- Which one of the following statements is correct with respect to above ?
- A) Both S1 and S2 are conflict serializable.                      B) Both S1 and S2 are not conflict serializable.  
 C) S1 is conflict serializable and                      D) S1 is not conflict serializable and  
 S2 is not conflict serializable.                      S2 is conflict serializable
37. Which of the following statements is TRUE?
- D1 : The decomposition of the schema R(A, B, C) into R1(A, B) and R2 (A, C) is always lossless.  
 D2 : The decomposition of the schema R(A, B, C, D, E) having AD → B, C → DE, B → AE and AE → C, into R1 (A, B, D) and R2 (A, C, D, E) is lossless.
- A) Both D1 and D2                      B) Neither D1 nor D2                      C) Only D1                      D) Only D2
- Let E 1 and E 2 be two entities in E-R diagram with simple single valued attributes. R1 and R2 are two relationships between E1 and E2 where R1 is one - many and R2 is many - many. R1 and R 2 do not have any attributes of their own. How many minimum numbers of tables are required to represent this situation in the Relational Model?
- A) 4                      B) 3                      C) 2                      D) 1

39. Two concurrent executing transactions T1 and T2 are allowed to update same stock item say 'A' in an uncontrolled manner. In such a scenario, following problems may occur: CO4 2(1)
- Dirty read problem
  - Lost update problem
  - Transaction failure
  - Inconsistent database state

Which of the following option is correct if database system has no concurrency module and allows concurrent execution of above two transactions?

- A) (a), (b) and (c) only    B) (c) and (d) only    C) (a) and (b) only    D) (a), (b) and (d) only

40. Find minimum number of tables required for converting the following entity relationship diagram into relational database? CO4 2(1)



- A) 2    B) 4    C) 3    D) 5

41. Consider the following statements. CO5 2(1)

I. If  $L1 \cup L2$  is regular, then both  $L1$  and  $L2$  must be regular.

II. The class of regular languages is closed under infinite union.

Which of the above statements is/are TRUE?

- A) I only    B) II only    C) Both I and II    D) Neither I nor II

42. Which one of the following regular expressions represents the set of all binary strings with an odd number of 1's? CO5 2(1)

- A)  $10^*(0^*10^*10^*)^*$     B)  $(0^*10^*10^*)^*0^*1$     C)  $(0^*10^*10^*)^*10^*$     D)  $((0+1)^*1(0+1)^*1)^*10^*$

43. If  $L$  is a regular language over  $\Sigma = \{a, b\}$ , which one of the following languages is NOT regular? CO5 2(1)

- A)  $L \cdot LR \{xy \mid x \in L, y \in L\}$     B)  $\text{Prefix}(L) = \{x \in \Sigma^* \mid \exists y \in \Sigma^* \text{ such that } xy \in L\}$   
 C)  $\text{Suffix}(L) = \{y \in \Sigma^* \text{ such that } xy \in L\}$     D)  $\{ww^R \mid w \in L\}$

44. Let  $L$  be the language represented by the regular expression  $\Sigma^*0011\Sigma^*$  where  $\Sigma = \{0, 1\}$ . What is the minimum number of states in a DFA that recognizes  $(L)^c$  (complement of  $L$ )? CO5 2(1)

- A) 4    B) 5    C) 6    D) 8

45. Which one of the following is TRUE? CO5 2(1)

- A) The language  $L = \{an \mid n \geq 0\}$  is regular.    B) The language  $L = \{an \mid n \text{ is prime}\}$  is regular.  
 C) The language  $L = \{w \mid w \text{ has } 3k + 1 \text{ b's for some } k \in \mathbb{N}\}$  with  $\Sigma = \{a, b\}$  is regular.    D) The language  $L = \{ww \mid w \in \Sigma^* \text{ with } \Sigma = \{0, 1\}\}$  is regular.

46. If  $L_1 = \{an \mid n \geq 0\}$  and  $L_2 = \{bn \mid n \geq 0\}$ , consider CO5 2(1)

I)  $L_1 \cdot L_2$  is a regular language

II)  $L_1 \cdot L_2 = \{anbn \mid n \geq 0\}$

Which one of the following is CORRECT?

- A) Only (I)    B) Only (II)    C) Both (I) and (II)    D) Neither (I) nor (II)

47. Let  $L_1$  recursive language. Let  $L_2$  and  $L_3$  be languages that are recursively enumerable but not recursive. Which of the following statement is not necessarily true? CO5 2(1)

- A)  $L_2 - L_1$  is recursively enumerable.    B)  $L_1 - L_3$  recursively enumerable  
 C)  $L_2 \cap L_1$  is recursively enumerable.    D)  $L_2 \cup L_1$  is recursively enumerable.

48. Which one of the following languages over the alphabet  $\{0, 1\}$  is described by the regular expression  $(0+1)^*0(0+1)^*0(0+1)^*$  CO5 2(1)
- A) The set of all strings containing the substring 00  
B) The set of all strings containing at most two 0's  
C) The set of all strings containing at least two 0's  
D) The set of all strings that begin and end with either 0 or 1
49. The regular expression  $0^*(10^*)^*$  denotes the same set as CO5 2(1)
- A)  $(1^*0)^*1^*$   
B)  $0+(0+10)^*$   
C)  $(0+1)^*10(0+1)^*$   
D) None of these
50. The complement of any arbitrary context-free language is accepted by some ..... CO5 2(1)
- A) PDA but not by any DPDA  
B) NFA  
C) DPDA  
D) None of the above statements are correct