

Instructions to candidates:

All the sections are compulsory. Section I contains 40 objective type multiple choice questions, each carries 1 mark. In each question you are supposed to select the most appropriate alternative out of the given four. Response "none of these" means your answer is not matching to either of the given alternatives. In Section II you have to attempt any three out of the given five descriptive type questions. Each question in Section II carries 10 marks. Section III has four questions. You have to attempt any two. Each question in Section III carries 15 marks.

Section – I

- Valid_Words is a set of strings that are recognized by "My Laughter Machine (MLM)
Valid_Words = { a, abaabaaba, aba, abaabaabaabaabaabaabaabaabaaba }
Using this information, and given that x is a non negative integer, compare the following three regular expressions:
(i) $(aba)^{3x}$ (ii) $a(baa)^{3x-1}ba$ (iii) $ab(aab)^{3x-1}a$
(A) (ii) and (iii) are same, (i) is different. (C) (i), (ii) and (iii) are different.
(B) (ii) and (iii) are not same. (D) (i), (ii) and (iii) are same.
- A tautology in propositional logic is a statement that is always true. A minimal tautology is a tautology that is not an instance of a shorter tautology.
Is $(A \vee B) \rightarrow (A \vee B)$ a minimal tautology?
(A) yes (B) no (C) maybe (D) none of these
- A seven-segment display has 4 vertical segments and 3 horizontal segments in a figure-of-8 pattern, to display digits and letters. Assume that a decimal digit has to be displayed, given a 4-bit input. The left bottom segment has to be ON for the digits 0, 2, 6, 8. Let the 4 inputs from most significant to least significant be called A, B, C, D. What is the Boolean function of these four variables to drive the left bottom segment?
(A) $BD' + CD'$ (B) $B'D + CD'$ (C) $B'D' + CD'$ (D) $B'D' + C'D'$
- The expression: $a * (b+c) / ((d-e) * (f+g))$ is in infix notation. What is its prefix equivalent?
(A) $/*a+bc*-de+fg$ (C) $*/+fg-de+bc a$
(B) (i) and (ii) (D) none of these
- If you are given a trail of the pre-order binary tree traversal to solve the above expression, would it be possible to deduce its trail in post-order and in, in-order traversal?
(A) yes (B) no (C) maybe (D) none of these

6. For a specific expression, given any two of the three trails (i.e., pre-order, in-order and post-order), is it possible to deduce the remaining one uniquely?
 (A) yes (B) no (C) maybe (D) none of these
7. Imagine that instead of a bit (0 or 1), "my-machine" is capable of storing a zit (0, 1 or 2). The biggest unsigned integer that I would be able to store using 1 word (= 9 zits) of "my-machine" would be _____
 (A) 560 (B) 6560 (C) 6561 (D) none of these
8. Which is the biggest signed integer that "my-machine" is able to store in its one word?
 (A) 6560 (B) 13120 (C) (A) or (B) (D) none of these
9. Given is a relation schema R_Transport [Truck (T), Capacity (C), Data (Y), Cargo (G), Destination (D), Value (V)] with the following functional dependencies { $T \rightarrow C$, $TY \rightarrow G$, $TY \rightarrow D$, $CG \rightarrow V$ }. Is the decomposition of R_Transport into R1 (TCD) and R2 (TGDVY) dependency preserving?
 (A) yes (B) no (C) maybe (D) none of these
10. Is this decomposition of R_Transport into R1 and R2 lossless?
 (A) yes (B) no (C) maybe (D) none of these
11. The decomposition of R_Transport into R1 and R2 as given above is in _____
 (A) Un-normalized form (B) 1NF (C) 2NF (D) 3NF
12. Would it be possible to separate out individual alphabets from a given speech signal spectrogram, say for example separate out c, r, i in the input "Cricket fever"?
 (A) yes (B) no (C) not in a polynomial time (D) none of these
13. In information theory, entropy is _____
 (A) a measure of the uncertainty associated with a random variable.
 (B) the expected value of the information contained in a message.
 (C) (A) and (B)
 (D) none of these
14. Let $f(x,y)$ be an image. The derivatives $\partial f / \partial x$, $\partial^2 f / \partial x^2$, $\partial y / \partial x$ etc., have standard interpretations in the image processing. Interpret the mixed derivative $\partial^2 f / \partial y \partial x$ in this context. In your interpretation, is $\partial^2 f / \partial y \partial x = \partial^2 f / \partial x \partial y$?
 (A) yes (B) no (C) maybe (D) none of these
15. Compared to expert systems, traceability and knowledge representation in two soft computing tools, namely ANNs and fuzzy sets respectively, could be rated as _____
 (A) (better, worse) (B) (much bad, good) (C) similar performing (D) none of these

16. In an error detection and correction code, a message M : "You are good students", is stored as M' : "Youare areyou aregood goodare goodstudents studentsgood". Given that in general the length of M is n , what is the space required to store M' ?
 (A) $2n$ (B) $3n$ (C) $4n$ (D) less than $4n$
17. The number of straight lines obtained by joining n points on a circle is _____
 (A) nC_3 (B) ${}^nC_2 - 1$ (C) nC_2 (D) none of these
18. When an error of 1% is made in the length of a square, the percentage error in the area of a square will be _____
 (A) 0 (B) $\frac{1}{2}$ (C) 1 (D) none of these
19. A five digit number divisible by 3 is to be formed using the numerals 0, 1, 2, 3, 4 and 5, and without repeating any numeral. This can be done in _____ ways:
 (A) 600 (B) 3125 (C) 216 (D) 240
20. Black Box testing is done _____
 (A) to show that software is operational at its interfaces, i.e., input and output
 (B) to examine internal details of code
 (C) at the client side
 (D) none of above
21. The number of students in four classes A, B, C, D and their respective mean marks obtained by each of the class are given below:
- | | A | B | C | D |
|--------------------|----|----|----|----|
| Number of students | 10 | 40 | 30 | 20 |
| Arithmetic mean | 20 | 30 | 50 | 15 |
- The combined mean of the marks of four classes together will be :
 (A) 32 (B) 50 (C) 20 (D) 15
22. A page fault _____
 (A) is an error-specific page.
 (B) is an access to the page not currently in memory.
 (C) is an access to the page used in the previous page reference.
 (D) none of these
23. The cost of the network is usually determined by _____
 (A) time complexity (B) switching complexity
 (C) circuit complexity (D) none of these
24. A hash function f is defined as $f(\text{key}) = \text{key} \bmod 7$, with linear probing used to resolve collisions. Insert the keys 37, 38, 72, 48, 98 and 11 into the table indexed from 0 to 6. What will be the location of 11?
 (A) 3 (B) 4 (C) 5 (D) 6
25. A good piece of research is a product of _____
 (A) collective scholarship (B) a good research library
 (C) a penetrating and analytical mind (D) a touch of genius

26. What would be the output of the following program, if run from the command line as "myprog 1 2 3" ?
- ```
main (int argc, char ..argv[])
{
 int i ;
 i = argv[1] + argv[2] + argv[3] ;
 printf ("% d", i) ;
}
```
- (A) 123 (B) 6 (C) Error (D) "123"
27. Formulation of hypothesis may not be necessary in \_\_\_\_\_
- (A) survey studies (B) fact finding (historical) studies  
(C) normative studies (D) experimental studies
28. \_\_\_\_\_ refers to the way a GIF file is saved by graphics software
- (A) Dithering (B) Interlacing (C) Balancing (D) Division
29. Which of the following statement(s) are always false?
- (i) The sun will not rise in the east some day.  
(ii) A wooden table is not a table.  
(iii) Delhi city will be drowned under water.  
(iv) Cars run on water as fuel.
- (A) (i), (iii) and (iv) (B) Only (iii)  
(C) (i), (ii) and (iii) (D) (ii) alone
30. A \_\_\_\_\_ based platform is suitable for a production environment while a \_\_\_\_\_ based platform is suited for a program development environment.
- (A) Interpreter, compiler (B) Assembler, compiler  
(C) Compiler, assembler (D) Compiler, interpreter
31. Which of the following is an appropriate definition of computer?
- (A) A machine that can process information.  
(B) An electronic device that can store, retrieve and process both qualitative and quantitative data quickly and accurately.  
(C) An electronic device that can store, retrieve and quickly process only quantitative data.  
(D) A machine that can store, retrieve and process quickly and accurately only qualitative information
32. Which of the following is an example of circular argument?
- (A) God created man in his image and man created God in his own image.  
(B) God is the source of a scripture and the scripture is the source of our knowledge of God.  
(C) Some of the Indians are great because India is great.  
(D) Rama is great because she is Rama.



33. "Action research" means \_\_\_\_\_  
 (A) Longitudinal research  
 (B) Applied research  
 (C) Research initiated to solve an immediate problem  
 (D) Research with a socioeconomic objective
34. Logic of induction is very close to \_\_\_\_\_  
 (A) the logic of sampling (B) the logic of observation  
 (C) the logic of controlled variable (D) none of these
35. Which of the following statement(s) is wrong?  
 (i) 2-phase locking protocol suffers from deadlock.  
 (ii) Time stamp protocol suffers from more aborts.  
 (iii) Multivalued dependency among attribute is checked at 3 NF level.  
 (iv) An entity-relationship diagram is a tool to represent event model.  
 (A) i, ii and iii (B) ii, iii and iv (C) iii, iv and i (D) none of these
36. Which of the following indicates evaluation?  
 (A) Ram got 45 marks out of 200  
 (B) Mohan got 38 percent marks in English  
 (C) Shyam got First Division in final examination  
 (D) All of these
37. Looking at the very big rally, it was reported that XYZ party will win the election. The conclusion was based on \_\_\_\_\_  
 (A) random sampling  
 (B) cluster sampling  
 (C) systematic sampling  
 (D) purposive sampling
38. The activity that is must in experimental research is \_\_\_\_\_  
 (A) observation  
 (B) control  
 (C) manipulation and replication  
 (D) reference collection
39. A semaphore count of  $-n$  means that the queue contains \_\_\_\_\_ waiting processes.  
 (A)  $n + 1$  (B)  $n$  (C)  $n - 1$  (D) 0
40. Consider a schemata  $H = 1*****1$  in a genetic algorithm. The order and defining length of  $H$  are given by:  
 (A) 1 and 7 (B) 2 and 6 (C) 3 and 5 (D) none of the above

Section - II

1. Two point sets are linearly separable in  $n$ -dimensional space if they can be separated by a hyperplane. Discuss the problems that involve linearly separable and non-separable item sets and describe the ways to handle such problems computationally [Hint: You may think of the strength and weaknesses of the softcomputing techniques and the typical problems].

**OR**

Briefly outline the major ideas of naïve Bayesian classification

The following table contains training data from student database. Here, Count represents the number of data tuples having the values for Department, Status, Age and Salary are given in that row. Let Status be the class level attribute. Given a tuple having values "systems", "26..30", and "46..50K" for the attributes Department, Age and Salary, Compute a naïve Bayesian classification of the Status.

| Department | Status | Age    | Salary   | Count |
|------------|--------|--------|----------|-------|
| Sales      | Senior | 31..35 | 46K..50K | 20    |
| Sales      | Junior | 26..30 | 26K..30K | 20    |
| Sales      | Junior | 31..35 | 31K..35K | 30    |
| Systems    | Junior | 21..25 | 46K..50K | 10    |
| Systems    | Senior | 31..35 | 66K..70K | 7     |
| Systems    | Junior | 26..30 | 46K..50K | 5     |
| Systems    | Senior | 41..45 | 66K..70K | 6     |

Also describe decision tree based classification. Use the data in the above table to construct the decision tree.

2. (a) What are the parse tree and syntax tree? Draw parse tree of the expression string \* arr[5]; What could be its syntax tree according to ANSI C grammar?
- (b) Read the following conversation. In the end if you feel the student is right, provide a logically consistent sequence of the statements that justifies your opinion.

*Teacher:* You have been absent from class 11 times this month. You fail.

*Student:* What? That's impossible! The class only meets twice a week.

*Teacher:* True, but you have missed it 11 times nevertheless.

*Student:* That doesn't make any sense. You can't be absent from a class on days that it doesn't meet.

*Teacher:* You're saying you weren't absent on those days?

*Student:* That's right..

*Teacher:* So you were here?

*Student:* No!

*Teacher:* You are wasting my time. If you weren't here, then you were absent.

3. (a) What is a logical paradox? Common themes in paradoxes include self-reference, the infinite regress, contradiction, and confusion between different levels of abstraction. Give one examples of each to explain how they lead to the apparent contradictions.
- (b) What is an "a priori property"? Explain an a priori algorithm for generating frequent item sets with an example. Generate frequent (large) item sets for the following set of transactions with minimum support = 3

| Transaction ID | ITEMS            |
|----------------|------------------|
| T10            | M, O, K, E, Y    |
| T20            | D, O, N, K, E, Y |
| T30            | M, A, K, E       |
| T40            | C, A, K, E       |
| T50            | C, O, K, E       |
| T 60           | D, A, Y          |
| T70            | B, R, E, A, D    |

4. A curve is part of an image. How will you compute a curve that is at a distance 'r' from this curve? Discuss a specific application in which you will require to employ this technique.

OR

Different memory partitions of 100 k, 500 k, 200 k, 300 k and 600 k in order are given. Show how a process of size 212 k would be placed by the first-fit, worst-fit and best-fit algorithms.

5. Compare and contrast between the following Hill climbing algorithms (any two).
- Stochastic Hill Climbing
  - First Choice Hill Climbing
  - Random Restart Hill Climbing

Take a problem of your choice and explain which one of the three would perform better. Could you suggest a scheme that employs the Hill climbing to improve performance of the genetic algorithms.

OR

There are n objects of different size and shape distributed on a shop floor. A robot is to navigate from point 'A' to point 'B'. You are required to generate a collision-free path for the robot. Formulate this problem as a graph theoretic problem. What are the other ways to model this problem? Discuss various approaches to solve the same.

[ TURN OVER



Section - III

1. What are the contemporary mathematical, statistical and hybrid approaches that have been employed to solve the computational research problems? Discuss at least one technique in each of the three approaches. Give suitable illustration(s).
2. Choose an appropriate domain of interest for your computational research and provide information on the present state of the art in the same.
3. Choose any two areas from the following. Speculate on a problem in each and discuss the research possibilities.  
Algorithms / theoretical computer science, software engineering, programming, operating systems, databases, graphics, high performance computing, signal processing, networking, cognitive science
4. Write short notes on
  - i. Philosophy of science
  - ii. Research methodology for computational research