Ramakrishna Mission Vivekananda Educational and Research Institute

Deemed-to-be-University as declared by Government of India under section 3 of UGC Act, 1956

Admission Test for MSc in Computer Science

Model Test Paper

Exam Set: **C**

Instructions:

∗ *Mark your answers on the OMR answer sheet only*

∗ *Correct answer fetches **4** marks, incorrect answer **-1** mark, and unanswered question **0** mark*

Applicant's Name (in block letters):

Application No: Time: 2 hr

Part A

1. There are three people P, Q and R, wearing hats that are either black or white, standing in a queue. They know that at least two of them are wearing black hats but they cannot see their own hats. P, who can see Q and R, declares, "I don't know the color of my hat". Q, who can see R, declares, "I know the color of my hat". What colors are Q's and R's hats respectively?

   a. White and white b. White and black c. Black and white d. Black and black e. Cannot be determined from the given conditions

2. Which number in the finite sequence does not fit in naturally: $28, 84, 112, 196, 308, 504, 872$?

   a. 308 b. 872 c. 196 d. 112 e. 504

3. If $y = e^x \sin x$, then what is $\frac{d^2y}{dx^2}$?

   a. $e^x \sin x$ b. $2e^x \sin x$ c. $e^x \cos x$ d. $-2e^x \sin x$ e. $2e^x \cos x$

4. What is $1 - \frac{1}{3!} + \frac{1}{5!} - \frac{1}{7!} + \cdots$?

   a. $\frac{1}{2}\left(e - e^{-1}\right)$ b. $\ln 2$ c. $\sin 1$ d. $\cos 1$ e. ∞

5. What is the area of the region bounded by the curve $y^2 = 4x$ and the line $x = 3$.

   a. $8\sqrt{3}$ b. $12\sqrt{3} - 4$ c. 4 d. 3 e. $\frac{9}{4}$

6. We have to form a committee of four members from a group of nine people. However, if we choose person A, then we cannot choose person B and vice versa. How many different committees can we form?

   a. 75 b. 80 c. 105 d. 126 e. 70

7. What is $\frac{dy}{dx}$ when $x^2y^2 = (x + y)^5$?

   a. $\frac{(3x-2y)y}{(2x-3y)x}$ b. $\frac{(3x-2y)}{(2x-3y)}$ c. $\frac{5(x+y)^4-2x^2y}{2xy^2-5(x+y)^4}$ d. $\frac{3(x+y)^4}{2x^2y^2}$ e. $\frac{5(x+y)^4-2xy^2}{2x^2y-5(x+y)^4}$

8. In a chess tournament, there are 8 players. Each player plays against every other player exactly once. Additionally, each game can result in a win, a loss, or a draw. A tournament outcome tabulates all the results of the games played. How many distinct tournament outcomes are there?

   a. 175616 b. 48 c. 21952 d. 784 e. None of the above

9. What is the mid-point of the chord formed by the intercept of $x + 3y - 2 = 0$ with the circle $x^2 + y^2 = 4$?

   a. $(\frac{1}{5}, \frac{3}{5})$ b. $(1, \frac{1}{3})$ c. $(-1, 1)$ d. $(2, 0)$ e. $(0, \frac{2}{3})$

Read the text below to answer the next 3 questions:

Seven sports awardees, A, B, C, D, E, F and G were honoured at a function. There were seven seats on the dais in a row. First, A and G came and sat together at one end. Second, B, the Khel Ratna recipient sat at the centre. Next, C and D were bitter rivals and therefore sat as farthest apart as possible. Lastly, others came and sat on remaining seats.

10. Which of the following pairs cannot occupy the seats on either side of B in any possible arrangements of seating?
    a. A & F b. C & E c. F & C d. F & D e. D & E

11. Who among C, D, F and G could not sit at any end in any possible arrangements of seating?
    a. D b. C c. F d. G e. Cannot be determined

12. Which of the following pairs cannot be seated adjacent to each other in any possible arrangements of seating?

    a. A & E b. B & D c. C & F d. D & G e. B & F

13. There are 8 letters and 8 envelopes. Each letter is destined to a unique distinct address. These addresses are written on the envelope. In how many ways can you misplace exactly 4 letters?
    a. 70 b. 840 c. 720 d. 630 e. 560

14. The system of equations
    $x + y + z = 1$,
    $2x + 3y - z = 5$, and
    $x + 2y + kz = 4$,
    has an infinite number of solutions for some real number k. What is the value of k?

    a. $+1$ b. 0 c. -1 d. $+2$ e. -2

15. Consider two series (i) $\sum_{n=1}^{\infty} \sin \frac{x}{n}$ and (ii) $\sum_{n=1}^{\infty} (-1)^n \cos \frac{x}{n}$. Which of the following is true?

    a. both (i) and (ii) converge b. (i) diverges but (ii) converges c. both (i) and (ii) diverge d. (i) converges but (ii) diverges e. both convergences depend on value of x

16. Two chess tournaments are being held in Chennai and Kolkata at the same time so that the same player cannot attend both the tournaments. A chess club, which has 10 members, decides to send at least one player to each of these tournaments. In how many ways the club can do so?
    a. $3^{10} - 2 \cdot 2^{10}$ b. 3^{10} c. $3^{10} - 1$ d. $3^{10} - 2 \cdot 2^{10} + 1$ e. $2(2^{10} - 1)$

17. Consider a set S of 9 points in a plane, where no three points are collinear. Each point is coloured with either red, green or blue. Consider all triangles whose vertices are from set S. Any of these triangles is called *empty* if its interior does not contain any point from S. Which of the statements below is necessarily true, for any possible colouring, where each colour is used at least once.

    a. There exists an empty triangle where two vertices are blue and one is red.
    b. There exists an empty triangle in which two vertices are red and one is green.
    c. There exists an empty triangle with vertices of all three colors .
    d. There exists an empty triangle all of whose vertices are red.
    e. There exists an empty triangle where two vertices are green and one is red.

18. We draw four lines on a plane with no two of them parallel and no three of them concurrent. Then we additionally draw new lines joining all the points of intersection of the previous four lines. What is the number of such new lines?
    a. 5 b. 3 c. 0 d. 2 e. 12

19. Vidyasagar was walking on the street, one boy requested him to donate for social welfare fund. He gave him a rupee more than half the money he had. Then came a girl who requested him to donate for poor people's fund for which he gave two rupees more than half the money he had then. After that, again a boy approached him for an orphanage fund. He gave three rupees more than half of what he had. At last he had just two rupee remaining in his hand. How much amount did Vidyasagar have in his pocket in the beginning?

   a. 50 b. 42 c. 72 d. 60 e. 35

20. We form a password using two distinct English capital letters followed by two non-zero distinct digits. How many such passwords are possible?

   a. 11700 b. 46800 c. 70 d. 58500 e. 1256640

<u>Part B</u>

21. What is the minimum number of NAND gates required to implement a 2-input XOR function using NAND gates only?

   a. 6 b. 3 c. 5 d. 4 e. 2

22. Let L_1 denote all those binary strings whose third bit from the end is 1. Let L_2 be all those binary string which contain odd number of 1's. Then which of the following is a correct statement?

   a. L_1 is regular but L_2 is not regular.
   b. $L_1 \cap L_2$ is not regular.
   c. $L_1 \cap L_2$ is regular.
   d. $L_1 \cup L_2$ is not regular.
   e. $L_1 \cup L_2$ will always contain odd number of 1's.

23. Stack A has the entries $\langle x, y, z \rangle$, with x on top. Stack B is empty. An entry popped out of stack A can be either printed immediately or pushed to stack B. An entry popped out of stack B can only be printed. Given the conditions, which of the following outputs is not possible?

   a. yzx b. zxy c. yxz d. xzy e. zyx

24. What is the worst-case running time to search an element in a balanced binary search tree with $n2^n$ elements?
   a. $\theta(\log n)$ b. $\theta(n \log n)$ c. $\theta(2^n)$ d. $\theta(n^2)$ e. $\theta(n)$

25. Consider the C function

```
int find(int x, int y) {
        return ((x < y) ? 0 : (x - y));
}
```

   Let a, b be two non-negative integers. What can function call `find(a, find(a, b))` be used for?
   a. sum of a and b
   b. minimum of a and b
   c. maximum of a and b
   d. negative difference of a and b
   e. positive difference of a and b

26. What is the output of the following code snippet?

```
for (int i = 3; i < 15; i +=3) {
        printf("%d ", i++);
}
```

a. 3 6 9 12 15 b. 3 7 11 c. 3 6 9 12 d. 3 7 11 15 e. 4 8 12

27. What is the average number of comparisions performed by the merge sort algorithm, in merging two sorted sequences of length 2 each?
    a. $\frac{8}{5}$ b. $\frac{8}{3}$ c. 3 d. 2 e. $\frac{10}{3}$

28. What is the sum of `5E9` and `1B7` in hexadecimal?
    a. `760` b. `789` c. `707` d. `6A0` e. `7A0`

29. Let languages L_1 and L_2 be as follows.
    L_1: All binary strings whose number of 1's and number of 0's differ by 2.
    L_2: All binary strings whose number of 1's are even and number of 0's are odd.
    Which of the following statements is correct?
    a. $L_1 \cap L_2$ is regular, L_1 is not regular and L_2 is regular.
    b. $L_1 \cap L_2$ is regular, L_1 is not regular and L_2 is not regular.
    c. $L_1 \cap L_2$ is not regular.
    d. $L_1 \cap L_2$ is regular, L_1 is regular and L_2 is not regular.
    e. $L_1 \cap L_2$ is regular, L_1 is regular and L_2 is regular.

30. Consider the C code

```
void main(){
        int a = 5, *b = &a;
        printf("%d\n", a*b);
}
```

    What will be its output?
    a. 25 b. runtime error c. garbage value d. 5 × the address of b e. compilation error

31. What is the average number of comparisions performed by the merge sort algorithm, in merging two sorted sequences of length 2 each?
    a. $\frac{10}{3}$ b. $\frac{8}{5}$ c. 3 d. $\frac{8}{3}$ e. 2

32. For large n which of the following ordering is correct?
    a. $n^2 < 2^{\log_2 n} < 2^{(\log_2 n)^2} < 2^{|\sin n|}$
    b. $2^{|\sin n|} < 2^{\log_2 n} < 2^{(\log_2 n)^2} < n^2$
    c. $2^{\log_2 n} < n^2 < 2^{(\log_2 n)^2} < 2^{|\sin n|}$
    d. $2^{|\sin n|} < 2^{\log_2 n} < n^2 < 2^{(\log_2 n)^2}$
    e. $2^{|\sin n|} < n^2 < 2^{(\log_2 n)^2} < 2^{\log_2 n}$

33. Consider a sequence S consisting of integers none of which are multiples of 3. We say S satisfies property $\mathcal{P}_i$ if it contains a contiguous sub-sequence of length at least i such that its sum is divisible by three. For example, the sequence $4, 1, 5$ satisfies $\mathcal{P}_2$ as it contains the sub-sequence $1, 5$ with the required property. What is the minimum length of S such that it necessarily satisfies $\mathcal{P}_3$?
    a. 4 b. 5 c. 6 d. 7 e. 3

34. Suppose you are given a connected undirected graph G as an adjacency list with m edges and n vertices. What is the time complexity of the fastest known algorithm that will detect whether G has a cycle?
    a. $O(n+m)$-time b. $O(m \log n)$-time c. $O(\log n)$-time d. $O(m)$-time e. $O(n)$-time

35. Let $L = \{a^n b^n \mid 100 \leq n < 1000, n \text{ is an integer}\}$. Which of the following statements is correct?

a. L is regular and accepted by a DFA with at most 2000 states.
b. L is not regular.
c. L is not regular but there exists a Push-down automata that accepts it.
d. L is regular and accepted by an NFA consisting of 5 states.
e. L is regular and accepted by a DFA consisting of at most 100 states.