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 Question Paper

Instructions:
Mark your answers only on the provided printed answer sheet
Correct answer: **4** marks
Incorrect answer: **-1** mark
Unanswered question: **0** mark

Applicant's Name (in block letters): Max Marks:140

Application No: Time: 2 hrs

Part A - Common

1. The distance of the point $(1, -2, 3)$ from the plane $x - y + z = 5$ measured parallel to the line $\frac{x}{2} = \frac{y}{3} = \frac{z}{-6}$ is
a. $1/7$ b. 1 c. $5/7$ d. 7 e. $7/5$

2. $\lim\limits_{\lambda \to 0} \frac{x^\lambda - 1}{\lambda}$ is equal to
a. 1 b. ∞ c. 0 d. $\ln(x)$ e. x

3. Let $f : \mathbb{R} \to \mathbb{R}$ be a continuous function satisfying $f(x) + f(3 - x) = 2$. What is $\int_0^3 f(x)dx$?
a. 4 b. 6 c. 1 d. 2 e. 3

4. What is $\int_1^2 \frac{1}{t} \ln(t)dt$?
a. $\frac{1}{2}(\ln(2))^2$ b. $\ln(4)$ c. $\ln(2)$ d. 1 e. $\frac{1}{2}\ln(4)$

5. Let $\int_1^8 f(x)dx = 12,\ \int_5^1 f(x)dx = 3,\ \int_7^8 f(x)dx = 4.$ What is $\int_5^7 (2f(x) - 1)dx$?
a. 11 b. 20 c. 15 d. 22 e. 17

6. The side of square is increasing at a rate of 3 inches per minute. Find the rate of change of the area of the square, in square inches per second, when the side length is 2 inches.
a. 12 b. 6 c. $\frac{3}{2}$ d. 18 e. $\frac{1}{5}$

7. Which of the following is *not* a continuous function for all x?
a. $f(x) = |x|$ b. $f(x) = mx - b$ c. $f(x) = \frac{x^2+1}{x+2}$ d. $f(x) = 1055$ e. $f(x) = (x + 3)^4$

8. What are the number of discontinuities of $f(x) = \frac{x}{\lfloor x \rfloor}$, $1 \le x \le 5$, where $\lfloor x \rfloor$ is the largest integer $\le x$?
a. 2 b. 1 c. 0 d. 3 e. 4

9. Let f be a strictly increasing and continuous function in $[a, b]$. Which of the following is correct about f^{-1} in $[f(a), f(b)]$?
a. f^{-1} does not exist b. f^{-1} is constant c. f^{-1} is neither decreasing nor increasing d. f^{-1} is strictly decreasing e. f^{-1} is strictly increasing and continuous

10. Let $f(x) = x^3 - 3x^2 + x - 1$. What is an equation of a tangent to f at $x = 3$?
a. $y = -10x + 28$ b. $y = 28x + 10$ c. $y = -10x - 28$ d. $2y = 10x + 28$ e. $y = 10x - 28$

11. What is the number of points where $(\sqrt{3}\cos\theta + \sin\theta)(\sin\theta + \cos\theta)$ is minimum in the interval $(0, 2\pi)$?
a. infinite number of points b. exactly four points c. exactly one point d. exactly two points e. no point

12. In a same way that the pattern 24685 gives 33776, pattern 35791 will give
a. 46682 b. 44682 c. 44826 d. 44880 e. none of these

13. Let $\mathbf{A}$ and $\mathbf{B}$ be two 3×3 matrices and $rank(\mathbf{AB})$ is equal to 1, then the $rank(\mathbf{BA})$ cannot be
a. 2 b. 3 c. 1 d. 0 e. none of these

14. For any $a, b, c > 0$, which of the following is correct?
a. $(1+a)(1+b)(1+c) = 8\sqrt{abc}$ b. $(1+a)(1+b)(1+c) \geq \sqrt{abc}$ c. $(1+a)(1+b)(1+c) \geq 8\sqrt{abc}$
d. $(1+a)(1+b)(1+c) \leq 8\sqrt{abc}$ e. $(1+a)(1+b)(1+c) \leq \sqrt{abc}$

15. In the beginning of year 2023, twelve new magazines appeared in the market. Four of these magazines were on current affairs, six were entertainment magazines, and two were women magazines. By middle of the year, only six of these new magazines were still circulating in the market. Five of those that remained were entertainment magazines. Which of the following is a logically inference?

a. Only one of the women magazines remained in the market.

b. Only one of the current affairs magazines remained in the market.

c. At least one of the women magazines was cancelled.

d. Sale of entertainment magazines is more than others.

e. Magazine readers prefer entertainment ones to others.

16. For any $n > 0$, which of the following is correct?
a. $(\frac{n+1}{2})^n \geq n!$ b. $(\frac{n+1}{2})^n \geq (n!)^2$ c. $(\frac{n+1}{2})^n = n!$ d. $(\frac{n+1}{2})^n \geq (n!)^3$ e. $(\frac{n+1}{2})^n < n!$

17. A is an regular hexagon with sides of length 2. What is the area of the hexagon?
a. $6\sqrt{3}$ b. $8\sqrt{3}$ c. $2\sqrt{3}$ d. $4\sqrt{3}$ e. $3\sqrt{3}$

18. Let an isosceles right angled triangle Δpqr have right angle $\angle q$ and $|\overline{pq}| = 4$ units. Let $\overline{qs}$ be the perpendicular dropped from q on the line $\overline{pr}$. What is the length $|\overline{qs}|$ approximately?
a. 4 units b. 3 units c. 2.8 units d. 1 unit e. 2 units

19. Suppose γ_1 and γ_2 are two non-intersecting closed and convex curves. What is the maximum number of common tangents that can be drawn on γ_1 and γ_2?
a. 1 b. 4 c. ∞ d. 2 e. 0

20. Let the two circles $x^2 + y^2 + 2g_1x + 2f_1y + c_1 = 0$ and $x^2 + y^2 + 2g_2x + 2f_2y + c_2 = 0$ be orthogonal. Which of the following is correct?
a. $2g_1g_2 + 2f_1f_2 = c_1c_2$ b. $g_1g_2 + f_1f_2 = 2c_1 + 2c_2$ c. $g_1g_2 + f_1f_2 = c_1 + c_2$ d. $2g_1g_2 + 2f_1f_2 = c_1 + c_2$
e. $2g_1g_2 - 2f_1f_2 = c_1 - c_2$

21. If $\alpha \sin\theta - \beta\cos\theta = \gamma$, then the value of $\alpha\cos\theta + \beta\sin\theta$ is
a. $\frac{\gamma^2}{\sqrt{\alpha^2+\beta^2-\gamma^2}}$ b. $\alpha^2 + \beta^2 - \gamma^2$ c. $\sqrt{\gamma^2 - \beta^2 - \alpha^2}$ d. $\frac{\alpha^2+\beta^2}{\sqrt{\alpha^2+\beta^2-\gamma^2}}$ e. $\sqrt{\alpha^2 + \beta^2 - \gamma^2}$

22. L, M and N are waiting in a queue meant for children to enter the zoo. There are 5 children between L and M. There are 8 children between M and N. There are 3 children ahead of N. Lastly, there are 21 children behind L. What is the minimum number of children in the queue?
a. 46 b. 40 c. 27 d. 41 e. 28

23. The maximum value of $z = x_1 - 7x_2$, subject to $2x_1 \geq 5$, $3x_1 - 35x_2 \leq 21$, $x_2 \leq 3$ is
a. 21 b. 0 c. $\frac{21}{2}$ d. 42 e. 20

24. If $\frac{a}{b} = \frac{c}{d} = \frac{e}{f}$, Then the value of $\frac{2a^4b^2+3a^2e^2-5e^4f}{2b^6+3b^2f^2-5f^5}$ is
a. $\frac{a^3}{b^3}$ b. $\frac{a^3c}{b^3d}$ c. $\frac{a^5}{b^5}$ d. $\frac{a^4c}{b^4d}$ e. $\frac{a^3c^2}{b^3d^2}$

25. The sum of the series $1 + \frac{4}{5} + \frac{7}{25} + \frac{10}{125} + \cdots$ to n terms is
a. $\frac{34}{16} - \frac{12n+6}{16\times5^{n-1}}$ b. $\frac{35}{16} - \frac{11n+8}{16\times5^{n-1}}$ c. $\frac{35}{16} - \frac{12n+7}{16\times5^{n-1}}$ d. $\frac{36}{16} - \frac{12n+8}{16\times5^{n-1}}$ e. $\frac{36}{16} - \frac{13n+7}{16\times5^{n-1}}$

Part B

26. What will be the output of the following C code?

```
#include <stdio.h>
#define VAL   2 + 6
void main() {
int a = VAL *  VAL;
printf("%d", a);
}
```

a. 16 b. 20 c. 22 d. 64 e. syntax error

27. Let $R = \{(1,1),(1,2),(2,3),(3,1)\}$ be a binary relation defined on $A = \{1,2,3\}$. The relation R is

a. reflexive b. symmetric c. transitive d. antisymmetric e. asymmetric

28. Let the set $A = \{1,2,3,....18\}$. Let the set B be any distinct 13 numbers from A. Which of the following statement about B is correct?

a. B always contains all odd numbers of the set A.

b. B always contains three numbers whose sum is divisible by 6.

c. B always contains all even numbers of the set A.

d. B always contains all multiples of 3 present in the set A.

e. None of the above.

29. An element $a[i]$ in an array $a[1..n]$ of numbers is a *leader* iff it is larger than all the elements to its right in a. The time complexity of the best algorithm to find all the leaders in the array a is

a. $O(\log n)$ b. $O(n)$ c. $O(n \log n)$ d. $O(n^2)$ e. $O(2^n)$

30. Which of the following languages is accepted by some non-deterministic pushdown automaton but not by any deterministic pushdown automaton?

a. $\{a^m b^n \mid m, n \geq 0\}$ b. $\{a^n b^n \mid n \geq 0\}$ c. $\{a^n b^n c^n \mid n \geq 0\}$
d. $\{a^l b^m c^n \mid l \neq m \text{ or } m \neq n\}$ e. $\{ww \mid w \in \{a,b\}^*\}$

31. Which of the following are regular languages?

$L_1 : \{wxw^r \mid w, x \in \{a,b\}^* \text{ and } |w|, |x| > 0,\ w^r \text{ is the reverse of string } w\}$

$L_2 : \{a^n b^m \mid m \neq n \text{ and } m, n \geq 0\}$

$L_3 : \{a^p b^q c^r \mid p, q, r \geq 0\}$

a. L_1 and L_3 only b. L_2 only c. L_2 and L_3 only d. L_3 only e. L_1 only

32. Let there be three vertices in a tree with degree 3. Which of the following is correct?

a. The tree will always have at most two leaves. b. The tree will always have nine leaves.
c. The tree will always have at least five leaves. d. The tree will always have at most six leaves.
e. The tree may have only one leaf.

33. The number of possible distinct binary relations on a set with n elements is

a. n^2 b. 2^n c. 2^{2n} d. 2^{n^2} e. 2^{2^n}

34. Let $W(n)$ and $A(n)$ denote the worst case and the average case running time, respectively, for an algorithm for input size n. Which of the following is *always true* irrespective of the algorithm?

a. $A(n) = \Omega(W(n))$ b. $A(n) = \Theta(W(n))$ c. $A(n) = O(W(n))$ d. $A(n) = o(W(n))$ e. $A(n) = \omega(W(n))$

35. Arrange the following functions in the increasing asymptotic order:

i n^π

ii e^n

iii $n^{22/7}$

iv $n^2 \log^2 n$

v 2^n

a. i, iv, iii, v, ii b. iv, i, iii, v, ii c. iv, iii, i, v, ii d. iv, i, v, iii, ii e. iv, i, iii, ii, v