Sample Paper

CODE - AG-TMC-TS-TERM-1- 002

2

Time : 90 Minutes **Max Marks : 40**

General Instructions

1. *This question paper contains three sections – A, B and C. Each part is compulsory.*
2. *Section-A has **20** MCQs, attempt any **16** out of 20.*
3. *Section-B has **20** MCQs, attempt any **16** out of 20.*
4. *Section-C has **10** MCQs, attempt any **8** out of 10.*
5. *All questions carry equal marks.*
6. *There is no negative marking.*

SECTION-A

*In this section, attempt **any 16** questions out of questions 1-20. Each question is of 1 mark weightage.*

1. The relation $R = \{(1, 1), (2, 2), (3, 3)\}$ on the set $\{1, 2, 3\}$ is :

(a) symmetric only (b) reflexive only

(c) an equivalence relation (d) transitive only

2. $\begin{vmatrix} \cos 15° & \sin 15° \\ \sin 75° & \cos 75° \end{vmatrix} =$

(a) 0 (b) 5 (c) 3 (d) 7

3. If $\sin y = x \sin (a + y)$, then $\frac{dy}{dx}$ is equal to :

(a) $\frac{\sin \sqrt{a}}{\sin (a + y)}$ (b) $\frac{\sin^2 (a + y)}{\sin a}$

(c) $\sin (a + y)$ (d) None of these

4. Find the maximum profit that a company can make, if the profit function is given by $P(x) = 41 + 24x - 18x^2$.

(a) 25 (b) 43 (c) 62 (d) 49

5. If $-3x + 17 < -13$, then

(a) $x \in (10, \infty)$ (b) $x \in [10, \infty)$

(c) $x \in (-\infty, 10]$ (d) $x \in [-10, 10)$

6. Let L denote the set of all straight lines in a plane. Let a relation R be defined by $\alpha R \beta \Leftrightarrow \alpha \perp \beta, \alpha, \beta \in L$. Then, R is

(a) Reflexive (b) Symmetric

(c) Transitive (d) None of these

7. At how many points between the interval $(-\infty, \infty)$ is the function $f(x) = \sin x$ is not differentiable.

(a) 0 (b) 7 (c) 9 (d) 3

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8. Which of the following functions from I to itself is a bijection?

(a) $f(x)=x^3$ (b) $f(x)=x+2$

(c) $f(x)=2x+1$ (d) $f(x)=x^2+x$

9. Let A be a matrix of order 3 and let Δ denotes the value of determinant A. Then determinant $(-2A)=$

(a) -8Δ (b) -2Δ (c) 2Δ (d) 8Δ

10. On which of the following intervals is the function f given by $f(x)=x^{100}+\sin x-1$ strictly decreasing ?

(a) $(0,1)$ (b) $\left(\frac{\pi}{2},\pi\right)$

(c) $\left(0,\frac{\pi}{2}\right)$ (d) None of these

11. Let S be the set of all real numbers. Then, the relation $R=\{(a,b):1+ab>0\}$ on S is

(a) Reflexive and symmetric but not transitive (b) Reflexive and transitive but not symmetric

(c) Symmetric, transitive but not reflexive (d) Reflexive, transitive and symmetric

12. What is the x-coordinate of the point on the curve $f(x)=\sqrt{x}\,(7x-6)$, where the tangent is parallel to x-axis?

(a) $-\frac{1}{3}$ (b) $\frac{2}{7}$ (c) $\frac{6}{7}$ (d) $\frac{1}{2}$

13. If $f(x)=\begin{cases}\frac{[x]-1}{x-1}, x\neq 1\\ 0\quad , x=1\end{cases}$ then $f(x)$ is

(a) continuous as well as differentiable at x = 1 (b) differentiable but not continuous at x = 1

(c) continuous but not differentiable at x = 1 (d) neither continuous nor differentiable at x = 1

14. If area of triangle is 4 sq units with vertices (–2, 0), (0, 4) and (0, k), then k is equal to

(a) 0, –8 (b) 8 (c) –8 (d) 0, 8

15. The equation of one of the tangents to the curve $y=\cos(x+y)$, $-2\pi\le x\le 2\pi$ that is parallel to the line $x+2y=0$, is

(a) $x+2y=1$ (b) $x+2y=\pi/2$

(c) $x+2y=\pi/4$ (d) None of these

16. If $x<5$, then

(a) $-x,\le -5$ (b) $-x,\ge -5$ (c) $-x>-5$ (d) $-x<-5$

17. Given that x, y and b are real numbers and $x<y$, $b<0$, then

(a) $\frac{x}{b}<\frac{y}{b}$ (b) $\frac{x}{b}\le\frac{y}{b}$

(c) $\frac{x}{b}>\frac{y}{b}$ (d) $\frac{x}{b}\ge\frac{y}{b}$

18. Area of the triangle whose vertices are (a, b + c), (b, c + a) and (c, a + b), is

(a) 2 sq units (b) 3 sq units (c) 0 sq unit (d) None of these

19. Angle formed by the positive y-axis and the tangent to $y=x^2+4x-17$ at $\left(\frac{5}{2},\frac{-3}{4}\right)$ is

(a) $\tan^{-1}9$ (b) $\frac{\pi}{2}-\tan^{-1}9$

(c) $\frac{\pi}{2}+\tan^{-1}9$ (d) $\frac{\pi}{2}$

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20. If $A > 0$, $B > 0$ and $A + B = \pi/3$, then the maximum value of $\tan A \tan B$ is

(a) $\frac{1}{\sqrt{3}}$ (b) $\frac{1}{3}$ (c) 3 (d) $\sqrt{3}$

SECTION-B

*In this section, attempt **any 16** questions out of the questions 21-40. Each question is of 1 mark weightage.*

21. The corner points of the feasible region determined by the following system of linear inequalities:

$2x + y \le 10$, $x + 3y \le 15$, $x, y \ge 0$ are $(0, 0)$, $(5, 0)$, $(3, 4)$ and $(0, 5)$. Let $Z = px + qy$, where $p, q > 0$. Condition on p and q so that the maximum of Z occurs at both $(3, 4)$ and $(0, 5)$ is

(a) $p = q$ (b) $p = 2q$

(c) $p = 3q$ (d) $q = 3p$

22. Let $P = \{(x, y) \mid x^2 + y^2 = 1, x, y \in R\}$. Then, P is

(a) Reflexive (b) Symmetric

(c) Transitive (d) Anti-symmetric

23. If the function f be given by

$f(x) = x^3 - 3x + 3$, then

I. $x = \pm 2$ are the only critical points for local maxima or local minima.

II. $x = 1$ is a point of local minima.

III. local minimum value is 2.

IV. local maximum value is 5.

(a) Only I and II are true (b) Only II and III are true

(c) Only I, II and III are true (d) Only II and IV are true

24. If $f(x) = \begin{cases} -x^2, \text{when } x \le 0 \\ 5x - 4, \text{when } 0 < x \le 1 \\ 4x^2 - 3x, \text{when } 1 < x < 2 \\ 3x + 4, \text{when } x \ge 2 \end{cases}$, then

(a) $f(x)$ is continuous at $x = 0$ (b) $f(x)$ is continuous at $x = 2$

(c) $f(x)$ is discontinuous at $x = 1$ (d) None of these

25. If $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = \begin{vmatrix} a_1 & b_1 & 1 \\ a_2 & b_2 & 1 \\ a_3 & b_3 & 1 \end{vmatrix}$ then two triangles with vertices (x_1, y_1), (x_2, y_2), (x_3, y_3) and (a_1, b_1); (a_2, b_2); (a_3, b_3) are

(a) congruent (b) similar

(c) triangles of equal area (d) none of these

26. If $f(x) = \frac{x}{\sin x}$ and $g(x) = \frac{x}{\tan x}$, where $0 < x \le 1$, then in this interval,

(a) both $f(x)$ and $g(x)$ are increasing functions (b) both $f(x)$ and $g(x)$ are decreasing functions

(c) $f(x)$ is an increasing function (d) $g(x)$ is an increasing function

27. For all real values of x, the minimum value of $\frac{1 - x + x^2}{1 + x + x^2}$ is

(a) 0 (b) 1 (c) 3 (d) $\frac{1}{3}$

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28. Find the cofactor of the element a_{32} of the determinant $\begin{vmatrix} 2 & 3 & -4 \\ 3 & 6 & 5 \\ 1 & 8 & 9 \end{vmatrix}$

(a) –2 (b) –4 (c) –6 (d) –9

29. If $y = \log(\log x)$, then the value of $e^y \frac{dy}{dx}$ is :

(a) e^y (b) $\frac{1}{x}$ (c) $\frac{1}{(\log x)}$ (d) $\frac{1}{(x \log x)}$

30. For real numbers x and y, we write $x\ R\ y \Leftrightarrow x - y + \sqrt{2}$ is an irrational number. Then, the relation R is

(a) Reflexive (b) Symmetric (c) Transitive (d) None of these

31. If $\Delta = \begin{vmatrix} 1^2 & 2^2 & 3^2 \\ 2^2 & 3^2 & 4^2 \\ 3^2 & 4^2 & 5^2 \end{vmatrix}$, the minor of a_{22} is

(a) –46 (b) 46 (c) –56 (d) 56

32. The maximum value of $[x(x-1)+1]^{\frac{1}{3}}$, $0 \le x \le 1$ is

(a) $\left(\frac{1}{3}\right)^{\frac{1}{3}}$ (b) $\frac{1}{2}$ (c) 1 (d) 0

33. The maximum area of rectangle inscribed in a circle of diameter R is

(a) R^2 (b) $\frac{R^2}{2}$ (c) $\frac{R^2}{4}$ (d) $\frac{R^2}{8}$

34. The curve $y = x^{\frac{1}{5}}$ at (0, 0) has

(a) a vertical tangent (parallel to y-axis) (b) a horizontal tangent (parallel to x-axis)
(c) no oblique tangent (d) no tangent

35. If B is a non-singular matrix and A is a square matrix, then $\det(B^{-1}AB)$ is equal to

(a) $\det(A^{-1})$ (b) $\det(B^{-1})$
(c) $\det(A)$ (d) $\det(B)$

36. The equation of normal to the curve $3x^2 - y^2 = 8$ which is parallel to the line $x + 3y = 8$ is

(a) $3x - y = 8$ (b) $3x + y + 8 = 0$
(c) $x + 3y \pm 8 = 0$ (d) $x + 3y = 0$

37. $\frac{d}{dx}\left[\log\left\{e^x\left(\frac{x-2}{x+2}\right)\right\}^{3/4}\right]$ is equal to

(a) 1 (b) $\frac{x^2+1}{x^2-4}$

(c) $\frac{x^2-1}{x^2-4}$ (d) $e^x \frac{x^2-1}{x^2-4}$

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38. If the curve $ay + x^2 = 7$ and $x^3 = y$, cut orthogonally at (1, 1), then the value of a is

(a) 1 (b) 0 (c) -6 (d) 6

39. If $A = \begin{bmatrix} \alpha & \beta \\ \gamma & \alpha \end{bmatrix}$, then Adj. A is equal to :

(a) $\begin{bmatrix} \delta & -\gamma \\ -\beta & \alpha \end{bmatrix}$ (b) $\begin{bmatrix} \delta & -\beta \\ -\gamma & \alpha \end{bmatrix}$

(c) $\begin{bmatrix} -\delta & \beta \\ \gamma & -\alpha \end{bmatrix}$ (d) $\begin{bmatrix} -\delta & -\beta \\ \gamma & \alpha \end{bmatrix}$

40. The equation of tangent to the curve $y(1 + x^2) = 2 - x$, where it crosses X-axis is

(a) $x + 5y = 2$ (b) $x - 5y = 2$

(c) $5x - y = 2$ (d) $5x + y = 2$

SECTION-C

*In this section, attempt **any 8** questions. Each question is of 1 mark weightage. Questions 46-50 are based on a case-study.*

41. If $A = [a_{ij}]_{3 \times 4}$ is matrix given by

$$A = \begin{bmatrix} 4 & -2 & 1 & 3 \\ 5 & 7 & 9 & 6 \\ 21 & 15 & 18 & -25 \end{bmatrix}$$

Then, $a_{23} + a_{24}$ will be equal to the element

(a) a_{14} (b) a_{44}

(c) a_{13} (d) a_{32}

42. If $A = [a_{ij}]$ is a matrix of order 4×5, then the diagonal elements of A are

(a) $a_{11}, a_{22}, a_{33}, a_{44}$ (b) $a_{55}, a_{44}, a_{33}, a_{22}, a_{11}$

(c) a_{11}, a_{22}, a_{33} (d) do not exist

43. For any 2×2 matrix A, if A (adj. A) $= \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$, then $|A|$ is equal to :

(a) 0 (b) 10 (c) 20 (d) 100

44. If $A = \begin{bmatrix} 4 & -5 & -2 \\ 5 & -4 & 2 \\ 2 & 2 & 8 \end{bmatrix}$, then adj. (A) equals:

(a) $\begin{bmatrix} 36 & -36 & 18 \\ 36 & 36 & -18 \\ 18 & -18 & 9 \end{bmatrix}$ (b) $\begin{bmatrix} -36 & 36 & -18 \\ -36 & 36 & -18 \\ 18 & -18 & 9 \end{bmatrix}$

(c) $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ (d) None of these

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45. $f(x) = \frac{1}{1+\tan x}$

(a) is a continuous, real-valued function for all $x \in (-\infty, \infty)$

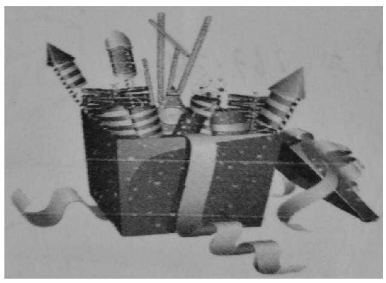
(b) is discontinuous only at $x = \frac{3\pi}{4}$

(c) has only finitely many discontinuities on $(-\infty, \infty)$

(d) has infinitely many discontinuities on $(-\infty, \infty)$

Case Study

On a Diwali day Niharika Singh went to bazaar to purchase fireworks at the rates given as:
10 hangers at ₹ 3 each, 8 fountains at ₹ 2 each, 6 atom bombs at ₹ 12 and 18 rockets at ₹ 8 each.



Based on the above information answer the following questions.

46. Representation of the prices in column matrix is

(a) [3 2 12 8]

(b) [3 2 8 12]

(c) $\begin{bmatrix} 3 \\ 2 \\ 8 \\ 12 \end{bmatrix}$

(d) $\begin{bmatrix} 3 \\ 2 \\ 12 \\ 8 \end{bmatrix}$

47. Find the individual total cost of each item

(a) [30 16 72 144]

(b) [3 2 12 8]

(c) [10 8 6 18]

(d) [30 16 144 72]

48. Find how much Niharika Singh paid for the fireworks.

(a) ₹ 262

(b) ₹ 42

(c) ₹ 25

(d) ₹ 1050

49. If each price hike by 2%, then how much Niharika Singh paid for the fireworks.

(a) ₹ 264

(b) ₹ 267

(c) ₹ 1052

(d) ₹ 1071

50. If Niharika purchase only 10 rockets, then how much she paid for the fireworks.

(a) ₹ 850

(b) ₹ 198

(c) ₹ 34

(d) ₹ 25

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Sample Paper 2

ANSWER KEYS																			
1	(b)	**6**	(b)	**11**	(a)	**16**	(c)	**21**	(d)	**26**	(c)	**31**	(c)	**36**	(c)	**41**	(d)	**46**	(d)
2	(a)	**7**	(a)	**12**	(b)	**17**	(c)	**22**	(b)	**27**	(d)	**32**	(c)	**37**	(c)	**42**	(b)	**47**	(a)
3	(b)	**8**	(b)	**13**	(d)	**18**	(c)	**23**	(d)	**28**	(a)	**33**	(c)	**38**	(d)	**43**	(b)	**48**	(a)
4	(d)	**9**	(a)	**14**	(d)	**19**	(b)	**24**	(b)	**29**	(b)	**34**	(b)	**39**	(b)	**44**	(b)	**49**	(b)
5	(a)	**10**	(d)	**15**	(b)	**20**	(b)	**25**	(c)	**30**	(a)	**35**	(c)	**40**	(a)	**45**	(d)	**50**	(b)

SOLUTIONS

1. **(b)** Given relation is $R=\{(1,1),(2,2),(3,3)\}$ on the set $\{1,2,3\}$.

This relation is not symmetric, not transitive. only reflexive. ($\because$ a R a, b R b, c R c).

2. **(a)** **3.** **(b)** **4.** **(d)**

5. **(a)** $-3x < -13 - 17 \Rightarrow -3x < -30 \Rightarrow x > 10$

$\Rightarrow \quad x \in (10, \infty)$.

6. **(b)** Given $\alpha R \beta \Leftrightarrow \alpha \perp \beta \therefore \alpha \perp \beta \Leftrightarrow \beta \perp \alpha \Rightarrow \beta R \alpha$

Hence, R is symmetric.

7. **(a)** The function f (x) = sin x is differentiable for all $x \in R$. Therefore the number of points in the interval $(-\infty, \infty)$ where the function is not differentiable are zero.

8. **(b)**

9. **(a)** $|-2A| = (-2)^3 |A| = -8\Delta$

10. **(d)**

11. **(a)** **Reflexive:** As $1 + a.\ a = 1 + a^2 > 0,\ a \in S$

$\therefore (a,a) \in R \quad \therefore$ R is reflexive.

Symmetric: $(a,b) \in R \Rightarrow 1 + ab > 0$

$\Rightarrow 1 + ba > 0 \Rightarrow (b,a) \in R, \quad \therefore$ R is symmetric.

Transitive: $(a,b) \in R$ and $(b,c) \in R$ need not imply $(a,c) \in R$. Hence, R is not transitive.

12. **(b)** **13.** **(d)** **14.** **(d)**

15. **(b)** $y = \cos(x+y) \qquad \ldots(i)$

$$\therefore \quad \frac{dy}{dx} = -\sin(x+y)\left\{1 + \frac{dy}{dx}\right\}$$

$$\therefore \quad \frac{dy}{dx} = -\frac{\sin(x+y)}{1+\sin(x+y)} = -\frac{1}{2}$$

$\Rightarrow \quad \sin(x+y) = 1$, so $\cos(x+y) = 0$

$\therefore$ from (i), $y = 0$ and $(x+y) = 2n\pi + \frac{\pi}{2}$

Tangent at $\left(\frac{\pi}{2}, 0\right)$ is $x + 2y = \frac{\pi}{2}$

16. **(c)** As $x < 5$, So $-x > -5$

If an inequality is multiplied by a negative number, then the sign of inequality get reversed.

17. **(c)** $x < y \Rightarrow \frac{x}{b} > \frac{y}{b} \quad (b < 0)$

18. **(c)** **19.** **(b)** **20.** **(b)**

21. **(d)** Maximum value of Z = px + qy occurs at (3, 4) and (0, 5),

At (3, 4), $Z = px + qy = 3p + 4q$

At (0, 5), $Z = 0 + q \cdot 5 = 5q$

Both are the maximum values

$\Rightarrow 3p + 4q = 5q \quad$ or $\quad q = 3p$

22. **(b)** The relation is not reflexive and transitive but it is symmetric, because $x^2 + y^2 = 1 \Rightarrow y^2 + x^2 = 1$

23. **(d)** **24.** **(b)** **25.** **(c)**

26. **(c)** We have $f(x) = \frac{x}{\sin x}, \ 0 < x \le 1$

$$\therefore f'(x) = \frac{\sin x - x\cos x}{\sin^2 x} = \frac{\cos x(\tan x - x)}{\sin^2 x}$$

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We know that $\tan x > x$ for $0 < x < \pi/2$

or $f'(x) > 0$ for $0 < x < \leq 1$

Hence, $f(x)$ is an increasing function. $g(x) = \dfrac{x}{\tan x}$

$$\therefore g'(x) = \frac{\tan x - x\sec^2 x}{\tan^2 x} = \frac{\sin x \cos x - x}{\sin^2 x}$$

$$= \frac{\sin 2x - 2x}{2\sin^2 x} = \frac{\sin\theta - \theta}{2\sin^2(\theta/2)}, \text{ where } \theta \in (0, 2).$$

We know that $\sin\theta < \theta \forall \theta > 0$.

Thus, $g'(x) < 0$, i.e., $g(x)$ is a decreasing function.

27. **(d)** **28.** **(a)** **29.** **(b)**

30. **(a)** Reflexive: For any $x \in R$, we have $x - x + \sqrt{2} = \sqrt{2}$ an irrational number.

$\Rightarrow x \, R \, x$ for all x. So, R is reflexive.

Symmetric: R is not symmetric, because $\sqrt{2}$ R 1 but $1 \not R \sqrt{2}$,

Transitive: R is not transitive also because $\sqrt{2}$ R 1 and 1 R $2\sqrt{2}$ but $\sqrt{2} \not R 2\sqrt{2}$.

31. **(c)**

32. **(c)** Let $y = [x(x-1)+1]^{1/3}$

$$\therefore \frac{dy}{dx} = \frac{(2x-1)}{3[x(x-1)+1]^{2/3}}, \frac{dy}{dx} = 0 \text{ at } x = \frac{1}{2}$$

$\dfrac{dy}{dx}$ Changes sign from –ve to + ve at $x = \dfrac{1}{2}$

$\therefore$ y is minimum at $x = \dfrac{1}{2}$

Value of y at $x = 0, (0+1)^{1/3} = 1^{1/3} = 1$

Value of y at $x = 1, (0+1)^{1/3} = 1^{1/3} = 1$

$\therefore$ The maximum value of y is 1.

33. **(c)**

34. **(b)** Given $y = x^{\frac{1}{5}}$

$$\Rightarrow \frac{dy}{dx} = \frac{1}{5}x^{-4/5} \Rightarrow \frac{dy}{dx} \text{ at } (0,0) = \frac{1}{5}(0) \Rightarrow \frac{dy}{dx} = 0$$

35. **(c)** $\det(B^{-1}AB) = \det(B^{-1})\det A \det B$

$= \det(B^{-1}).\det B.\ \det A = \det(B^{-1}B).\det A$

$= \det(I).\ \det A = 1.\ \det A = \det A.$

36. **(c)** **37.** **(c)** **38.** **(d)** **39.** **(b)** **40.** **(a)**

41. **(d)** **42.** **(b)** **43.** **(b)** **44.** **(b)** **45.** **(d)**

46. **(d)** **47.** **(a)** **48.** **(a)** **49.** **(b)** **50.** **(b)**

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