QUARTERLY EXAM - SEPTEMBER - 2024

12 – STD **Mathematics**

Time : 3.00 Hours Marks : 90

PART - I

Note : i) All questions are compulsory $20 \times 1 = 20$

ii) Choose the most appropriate answer from the given four alternatives and write the option code and the corresponding answer

1. If $P = \begin{bmatrix} 1 & x & 0 \\ 1 & 3 & 0 \\ 2 & 4 & -2 \end{bmatrix}$ is the adjoint of 3×3 matrix A and $|A| = 4$, then x is

   (1) 15 (2) 12 (3) 14 (4) 11

2. If $A = \begin{bmatrix} 3 & 5 \\ 1 & 2 \end{bmatrix}$, $B = \text{adj}\, A$ and $C = 3A$, then $\frac{|\text{adj } B|}{|C|} =$

   (1) $\frac{1}{3}$ (2) $\frac{1}{9}$ (3) $\frac{1}{4}$ (4) 1

3. If adj $A = \begin{bmatrix} 2 & 3 \\ 4 & -1 \end{bmatrix}$ and adj $B = \begin{bmatrix} 1 & -2 \\ -3 & 1 \end{bmatrix}$ then adj (AB) is

   (1) $\begin{bmatrix} -7 & -1 \\ 7 & -9 \end{bmatrix}$ (2) $\begin{bmatrix} -6 & 5 \\ -2 & -10 \end{bmatrix}$ (3) $\begin{bmatrix} -7 & 7 \\ -1 & -9 \end{bmatrix}$ (4) $\begin{bmatrix} -6 & -2 \\ 5 & -10 \end{bmatrix}$

4. $i^n + i^{n+1} + i^{n+2} + i^{n+3}$ is (1) 0 (2) 1 (3) -1 (4) i

5. If $\left|z - \frac{3}{z}\right| = 2$, then the least value of $|z|$ is

   (1) 1 (2) 2 (3) 3 (4) 5

6. The principal argument of $(\sin 40° + i\cos 40°)^5$ is

   (1) $-110°$ (2) $-70°$ (3) $70°$ (4) $110°$

7. If f and g are polynomials of degrees m and n respectively, and if $h(x) = (f \circ g)(x)$, then the degree of h is

   (1) mn (2) $m + n$ (3) m^n (4) n^m

8. The number of real numbers in $[0,2\pi]$ satisfying $\sin^4 x - 2\sin^2 x + 1$ is

   (1) 2 (2) 4 (3) 1 (4) ∞

9. If $p + \sqrt{q}$ and $-i\sqrt{q}$ are the roots of a polynomial equation with rational Coefficients then the least possible degree of the equation is

   1) 2 2) 1 3) 3 4) 4

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10. $If\ \sin^{-1} x + \sin^{-1} y = \frac{2\pi}{3}$ then $\cos^{-1} x + \cos^{-1} y$ is equal to

(1) $\frac{2\pi}{3}$ (2) $\frac{\pi}{3}$ (3) $\frac{\pi}{6}$ (4) π

11. $\cos(\cos^{-1} x) = x$ if

1) $|x| < 1$ 2) $|x| \leq 1$ 3) $|x| \geq 1$ 4) $|x| = 0$

12. If the function $f(x) = \sin^{-1}(x^2 - 3)$, then x belongs to

(1) $[-1,1]$ (2) $[\sqrt{2}, 2]$ (3) $[-2, -\sqrt{2}] \cup [\sqrt{2}, 2]$ (4) $[-2, -\sqrt{2}]$

13. The radius of the circle $3x^2 + by^2 + 4bx - 6by + b^2 = 0$ is

1) 1 2) 3 3) $\sqrt{10}$ 4) $\sqrt{11}$

14. If $x + y = k$ is a normal to the parabola $y^2 = 12x$, then the value of k is

1) 3 (2) −1 (3) 1 (4) 9

15. $y = mx + c$ is a tangent to the parabola $y^2 = 4ax$ then

1) $c = \frac{a}{m}$ 2) $c = \frac{m}{a}$ 3) $c^2 = a^2m^2 + m^2$ 4) $m = c$

16. The eccentricity of the ellipse $(x - 3)^2 + (y - 4)^2 = \frac{y^2}{9}$ is

1) $\frac{\sqrt{3}}{2}$ 2) $\frac{1}{3}$ 3) $\frac{1}{3\sqrt{2}}$ 4) $\frac{1}{\sqrt{3}}$

17. If $\vec{a} \cdot \vec{b} = \vec{b} \cdot \vec{c} = \vec{c} \cdot \vec{a} = 0$, then the value of $[\vec{a}, \vec{b}, \vec{c}]$ is

1) $|\vec{a}||\vec{b}||\vec{c}|$ 2) $\frac{1}{3}|\vec{a}||\vec{b}||\vec{c}|$ 3) 1 4) −1

18. Which one is meaningful ?

1) $(\vec{a} \times \vec{b}) \times (\vec{b} \cdot \vec{c})$ 2) $\vec{a} \times (5 + \vec{b})$ 3) $(\vec{a}.\vec{b}) \times (\vec{c}.\vec{d})$ 4) $(\vec{a} \times \vec{b}).(\vec{c} \times \vec{d})$

19. If $\vec{a} = \hat{\imath} + \hat{\jmath} + \hat{k}, \vec{b} = \hat{\imath} + \hat{\jmath}, \vec{c} = \hat{\imath}$ and $(\vec{a} \times \vec{b}) \times \vec{c} = \lambda\vec{a} + \mu\vec{b}$, then the value of $\lambda + \mu$ is

1) 0 2) 1 3) 6 4) 3

20. The distance between the planes $x + 2y + 3z + 7 = 0$ and $2x + 4y + 6z + 7 = 0$ is

(1) $\frac{\sqrt{7}}{2\sqrt{2}}$ (2) $\frac{7}{2}$ (3) $\frac{\sqrt{7}}{2}$ (4) $\frac{7}{2\sqrt{2}}$

PART – II

Note : i) Answer any Seven questions **7 ×2 = 14**

ii) Question number 30 is compulsory .

21. If $\text{adj}(A) = \begin{bmatrix} 0 & -2 & 0 \\ 6 & 2 & -6 \\ -3 & 0 & 6 \end{bmatrix}$, find A^{-1}.

22. Find the square root of $6 - 8i$.

23. If α, β, γ are the roots of the equation $x^3 + px^2 + qx + r = 0$, find the value of $\sum \frac{1}{\beta\gamma}$ in terms of the coefficients.

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24. Find the principal value of $tan^{-1}(\sqrt{3})$.

25. Find the general equation of the circle whose diameter is the line segment joining the points $(-4,-2)$ and $(1, 1)$.

26. If $2\hat{\imath}-\hat{\jmath}+3\hat{k}, 3\hat{\imath}+2\hat{\jmath}+\hat{k}, \hat{\imath}+m\hat{\jmath}+4\hat{k}$ are coplanar, find the value of m.

27. Find the product $\frac{3}{2}\left(cos\frac{\pi}{3}+i\,sin\frac{\pi}{3}\right).6\left(cos\frac{5\pi}{6}+i\,sin\frac{5\pi}{6}\right)$ in rectangular from.

28. Solve the following systems of linear equations by Cramer's rule:

$5x-2y+16=0, x+3y-7=0$

29. Find the coordinates of the point where the straight line $\vec{r}=(2\hat{\imath}-\hat{\jmath}+2\hat{k})+t(3\hat{\imath}+4\hat{\jmath}+2\hat{k})$ intersects the plane $x-y+z-5=0$.

30. The parabolic communications antenna has a focus at $4m$ distance from the vertex of the antenna. Write an equation of the parabolic arch.

Part – III

Note : i) Answer any Seven questions **7 ×3 = 21**

ii) Question number 40 is compulsory .

31. Solve the following system of linear equations, using matrix inversion method:

$5x+2y=3, 3x+2y=5.$

32. Write in polar form of the following complex numbers :$2+i2\sqrt{3}$

33. Show that the equation $x^9-5x^5+4x^4+2x^2+1=0$ has atleast 6 imaginary solutions.

34. Find the value of $tan^{-1}(-1)+cos^{-1}\left(\frac{1}{2}\right)+sin^{-1}\left(-\frac{1}{2}\right)$.

35. Find the equation of the parabola whose vertex is $(5,-2)$ and focus $(2,-2)$.

36. A particle acted on by constant forces $8\hat{\imath}+2\hat{\jmath}-6\hat{k}$ and $6\hat{\imath}+2\hat{\jmath}-2\hat{k}$ is displaced from the point (1,2,3) to the point (5,4,1). Find the total work done by the forces.

37. Construct a cubic equation with roots : 1,2, and 3

38. Find the rank of each of the following matrices: $\begin{bmatrix}3 & 2 & 5\\ 1 & 1 & 2\\ 3 & 3 & 6\end{bmatrix}$.

39. Find the angle between the straight lines $\frac{x-4}{2}=\frac{y}{1}=\frac{z+1}{-2}$ and $\frac{x-1}{4}=\frac{y+1}{-4}=\frac{z-2}{2}$ and state whether they are parallel or perpendicular.

40. Find the value of the real numbers x and y, if the complex numbers $(2+i)x+(1-i)y-5$ And $x+(-1+2i)\,y$ are equal.

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PART – IV

Note : i) Answer all the questions . 7×5 = 35

41. a) Prove by vector method that $sin(\alpha - \beta) = sin\,\alpha\,cos\,\beta - cos\,\alpha\,sin\,\beta$. **(OR)**

b) If $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$, verify that $A(\text{adj } A) = (\text{adj } A)A = |A|I_3$.

42. a) If $z = x + iy$ and $\arg\left(\frac{z-1}{z+1}\right) = \frac{\pi}{2}$, show that $x^2 + y^2 = 1$. **(OR)**

b) If $tan^{-1} x + tan^{-1} y + tan^{-1} z = \pi$, show that $x + y + z = xyz$.

43. a) Identify the type of conic and find centre, foci, vertices, and directrices of each of the following : $18x^2 + 12y^2 - 144x + 48y + 120 = 0$. **(OR)**

b) Find all cube roots of $\sqrt{3} + i$.

44 . a)Solve the equation $(x-2)(x-7)(x-3)(x+2) + 19 = 0$. **(OR)**

b)If the normal at the point $'t_1'$ on the parabola $y^2 = 4ax$ meets the parabola again at the point $'t_2'$ then prove that $t_2 = -\left(t_1 + \frac{2}{t_1}\right)$.

45 . a)Test for consistency of the following system of linear equations and if possible, solve:

$4x - 2y + 6z = 8,\ x + y - 3z = -1, 15x - 3y + 9z = 21$. **(OR)**

b) If $2 + i$ and $3 - \sqrt{2}$ are roots of the equation

$x^6 - 13x^5 + 62x^4 - 126x^3 + 65x^2 + 127x - 140 = 0$ find the all roots .

46. a) Evaluate $sin\left[sin^{-1}\left(\frac{3}{5}\right) + sec^{-1}\left(\frac{5}{4}\right)\right]$. **(OR)**

b) Find the parametric, non parametric form of vector and Cartesian form of the equations of the plane passing through the three non-collinear points $(3, 6, -2), (-1, -2, 6)$, and $(6, 4, -2)$.

47. a) If $\vec{a} = 2\hat{\imath} + 3\hat{\jmath} - \hat{k}, \vec{b} = 3\hat{\imath} + 5\hat{\jmath} + 2\hat{k}, \vec{c} = -\hat{\imath} - 2\hat{\jmath} + 3\hat{k}$, verify that $\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a}.\vec{c})\vec{b} - (\vec{a}.\vec{b})\vec{c}$. **(OR)**

b) On lighting a rocket cracker it gets projected in a parabolic path and reaches a maximum height of 4m when it is 6m away from the point of projection. Finally it reaches the ground 12m away from the starting point. Find the angle of projection.

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