

Total No. of Questions – 24

Total No. of Printed Pages - 4

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Part – III
MATHEMATICS, Paper – I(A)
(English Version)

Time : 3 Hours]

[Max. Marks : 75

Note : This question paper consists of **three** Sections – **A, B** and **C**.**SECTION – A****10 × 2 = 20****I. Very Short Answer Type questions :**(i) Answer **all** questions.(ii) Each question carries **two** marks.1. If $A = \{-2, -1, 0, 1, 2\}$, and $f: A \rightarrow B$ is a surjection defined by $f(x) = x^2 + x + 1$, then find B.2. Find the domain of the real valued function $f(x) = \sqrt{9 - x^2}$.3. Construct a 3×2 matrix whose elements are defined by $a_{ij} = \frac{1}{2} |i - 3j|$.4. If $A = \begin{bmatrix} 2 & 4 \\ -1 & k \end{bmatrix}$ and $A^2 = O$, then find the value of k.5. If α, β, γ are the angles made by the vector $3\vec{i} - 6\vec{j} + 2\vec{k}$ with the positive directions of the co-ordinate axes, then find $\cos \alpha, \cos \beta, \cos \gamma$.

6. Find the vector equation of the plane passing through the points $\vec{i} - 2\vec{j} + 5\vec{k}$, $-5\vec{j} - \vec{k}$ and $-3\vec{i} + 5\vec{j}$.
7. If $\vec{a} = \vec{i} - \vec{j} - \vec{k}$ and $\vec{b} = 2\vec{i} - 3\vec{j} + \vec{k}$, then find the projection vector of \vec{b} on \vec{a} .
8. If $\cos \theta = t$ ($0 < t < 1$) and θ does not lie in the first quadrant, find the values of $\sin \theta$ and $\tan \theta$.
9. Find the maximum and minimum values of $13 \cos x + 3\sqrt{3} \sin x - 4$.
10. Show that $\tan^{-1} \left(\frac{1}{2} \right) = \frac{1}{2} \log_e 3$.

SECTION - B

5 × 4 = 20

II. Short Answer Type questions :

- (i) Answer any **five** questions.
- (ii) Each question carries **four** marks.

11. If A is a non-singular matrix, then prove that $A^{-1} = \frac{\text{adj } A}{|A|}$.

12. If $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar vectors, then prove that the four points $-\vec{a} + 4\vec{b} - 3\vec{c}$, $3\vec{a} + 2\vec{b} - 5\vec{c}$, $-3\vec{a} + 8\vec{b} - 5\vec{c}$ and $-3\vec{a} + 2\vec{b} + \vec{c}$ are coplanar.

13. Find the unit vector perpendicular to the plane and passing through the points (1, 2, 3), (2, -1, 1) and (1, 2, -4).
14. Prove that $\sqrt{3} \operatorname{cosec} 20^\circ - \sec 20^\circ = 4$.
15. Solve the equation $1 + \sin^2 \theta = 3 \sin \theta \cos \theta$.
16. Show that $\tan^{-1} \frac{1}{2} + \tan^{-1} \frac{1}{5} + \tan^{-1} \frac{1}{8} = \frac{\pi}{4}$.
17. If $\cot \frac{A}{2} : \cot \frac{B}{2} : \cot \frac{C}{2} = 3 : 5 : 7$, then show that $a : b : c = 6 : 5 : 4$ (In ΔABC)

SECTION - C

5 × 7 = 35

III. Long Answer Type questions :

- (i) Answer any **five** questions.
- (ii) Each question carries **seven** marks.

18. If $f : A \rightarrow B$ be a bijection, then prove that (i) $f \circ f^{-1} = I_B$ (ii) $f^{-1} \circ f = I_A$.
19. Show that $49^n + 16n - 1$ is divisible by 64 for all positive integers n .

20. Show that
$$\begin{vmatrix} 1 & a^2 & a^3 \\ 1 & b^2 & b^3 \\ 1 & c^2 & c^3 \end{vmatrix} = (a - b)(b - c)(c - a)(ab + bc + ca).$$

21. Solve $x + y + z = 9$, $2x + 5y + 7z = 52$ and $2x + y - z = 0$ by using matrix inversion method.

22. If $A = (1, -2, -1)$, $B = (4, 0, -3)$, $C = (1, 2, -1)$ and $D = (2, -4, -5)$, then find the shortest distance between the lines \overleftrightarrow{AB} and \overleftrightarrow{CD} .

23. If $A + B + C = 180^\circ$, then show that

$$\cos 2A + \cos 2B + \cos 2C = -4 \cos A \cdot \cos B \cdot \cos C - 1.$$

24. If $r_1 = 8$, $r_2 = 12$, $r_3 = 24$, then find the values of a , b , c (in ΔABC).