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II

Total No. of Questions – 24 **Regd. No.**

Total No. of Printed Pages - 4

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 $10 \times 2 = 20$

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 → 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 lies 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 $\tanh^{-1}\left(\frac{1}{2}\right) = \frac{1}{2}\log_e 3$.

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 $\sqrt{3}$ cosec 20° – sec 20° = 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

$5 \times 7 = 35$

III. Long Answer Type questions :

(i) Answer any **five** questions.

(ii) Each question carries **seven** marks.

18. If $f : A \to B$ be a bijection, then prove that (i) $fof^{-1} = I_B$ (ii) $f^{-1}of = I_A$.

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°, then show that

cos 2A + cos 2B + cos 2C = – 4 cosA · cosB · cosC – 1.

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

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