



Total No. of Questions : 24
Total No. of Printed Pages : 3

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Part - III
MATHEMATICS - PAPER - I (A)
(English Version)

Max. Marks :

Time : 3 Hours

Note : This question paper consists of Three Sections - A, B and C.

SECTION - A



10x2=20

I. Very Short Answer Type Questions.

- (i) Answer *all* the questions.
(ii) Each question carries *two* marks.

1. Find the domain of the real valued function $f(x) = \frac{1}{\sqrt{1-x^2}}$.



2. If $A = \{1, 2, 3, 4\}$ and $f : A \rightarrow \mathbb{R}$ is a function defined by $f(x) = \frac{x^2 - x + 1}{x + 1}$, then find the range of f .

3. Find the co-factors of the elements 2, -5 in the matrix $\begin{bmatrix} -1 & 0 & 5 \\ 1 & 2 & -2 \\ -4 & -5 & 3 \end{bmatrix}$.



4. If $\begin{bmatrix} x-1 & 2 & 5-y \\ 0 & z & 1 \\ 1 & 0 & a-5 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 7 \\ 1 & 0 & 0 \end{bmatrix}$ then find the values of x , y , z and a .

5. Find a vector in the direction of vector $a = i - 2j$ that has magnitude 7 units.

6. Find the vector equation of the line joining the points $2i + j + 3k$ and $-4i + 3j - k$.

7. Find the angle between the planes $r \cdot (2i - j + 2k) = 3$ and $r \cdot (3i + 6j + k) = 4$.

8. Find the maximum and minimum values of $3 \sin x - 4 \cos x$.

9. If $\tan 20^\circ = \lambda$, then show that $\frac{\tan 160^\circ - \tan 110^\circ}{1 + \tan 160^\circ \cdot \tan 110^\circ} = \frac{1 - \lambda^2}{2\lambda}$.

10. Show that $\tanh^{-1}\left(\frac{1}{2}\right) = \frac{1}{2} \log_e 3$.

SECTION - B

II. Short Answer Type Questions.

5x4=20

(i) Answer any five questions.

(ii) Each question carries four marks.

11. If $A = \begin{bmatrix} 2 & -4 \\ -5 & 3 \end{bmatrix}$ then find $A+A'$ and AA' .

12. If the points whose position vectors are $3i-2j-k$, $2i+3j-4k$, $-i+j+2k$ and $4i+5j+\lambda k$ are coplanar, then show that $\lambda = -\frac{146}{17}$.

13. Find the volume of the tetrahedron whose vertices are $(1, 2, 1)$, $(3, 2, 5)$, $(2, -1, 0)$ and $(-1, 0, 1)$.

14. Prove that $\sin^2 \theta + \sin^2 \left(\theta + \frac{\pi}{3} \right) + \sin^2 \left(\theta - \frac{\pi}{3} \right) = \frac{3}{2}$.

15. Solve $\tan \theta + 3 \cot \theta = 5 \sec \theta$.

16. Prove that $\cos \left(2 \tan^{-1} \frac{1}{7} \right) = \sin \left(2 \tan^{-1} \frac{3}{4} \right)$.

17. Prove that $\frac{a}{bc} + \frac{\cos A}{a} = \frac{b}{ca} + \frac{\cos B}{b} = \frac{c}{ab} + \frac{\cos C}{c}$.



SECTION - C

III. Long Answer Type Questions.

5×7=35

(i) Answer *any five* questions.(ii) Each question carries *seven* marks.18. Let $f: A \rightarrow B$ be a bijection. Then prove that $f \circ f^{-1} = I_B$ and $f^{-1} \circ f = I_A$.

19. Using mathematical induction, prove that

$$\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} + \cdots + \frac{1}{(2n-1)(2n+1)} = \frac{n}{2n+1}, \text{ for all } n \in \mathbf{N}.$$

20. Solve the following system of equations by using matrix inversion method.

$$x + y + z = 1,$$

$$2x + 2y + 3z = 6,$$

$$x + 4y + 9z = 3.$$



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

22. Find the shortest distance between the skew lines $r = (6i + 2j + 2k) + t(i - 2j + 2k)$ and $r = (-4i - k) + s(3i - 2j - 2k)$.23. If $A + B + C = \pi$, then prove that

$$\cos^2 \frac{A}{2} + \cos^2 \frac{B}{2} + \cos^2 \frac{C}{2} = 2 \left(1 + \sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2} \right).$$

24. Show that $\cos A + \cos B + \cos C = 1 + \frac{r}{R}$.