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166**I**

Total No. of Questions : 24

Total No. of Printed Pages : 3

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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****I. Very Short Answer Type Questions.****10x2=20**

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

1. If $f: \mathbb{R} \setminus \{0\} \rightarrow \mathbb{R}$ is defined by $f(x) = x^3 - \frac{1}{x^3}$, then show that $f(x) + f\left(\frac{1}{x}\right) = 0$.

2. Determine whether the following function is even or odd :
 $f(x) = a^x - a^{-x} + \sin x$

3. If $A = \begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$, find A^2 .

4. Find the rank of the following matrix :

$$\begin{bmatrix} 1 & 4 & -1 \\ 2 & 3 & 0 \\ 0 & 1 & 2 \end{bmatrix}$$

5. $\vec{a} = 2\vec{i} + 5\vec{j} + \vec{k}$ and $\vec{b} = 4\vec{i} + m\vec{j} + n\vec{k}$ are collinear vectors, then find m and n .

6. Find the vector equation of the line passing through the point $2\vec{i} + 3\vec{j} + \vec{k}$ and parallel to the vector $4\vec{i} - 2\vec{j} + 3\vec{k}$.

7. For what values of λ , the vectors $\vec{i} - \lambda\vec{j} + 2\vec{k}$ and $8\vec{i} + 6\vec{j} - \vec{k}$ are at right angles ?

8. Find a sine function whose period is $\frac{2}{3}$.

9. Express $\frac{\sqrt{3} \cos 25^\circ + \sin 25^\circ}{2}$ as a \sin of an angle.

10. If $\sinh x = 3$, then show that $x = \log_e(3 + \sqrt{10})$.

SECTION - B

II. Short Answer Type Questions.

5x4=20

(i) Answer any five questions.

(ii) Each question carries four marks.

11. If $A = \begin{bmatrix} -1 & 2 \\ 0 & 1 \end{bmatrix}$ then find AA' . Do A and A' commute with respect to multiplication of matrices.

12. $\bar{a}, \bar{b}, \bar{c}$ are non-coplanar vectors. Prove that the following four points are coplanar :

$$-\bar{a} + 4\bar{b} - 3\bar{c}, 3\bar{a} + 2\bar{b} - 5\bar{c}, -3\bar{a} + 8\bar{b} - 5\bar{c}, -3\bar{a} + 2\bar{b} + \bar{c}$$

13. Find a vector of magnitude 3 and perpendicular to both the vectors.

$$\bar{b} = 2\bar{i} - 2\bar{j} + \bar{k} \text{ and } \bar{c} = 2\bar{i} + 2\bar{j} + 3\bar{k}$$

14. If $3 \sin \theta + 4 \cos \theta = 5$, then find the value of $4 \sin \theta - 3 \cos \theta$.

15. Show that :

$$\cos^2\left(\frac{\pi}{10}\right) + \cos^2\left(\frac{2\pi}{5}\right) + \cos^2\left(\frac{3\pi}{5}\right) + \cos^2\left(\frac{9\pi}{10}\right) = 2$$

16. Show that, for any $\theta \in \mathbb{R}$,

$$4 \sin \frac{5\theta}{2} \cos \frac{3\theta}{2} \cos 3\theta = \sin \theta - \sin 2\theta + \sin 4\theta + \sin 7\theta.$$

17. Prove that :

$$\tan \frac{A}{2} + \tan \frac{B}{2} + \tan \frac{C}{2} = \frac{bc + ca + ab - s^2}{\Delta}$$

SECTION - C

3002

III. Long Answer Type Questions.

5x7=35

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

18. If $f(x) = x^2$ and $g(x) = |x|$, find the following functions.

- (i) $f + g$ (ii) $f - g$ (iii) fg
(iv) $2f$ (v) f^2 (vi) $f + 3$

19. Solve $3x + 4y + 5z = 18$, $2x - y + 8z = 13$ and $5x - 2y + 7z = 20$ by using 'Matrix Inversion Method'.

20. Solve $x - y + 3z = 5$, $4x + 2y - z = 0$, $-x + 3y + z = 5$ by using Cramer's Rule.

21. Show that the line joining the pair of points $6\bar{a} - 4\bar{b} + 4\bar{c}$, $-4\bar{c}$ and the line joining the pair of points $-\bar{a} - 2\bar{b} - 3\bar{c}$, $\bar{a} + 2\bar{b} - 5\bar{c}$ intersect at the point $-4\bar{c}$ when \bar{a} , \bar{b} , \bar{c} are non-coplanar vectors.

22. If $\bar{a} = 7\bar{i} - 2\bar{j} + 3\bar{k}$, $\bar{b} = 2\bar{i} + 8\bar{k}$ and $\bar{c} = \bar{i} + \bar{j} + \bar{k}$, then compute $\bar{a} \times \bar{b}$, $\bar{a} \times \bar{c}$ and $\bar{a} \times (\bar{b} + \bar{c})$. Verify whether the cross product is distributive over vector addition.

23. If A, B, C are angles of a triangle, then prove that :

$$\sin^2 \frac{A}{2} + \sin^2 \frac{B}{2} - \sin^2 \frac{C}{2} = 1 - 2\cos \frac{A}{2} \cos \frac{B}{2} \sin \frac{C}{2}$$

24. Show that :

$$r + r_3 + r_1 - r_2 = 4R \cos B$$

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