



166

I

Total No. of Questions : 24

Total No. of Printed Pages : 3

Reg. No.

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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** the 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  $f(x) = \log(x^2 - 4x + 3)$ .

3) Define trace of matrix. Find the trace of A if  $A = \begin{bmatrix} 1 & 2 & -\frac{1}{2} \\ 0 & -1 & 2 \\ -\frac{1}{2} & 2 & 1 \end{bmatrix}$ .

4) Find the Rank of  $\begin{bmatrix} -1 & -2 & -3 \\ 3 & 4 & 5 \\ 4 & 5 & 6 \end{bmatrix}$ .

5) If the vectors  $-3\vec{i} + 4\vec{j} + \lambda\vec{k}$  and  $\mu\vec{i} + 8\vec{j} + 6\vec{k}$  are collinear vectors, then find  $\lambda$  and  $\mu$ .

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

7) If  $\vec{a} = 2\vec{i} - 3\vec{j} + 5\vec{k}$ ,  $\vec{b} = -\vec{i} + 4\vec{j} + 2\vec{k}$  then find  $\vec{a} \times \vec{b}$  and unit vector perpendicular to both  $\vec{a}$  and  $\vec{b}$ . 

8) Find the period of the function  $\tan(x + 4x + 9x + \dots + n^2x)$  where  $n$  is any positive integer.



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

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  $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$  and  $E = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$  then show that  $(aI + bE)^3 = a^3I + 3a^2bE$ , where  $I$  is unit matrix of order 2. 

12) Let ABCDEF be a regular hexagon with centre 'O', show that

$$\overline{AB} + \overline{AC} + \overline{AD} + \overline{AE} + \overline{AF} = 3 \overline{AD} = 6 \overline{AO}.$$

13)  $\vec{a} = 2\vec{i} + \vec{j} - \vec{k}$ ,  $\vec{b} = -\vec{i} + 2\vec{j} - 4\vec{k}$  and  $\vec{c} = \vec{i} + \vec{j} + \vec{k}$ , then find  $(\vec{a} \times \vec{b}) \cdot (\vec{b} \times \vec{c})$ .

14) Find the value of  $\sin^2 \frac{\pi}{10} + \sin^2 \frac{4\pi}{10} + \sin^2 \frac{6\pi}{10} + \sin^2 \frac{9\pi}{10}$ .

15) Prove that  $\frac{1}{\sin 10^\circ} - \frac{\sqrt{3}}{\cos 10^\circ} = 4$ .

16) If  $\sin x + \sin y = \frac{1}{4}$  and  $\cos x + \cos y = \frac{1}{3}$  then show that

(i)  $\tan\left(\frac{x+y}{2}\right) = \frac{3}{4}$  (ii)  $\cot(x+y) = \frac{7}{24}$ . 

17) In  $\triangle ABC$ , prove that  $\cot A + \cot B + \cot C = \frac{a^2 + b^2 + c^2}{4\Delta}$ .

### SECTION - C

(5×7=35)

III. Long answer type questions :

(i) Answer **ANY FIVE** questions.

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

18) If  $f = \{(4, 5), (5, 6), (6, -4)\}$  and  $g = \{(4, -4), (6, 5), (8, 5)\}$  then find

(i)  $f + g$

(ii)  $f - g$

(iii)  $2f + 4g$



- (iv)  $f + 4$
- (v)  $fg$
- (vi)  $f/g$
- (vii)  $|f|$ .

19) If  $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$  then show that  $A^{-1} = A^3$ .

20) Solve the following simultaneous linear equations by using Cramer's rule

$$x + y + z = 1, 2x + 2y + 3z = 6, x + 4y + 9z = 3.$$



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  $\bar{a} = 2\bar{i} + 3\bar{j} + 4\bar{k}$ ,  $\bar{b} = \bar{i} + \bar{j} - \bar{k}$  and  $\bar{c} = \bar{i} - \bar{j} + \bar{k}$ , then compute  $\bar{a} \times (\bar{b} \times \bar{c})$  and verify that it is perpendicular to  $\bar{a}$ .



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) In  $\triangle ABC$  if  $a = 13$ ,  $b = 14$ ,  $c = 15$ , show that  $R = \frac{65}{8}$ ,  $r = 4$ ,  $r_1 = \frac{21}{2}$ ,  $r_2 = 12$  and  $r_3 = 14$ .

