0166 **SET -**

Total No. of Questions - **37**
Total No. of Printed Pages - **4**

Regd. No. | | | | | | | | | | |

Part - III

MATHEMATICS, Paper - IA

(English Version)

MODEL QUESTION PAPER

(For the Academic year 2021-22 only)

Time : **3 Hours** ***Max. Marks :*** **75**

Note: This question paper consists of three section A, B and C.

Section - A

Very short answer type questions.

(i) Answer ANY TEN questions.

(ii) Each question carries 2 marks. **10×2=20**

1. If $A=\left\{0,\frac{\pi}{6},\frac{\pi}{4},\frac{\pi}{3},\frac{\pi}{2}\right\}$ and F : A$\rightarrow$B is a surjection defined by $f(x) = \cos x$, then find B.

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

3. If $A=\begin{bmatrix}2 & 3 & -1\\ 7 & 8 & 5\end{bmatrix}$ and $B=\begin{bmatrix}1 & 0 & 1\\ 2 & -4 & -1\end{bmatrix}$ then find A+B.

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

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

Turn Over

6. If $A = \begin{bmatrix} 2 & 4 \\ -1 & k \end{bmatrix}$ and $A^2 = 0$, then find the value of k.

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

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

9. Let $\bar{a} = 2\bar{i} + 4\bar{j} - 3\bar{k}$, $\bar{b} = \bar{i} + \bar{j} + \bar{k}$ and $\bar{c} = \bar{j} + 2\bar{k}$, find the unit vector in the opposite direction of $a + b + c$.

10. If $\bar{a} = \bar{i} + 2\bar{j} - 3\bar{k}$ and $\bar{b} = 3\bar{i} - \bar{j} + 2\bar{k}$ then show that $\bar{a} + \bar{b}$ and $\bar{a} - \bar{b}$ are perpendicular to each other.

11. If $|p| = 2, |q| = 3$ and $(p,q) = \frac{\lambda}{6}$, then find $|p \times q|^2$.

12. Prove that $\frac{\cos 9^o + \sin 9^o}{\cos 9^o - \sin 9^o} = \cot 36^o$.

13. Find the period of the function defined by $f(x) = \tan\left(x + 4x + 9x + ... + n^2 x\right)$.

14. If $\sinh x = \frac{3}{4}$, find cosh(2x) and sinh(2x).

15. If cosh$x$ = secθ, then prove that $\tanh^2 \frac{x}{2} = \tan^2 \frac{\theta}{2}$.

Section - B

Short answer type questions. **5×4=20**

(i) Answer any FIVE questions.

(ii) Each question carries four marks.

16. 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.

17. Show that $A = \begin{bmatrix} 1 & 2 & 1 \\ 3 & 2 & 3 \\ 1 & 1 & 2 \end{bmatrix}$ is non-singular and find A^{-1}.

18. If $A = \begin{bmatrix} 0 & 1 & 2 \\ 2 & 3 & 4 \\ 4 & 5 & 6 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 2 & 3 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$, find B – A and 4A – 5B.

19. Let ABCDEF be regular hexagone with centre O, show that $\overline{AB}+\overline{AC}+\overline{AD}+\overline{AE}+\overline{AF}=3\overline{AD}=6\overline{AO}$.

20. Find the vector equation of the plane passing through the points $\bar{i}-2\bar{j}+3\bar{k}$, $-5\bar{j}-\bar{k}$ and $-3\bar{i}+5\bar{j}$.

21. If the vectors $2\bar{i}+\lambda\bar{j}-\bar{k}$ and $4\bar{i}-2\bar{j}+2\bar{k}$ are perpendicular to each other, find λ.

22. Find the unit vector perpendicular both $\bar{i}+\bar{j}+\bar{k}$ and $2\bar{i}+\bar{j}+3\bar{k}$.

23. If A is not an integral multiple of $\frac{\pi}{2}$, then prove that

    (i) tanA + cotA = 2 cosec2A

    (ii) cotA – tanA = 2 cot2A

24. Find the range of $7\cos x-24\sin x+5$.

25. Prove that $\frac{\cosh x}{1-\tanh x}+\frac{\sinh x}{1-\coth x}=\sinh x+\coth x$ for $x\neq 0$.

26. Prove that $\cot\frac{A}{2}+\cot\frac{B}{2}+\cot\frac{C}{2}=\frac{s^2}{\Delta}$.

27. If $\sin\theta=\frac{a}{b+c}$ then show that $\cos\theta=\frac{2\sqrt{bc}}{b+c}\cos\frac{A}{2}$.

Section - C

Long Answer type questions. **5×7=35**

(i) Answer any FIVE questions.

(ii) Each question carries seven marks.

28. If $f=\{(1,2),(2,-3),(3,-1)\}$ then find (i) 2f (ii) 2+f (iii) f^2 (iv) $\sqrt{f}$

29. If $A=\begin{bmatrix}1 & -2 & 1\\ 0 & 1 & -1\\ 3 & -1 & 1\end{bmatrix}$, then find A^3-3A^2-A-3I, where I is unit matrix of order 3.

30. Solve the following system of equations by Cramer's rule

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

31. Solve the following system of equations by Matrix Inversion method

    $2x-y+3z=9,\ \ x+y+z=6,\ x-y+z=2$.

32. Find the vector equation of the plane passing through points $4\bar{i}-3\bar{j}-\bar{k}$, $3\bar{i}+7\bar{j}-10\bar{k}$ and $2\bar{i}+5\bar{j}-7\bar{k}$ and show that the point $\bar{i}+2\bar{j}-3\bar{k}$ lies in the plane.

33. 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 $\bar{a}\times\left(\bar{b}+\bar{c}\right)$. Verify whether the cross product is distributive over vector addition.

34. If [b c d] + [c a d] + [a b d] = [a b c]. Then show that the points with position vectors a, b, c and d are coplanar.

35. If A, B, C are angles in a triangle, then prove that

sinA + sinB – sinC = $4\sin\frac{A}{2}\sin\frac{B}{2}\cos\frac{C}{2}$.

36. 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.

37. 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.

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