

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

Regd.  
No.

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Part - III  
**MATHEMATICS - PAPER - I(B)**  
(English Version)

Time : 3 Hours

Max. Marks : 75

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

**SECTION - A**



10x2=20

Very Short Answer Type Questions.

- (i) Attempt all questions.  
(ii) Each question carries two marks.

1. Find the value of  $y$ , if the line joining the points  $(3, y)$  and  $(2, 7)$  is parallel to the line joining the points  $(-1, 4)$  and  $(0, 6)$ .
2. Find the image of the point  $(1, 2)$  w.r.t. straight line  $3x + 4y - 1 = 0$ .
3. Find the distance between the mid-point of the line segment  $\overline{AB}$  and the point  $(3, -1, 2)$  where  $A = (6, 3, -4)$  and  $B = (-2, -1, 2)$ .
4. Find the equation of the plane passing through  $(-2, 1, 3)$  and having  $(3, -5, 4)$  as d.r.'s of its normal.
5. Compute  $\lim_{x \rightarrow 0} \frac{\sin ax}{x \cos x}$ .
6. Evaluate  $\lim_{x \rightarrow \infty} \frac{11x^3 - 3x + 4}{13x^3 - 5x^2 - 7}$ .
7. If  $f(x) = x e^x \sin x$ , then find  $f'(x)$ .
8. If  $y = ae^{nx} + be^{-nx}$  then prove that  $y' = n^2 y$ .
9. Find  $\Delta y$  and  $dy$  for the function  $y = e^x + x$ , at  $x = 5$  and  $\Delta x = 0.02$ .
10. Verify Rolle's theorem for the function  $f(x) = x(x+3) e^{-x/2}$  in  $[-3, 0]$ .

## SECTION - B

Short Answer Type Questions.

5x4=20

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

11. Find the equation of the locus of P, if  $A = (4, 0)$ ,  $B = (-4, 0)$  and  $|PA - PB| = 4$ .

12. When the axes are rotated through an angle  $45^\circ$ , the transformed equation of a curve is  $17x^2 - 16xy + 17y^2 = 225$ . Find the original equation of the curve.

13. A straight line through  $P(3, 4)$  makes an angle of  $60^\circ$  with the positive direction of the X-axis. Find the coordinates of the points on the line which are 5 units away from P.

14. Find real constants a, b so that the function f given by

$$f(x) = \begin{cases} \sin x & \text{if } x \leq 0 \\ x^2 + a & \text{if } 0 < x < 1 \\ bx + 3 & \text{if } 1 \leq x \leq 3 \\ -3 & \text{if } x > 3 \end{cases} \text{ is continuous on } \mathbb{R}.$$

15. Find the derivative of the function  $\cos ax$  from the first principle.

16. Find the value of k, so that the length of the subnormal at any point on the curve  $y = a^{1-k} x^k$  is a constant.

17. The volume of a cube is increasing at a rate of 9 cubic centimetres per second. How fast is the surface area increasing when the length of the edge is 10 centimetres?

## SECTION - C

III. Long Answer Type Questions.

5x7=35

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

18. Find the orthocenter of the triangle whose vertices are  $(5, -2)$ ,  $(-1, 2)$  and  $(1, 4)$ .

19. If the second degree equation  $S = ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$  in the two variables x and y represents a pair of straight lines, then prove that

- (i)  $abc + 2fgh - af^2 - bg^2 - ch^2 = 0$  and  
 (ii)  $h^2 \geq ab$ ,  $g^2 \geq ac$  and  $f^2 \geq bc$ .

20. Find the values of  $k$ , if the lines joining the origin to the points of intersection of the curve  $2x^2 - 2xy + 3y^2 + 2x - y - 1 = 0$  and the line  $x + 2y = k$  are mutually perpendicular.

21. Show that the lines whose d.c.'s are given by  $l + m + n = 0$ ,  $2mn + 3nl - 5lm = 0$  are perpendicular to each other.

22. Find the derivative of the function  $(\sin x)^{\log x} + x^{\sin x}$ .

23. If the tangent at any point  $P$  on the curve  $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$  intersects the coordinate axes in  $A$  and  $B$ , then show that the length  $AB$  is a constant.

24. From a rectangular sheet of dimensions  $30 \text{ cm} \times 80 \text{ cm}$ , four equal squares of side  $x \text{ cm}$ , are removed at the corners, and the sides are then turned up so as to form an open rectangular box. Find the value of  $x$ , so that the volume of the box is the greatest.