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Your Roll No . .

5186

B.Sc. Prog./II J

MA-201—MATHEMATICS—I

(Calculus and Geometry)

(For Physical Sciences/Applied Sciences)

(Admissions of 2008 and onwards)

Time 3 *House* *Maximum Marks* . 112

(Write your Roll No on the top immediately on receipt of this question paper)

All questions are compulsory

Attempt any *two* parts from each question except Question No 5 In questions No 5 attempt any *one*

Section I

1 (*a*) (*i*) Represent geometrically the set

$$\{z \quad |z - i| > |z + i|\} \qquad 5\frac{1}{2}$$

(*ii*) Find centre and radius of the circle whose equation is

$$|z - i| = 4|z + i|$$

Check if the origin lies inside the circle 7

P.T O

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(*b*) (*i*) Solve the equation

$$x^4 - 2x^3 - 21x^2 - 22x + 40 = 0,$$

the sum of the two roots being equal to sum of the other two 7

(*ii*) If α, β and γ are the roots of the equation $x^3 - ax^2 + bx - c = 0$, find the value of $\sum \frac{\alpha^2}{\beta\gamma}$. 5½

(*c*) (*i*) Prove that :

$$(1+i)^n + (1-i)^n = 2^{n/2+1}\cos(n\pi/4) \quad 5½$$

(*ii*) Solve the equation

$$z^6 - z^5 + z^4 - z^3 + z^2 - z + 1 = 0 \quad 7$$

Section II

2 (*a*) State intermediate value theorem and show that if the continuity hypothesis of the *theorem* is dropped, then its conclusion may fail to hold 10

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(*b*) Show that the function f defined as

$$f(x) = |x| + |x - 1|$$

is continuous at $x = 0$, and $x = 1$ But is not derivable at these points 10

(*c*) Define uniform continuity of a function. Give an example of a continuous function which is not uniformly continuous 10

3 (*a*) Find the asymptotes of the curve

$$x^3 + 2x^2y + xy^2 - x^2 - xy + 2 = 0.$$ 10

(*b*) (*i*) Determine the position and nature of double points on the curve

$$x^3 + x^2 + y^2 - x - 4y + 3 = 0$$

(*ii*) Trace the polar curve

$$r = a(1 + \cos \theta)$$ 5+5

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(c) Trace the curve 10

$$y(1 - x^2) = x^2$$

4 (a) Obtain the reduction formula for

$$\int \sin^n x \, dx,$$

n being a positive integer and hence evaluate

$$\int_0^{\pi/2} \sin^6 x \, dx$$ 10

(b) Find the area of the parabola $y^2 = 4ax$ bounded by its latus rectum Also find the volume of the solid obtained by rotating this area about x-axis 10

(c) Find the arc length of the cycloid

$x = a(\theta + \sin \theta)$, $y = a(1 + \cos \theta)$, $-\pi \leq \theta \leq \pi$ 10

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Section III

5 Identify and sketch the graph of the conic

$$4x^2 - 4xy + y^2 - 8x - 6y + 5 = 0$$

by rotating co-ordinate axes 14

Or

Find the nature of the following conic and trace it completely giving essential details

$$x^2 + xy + y^2 - x + 4y + 3 = 0$$ 14

6 (*a*) A particle moves along the curve $x = t^3 + 1$, $y = t^2$, $z = 2t + 5$, where t is the time Find the component of the velocity and acceleration at $t = 1$ in the direction $\hat{i} + \hat{j} + 3\hat{k}$ 6½

(*b*) Show that

$$\nabla^2\left(\frac{1}{r}\right) = 0$$ 6½

P T O

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(c) For what value of the component a will the vector

$$\vec{A} = (axy - z^3)\hat{i} + (a - 2)\, x^2\hat{j} + (1 - a)\, xz^2\hat{k}$$

have its curl identically equal to zero ? 6½

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