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Your Roll No. : .....2019.......

Sl. No. of Q. Paper : **7461**   J

Unique Paper Code : 32351101 - OC

Name of the Course : **B.Sc.(Hons.) Mathematics**

Name of the Paper : Calculus

Semester : I

Time : 3 Hours   *Maximum M...*

Instructions for Candidates :

(a) Write your Roll No. on the top in... on receipt of this question paper...

(b) **All** the sections are compulsory.

(c) All questions carry equal marks.

(d) Use of non-programmable scientific calculator is allowed.

Section-I

Note : Attempt any **four** questions from this **Section**.

1. If $y = \sin^{-1} x$, prove that $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}-n^2y_n = 0$.

2. Sketch the graph of $f(x) = \dfrac{1}{x+1} + \dfrac{1}{x-1}$ by finding intervals of increase and decrease, critical points, points of relative maxima and minima, concavity of the graph and inflection points.

P.T.O.

3. Evaluate analytically following problem :

$$\lim_{x \to \infty} \left(x \sin^{-1}\left(\frac{1}{x}\right) \right)^x$$

4. Suppose a manufacturer estimates that, when the market price of a certain product is p, the number of units sold will be $= -6\ln\left(\frac{p}{40}\right)$. It is also estimated that the cost of producing these x units will be $C(x) = 4xe^{-\frac{x}{6}} + 30$.

(a) Find the average cost, the marginal cost, and the marginal revenue for this production process.

(b) What level of production x corresponds to maximum profit ?

5. Sketch the graph of the curve in polar coordinates $r = 4 - 4\cos\theta$.

Section - II

Note : Attempt any **four** questions from this **Section**.

6. Find the reduction formula for $\int x^n e^x dx$ and hence evaluate $= \int_0^1 xe^{-\sqrt{x}} dx$.

7. Find the volume of the solid generated when the region enclosed by the curves $y = \sqrt{25 - x^2}$ and $y = 3$, is revolved about x-axis.

8. Use cylindrical shells to find the volume of the solid generated when the region enclosed by the curve $y = \dfrac{1}{x^3}, x = 1, x = 2, y = 0$ is revolved about the line $x = -1$.

9. Find the exact arc length of the curve $y = \dfrac{x^6 + 8}{16x^2}$ from $x = 2$ to $x = 3$.

10. Find the area of the surface generated by revolving the curve $x = \sqrt{9 - y^2}, \ -2 \le y \le 2$. about y-axis.

Section- III

Note : Attempt any **three** questions from this **Section**.

11. State the reflection properties of the conic sections : parabolas, ellipses and hyperbolas with diagram.

12. Find an equation for the parabola that has its vertex at $(1,2)$ and its focus at $(4,2)$.

13. Describe the graph of the equation $9x^2 + 4y^2 + 18x - 24y + 9 = 0$ with rough sketch label the foci, vertices and the ends of minor axis.

14. Trace the conic $x^2 + 2\sqrt{3}xy + 3y^2 + 2\sqrt{3}x - 2y = 0$ by rotating the coordinate axes to remove the xy term.

Section - IV

Note : Attempt any **four** questions from this **Section.**

15. Find the position vector and velocity vector if acceleration vector with initial conditions are given as $A(t) = (\cos t)\hat{i} - (t\sin t)\hat{k}; R(0) = \hat{i} - 2\hat{j} + \hat{k}$;

$V(0) = 2\hat{i} + \hat{k}$.

16. A boy standing at the edge of a cliff throws a ball upward at a 30° angle with an intial speed of 64 ft/s. Suppose that when the ball leaves the boy's hand, it is 48 ft above the ground at the base of the cliff.

    (a) What are the time of flight of the ball and its range ?

    (b) What are the velocity of the ball and its speed at impact ?

    (c) What is the highest point reached by the ball during its flight ?

17. Find the tangential and normal components of acceleration of an object that moves with position vector $R(t) = (\sin t)\hat{i} + (\cos t)\hat{j} + (\sin t)\hat{k}$.

18. An object moves along the curve in the plane described in polar form $r = 3 + 2\sin t$; $\theta = t$.

    Find its velocity and acceleration in terms of unit polars U_r and U_θ.

19. Find the curvature and radius of curvature at the stated point for a curve

    $x = e^t \cos t$, $y = e^t \sin t$, $z = et$ $t = 0$

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