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B.Tech. Degree I Semester Regular/Supplementary Examination in Marine Engineering November 2023

19-208-0101 ENGINEERING MATHEMATICS I (2019 Scheme)

Time: 3 Hours

Maximum Marks: 60

Course Outcome

On successful completion of the course, the students will be able to:

CO1: Apply parabola, ellipse and hyperbola in engineering disciplines.

CO2: Use differential calculus and integral calculus for solving engineering problems.

CO3: Estimate the maxima and minima of multi variable functions.

CO4: Find area as double integrals and volume as triple integrals in engineering applications.

CO5: Apply vector methods in solving engineering problems.

Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

PI – Programme Indicators

(Answer ALL questions)

(5 × 15 = 75)

		Marks	BL	CO	PI
I.	(a) Find the equation of the tangents from (5,6) to the Ellipse $9x^2 + 16y^2 = 144$.	7	L1	1	1
	(b) If $2x - y - 30 = 0$ and $3x + y - 7 = 0$ are the asymptotes of a hyperbola which is passing through (1,1) find its equation.	8	L1	1	1
OR					
II.	(a) Find the vertex focus, equation of directrix and equation of axis of the $y^2 - x + 4y + 5 = 0$.	8	L3	1	1
	(b) Tangents from a point to the parabola $y^2 = 4ax$ include an angle of 45° . Prove that the locus of their point of intersection is given by $y^2 - 4ax = (x + a)^2$.	7	L2	1	1
III.	(a) State Rolle's theorem and verify it for the function $f(x) = x^2 - 5x + 6 = 0$ in (2,3).	8	L2	2	1
	(b) Evaluate $\lim_{x \rightarrow \frac{\pi}{4}} \frac{\sec^2 x - 2 \tan x}{1 + \cos 4x}$	7	L3	2	1
OR					
IV.	(a) Evaluate $\int_0^{\frac{\pi}{4}} x^4 \sin x dx$.	8	L3	2	1
	(b) The circular disc $(x-4)^2 + y^2 \leq 4$ is revolved about the line $y = x$. Find the volume of the solid generated.	7	L3	2	1
V.	(a) Find the nth derivative of $\sin 3x \sin 4x$.	7	L3	3	1
	(b) If $y = e^{a \sin^{-1} x}$ prove that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2 + a^2)y_n = 0$	8	L3	3	1

OR

(P.T.O.)

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		Marks	BL	CO	PI
VI.	(a) If $v = f(y - z, z - x, x - y)$ prove that $\frac{\partial v}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial v}{\partial z} = 0$.	7	L3	3	1
	(b) Find and classify the critical points of $x^3 + y^3 - 3axy, a > 0$	8	L3	3	1
VII.	(a) Using double integration find the area cut off between the parabola $x^2 = 4y$ and $x + y - 8 = 0$.	8	L3	4	1
	(b) Evaluate $\int_{-1}^1 \int_0^x \int_{x-z}^{x+z} (x + y + z) dx dy dz$.	7	L3	4	1
OR					
VIII.	(a) Verify that $\bar{a} \times (\bar{b} + \bar{c}) + \bar{b} \times (\bar{c} + \bar{a}) + \bar{c} \times (\bar{a} + \bar{b}) = 0$ for $\bar{a} = 2\hat{i} + \hat{j} + 2\hat{k}, \bar{b} = \hat{i} + 2\hat{j} - \hat{k}, \bar{c} = \hat{i} - \hat{j} + \hat{k}$	8	L2	4	1
	(b) Prove that $\bar{a} \cdot (\bar{b} + \bar{c}) \times (\bar{a} + \bar{b} + \bar{c}) = 0$.	7	L3	4	1
IX.	(a) Show that the vector point function \bar{F} forms a conservative field where $\bar{F} = \text{grad}(x^3 + y^3 + z^3 - 3xy)$.	7	L3	5	1
	(b) Show that $\text{div}(\text{grad } r^n) = \nabla^2(r^n) = n(n+1)r^{n-2}$.	8	L3	5	1
OR					
X.	(a) If $A = (3x^2 + 6y)\hat{i} - 14yz\hat{j} + 20xz^2\hat{k}$ evaluate $\int A \cdot dr$ from $(0,0,0)$ to $(1,1,1)$ along the path $x = t, y = t^2, z = t^3$.	7	L4	5	1
	(b) Using Green's theorem evaluate $\int_c (3x - 8y^2) dx + (4y - 6xy) dy$ where c is the boundary of the region bounded by $x = 0, y = 0, x + y = 1$.	8	L4	5	1

Bloom's Taxonomy Levels

L1-10%, L2-15%, L3-65%, L4-10%.
