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Mahindra University Hyderabad
École Centrale School of Engineering
Program: B. Tech. Branch: CSE/CM/ECE/ECM/AI/CE/ME/MEC/NT
Semester: Fall 2022
Subject: MA 1101 Mathematics I

Date: 26/12/2022 **Time: 09.00 AM to 12.00 PM**
Time Duration: 3 Hours **Max. Marks: 100**

Instructions:

1. There are 5 questions, all of which are compulsory
2. Justify your answer wherever required. Guesswork will not be considered in evaluation.

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1. (a) State Intermediate Value Theorem and Rolle's Theorem. **(5M+5M)**
   (b) Using one of these theorems prove that $x^3 - 3x + c$ has at most one root in $[0, 1]$ for all values of c. **10M**

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2. Using the method of variation of parameters, find the general solution of $y'' - 3y' + 2y = e^{-x}$. **20 M**

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3. Find the extreme values of the scalar field $f(x, y, z) = x + 2y - 3z$ on the sphere $x^2 + y^2 + z^2 = 1$. **20 M**

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4. Sketch the domain of integration of the double integral $\int_0^1 \int_x^1 \frac{xy}{\sqrt{1+y^4}} dydx$. Also, evaluate the integral by changing the order of the integration. **20 M**

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5. Verify the Stokes' theorem if $\mathbf{F}(x, y, z) = yz\mathbf{i} + xz\mathbf{j} + xy\mathbf{k}$, S is the part of the paraboloid $z = 9 - x^2 - y^2$ that lies above the plane $z = 5$, oriented upward. **20 M**

Note that the conclusion of Stokes' theorem is

$$\oint_C \mathbf{F}.d\boldsymbol{\alpha} = \iint_S \text{curl } \mathbf{F}.\mathbf{n}\, dS$$

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