B.Sc. in EEE,2nd Sem./
BScTE(2Y), 2nd Sem.

Date: July 8, 2025

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF NATURAL SCIENCE

Mid-Semester Examination **Summer Semester.** A. Y. 2023-2024
Course Code.: Math 4221/4629 **Full Marks:** 120
Course Title: Mathematics III **Time:** 2 hours

Answer all **4 (FOUR)** questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

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1. a) Explain the geometrical meaning of the scalar triple product of three vectors. Prove that in scalar triple product dot and cross can be interchanged. **(15)** (CO1) (PO1)

b) Show that $\mathbf{a}\times(\mathbf{b}\times\mathbf{c}) = (\mathbf{a}.\mathbf{c})\mathbf{b} - (\mathbf{a}.\mathbf{b})\mathbf{c}$ hence obtain the value of $\mathbf{a}\times(\mathbf{b}\times\mathbf{c}) + \mathbf{b}\times(\mathbf{c}\times\mathbf{a}) + \mathbf{c}\times(\mathbf{a}\times\mathbf{b})$. **(15)** (CO1) (PO1)

2. a) Find the values of (i) $\nabla\times\nabla\phi$ and (ii) $\nabla.(\nabla\times\mathbf{A})$ **(15)** (CO1) (PO1)

b) Find the directional derivative of $\phi = x^2yz+4xz^2$ at P (-1, -2, 1) in the direction of the vector $\mathbf{a} = 2\mathbf{i}+3\mathbf{j}+4\mathbf{k}$. Also find the maximum rate of change of ϕ at this point. **(15)** (CO1) (PO1)

3. a) Evaluate $\int_C \mathbf{F}.d\mathbf{r}$ where $\mathbf{F} = xy\mathbf{i}+(x^2+y^2)\mathbf{j}$ and C is the portion of the x-axis from $x = 4$ to $x = 6$ and then the line $x = 6$ from $y = 0$ to $y = 20$. Is the force $\mathbf{F}$ conservative? **(15)** (CO2) (PO1)

b) Find the flow of current through the surface S where S is the part of the plane $x + 3y + 5z = 15$ which is located in the first octant, if the current density is $\mathbf{J} = 10\mathbf{z}\mathbf{i}+10\mathbf{j}+3\mathbf{y}\mathbf{k}$. **(15)** (CO2) (PO1)

4. a) State and prove Green's theorem in the plane. **(15)** (CO3) (PO1)

b) Evaluate $\int_C (y-\sin x)dx+\cos x dy$ by using Green's theorem where C is the triangle formed by the straight lines y=0 from (0,0) to $(\frac{\pi}{2},0)$, x=$\frac{\pi}{2}$ from $(\frac{\pi}{2},0)$ to $(\frac{\pi}{2},1)$ and y=$\frac{2x}{\pi}$ from $(\frac{\pi}{2},1)$ to (0,0). **(15)** (CO3) (PO1)