BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2024)

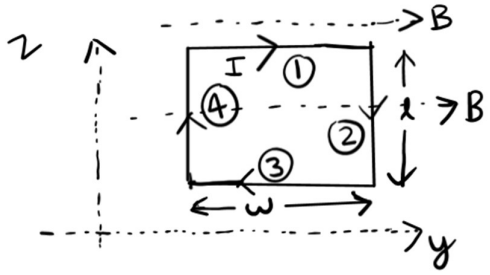
CLASS: BTECH **SEMESTER : III**
BRANCH: EEE **SESSION : MO/2024**

SUBJECT: EE253 ENGINEERING ELECTROMAGNETICS

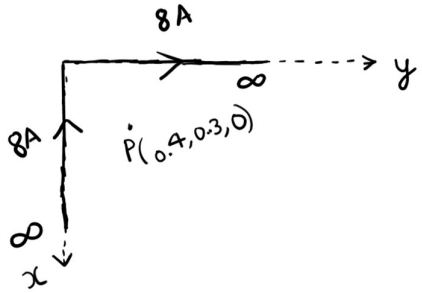
TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. Give answer in three decimal places. Answers in fraction is considered as incomplete.
4. The missing data, if any, may be assumed suitably.

			CO	BL
Q.1(a)	The finite sheet $0 \le x \le 4$, $2 \le y \le 7$, on the $z = 0$ plane has a charge density $\rho_s = xy\,(x^2 + 36)^{3/2}$ nC/m^2. Find the total charge on the sheet in micro Coulomb.	[2]	1	2
Q.1(b)	Point charge -6 mC are located at (1,-2,3). Calculate the electric field at point (0,1,-2).	[3]	1	3
Q.2(a)	What is electric potential? What are the properties of electric potential in an electrostatic field?	[2]	2	2
Q.2(b)	Derivation of energy density in an electrostatic field.	[3]	2	2
Q.3(a)	Find forces on all the current element of loop due to applied magnetic field B along y-axis.	[2]	1	2



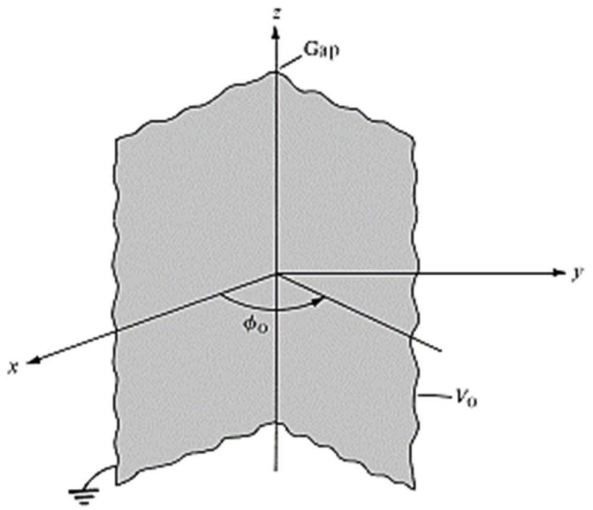
Q.3(b)	The current is directed inward from infinity to the origin on the positive *x* axis, and then outward to infinity along the *y* axis. Determine H at point *P*(0.4, 0.3, 0) due to an 8-ampere filamentary current only due to current along the x-axis.	[3]	1	3



Q.4(a)	Write integral and differential form of Ampere circuital Law for time varying conditions.	[2]	1	1
Q.4(b)	A homogeneous dielectric $\varepsilon_r = 4$ fills region 1 $x < 0$ while region 2 $x \ge 0$ $\varepsilon_r = 8$. If $E_1 = 4\,a_x - 6\,a_y + a_z$ kV/m for region 1. Find E_2 for region 2. Also find the angles made by E_1 and E_2 at the interface.	[3]	3	3

PTO

Q.5(a)	Write expressions and explain for transformer and motional emf. What are applications of transformer and motional emf.	[2]	3	2
Q.5(b)	Semi-infinite conducting planes at $\phi = 0$ and $\phi = \pi/3$ are separated by an infinitesimal insulating gap as shown in Figure. If $V(\phi = 0) = 0$ and $V(\phi = \pi/3) = 150\,V$, calculate *V* and E in the region between the planes. Assume $\rho_v = 0$ C/m^3	[3]	2	3



Formula for Laplacian for V is

$$\frac{1}{\rho}\frac{\partial}{\partial\rho}\left(\rho\frac{\partial V}{\partial\rho}\right)+\frac{1}{\rho^2}\frac{\partial^2 V}{\partial\phi^2}+\frac{\partial^2 V}{\partial z^2}=0$$

Gradient in cylindrical coordinate system

$$\nabla V=\frac{\partial V}{\partial\rho}\mathbf{a}_\rho+\frac{1}{\rho}\frac{\partial V}{\partial\phi}\mathbf{a}_\phi+\frac{\partial V}{\partial z}\mathbf{a}_z$$

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