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

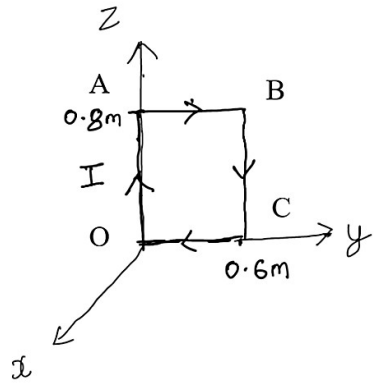
CLASS: B.Tech **SEMESTER : III/ADD**
BRANCH: EEE **SESSION : MO/2025**

SUBJECT: EE24205 ENGINEERING ELECTROMAGNETICS

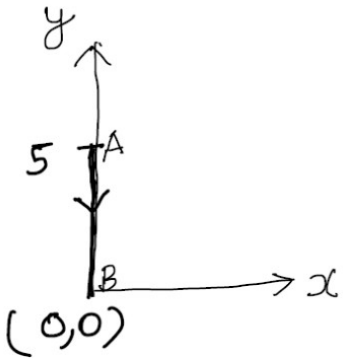
TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	i) Discuss Gauss Law. ii) What is dielectric strength of a dielectric material?	[1+1]	1	2
Q.1(b)	Given the potential $V = \frac{25 \sin\theta \cos\phi}{r^3}$, Find the electric field and electric flux density at $(4, \pi/3, \pi/6)$. Gradient in spherical coordinate is $$\nabla V = \frac{\partial V}{\partial r}\mathbf{a}_r + \frac{1}{r}\frac{\partial V}{\partial \theta}\mathbf{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial V}{\partial \phi}\mathbf{a}_\phi$$	[3]	1	3
Q.2(a)	Discuss the forces on a charge and a current carrying conductor in a magnetic field.	[2]	1	2



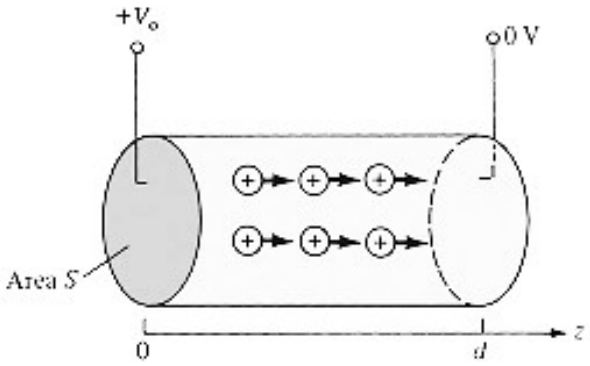
Q.2(b)	A rectangular loop shown in Figure carries current I= 4 A and is situated in the magnetic field $B = 0.5\ a_y$ Wb/m^2. Find the force on each element of loop. How will the loop rotate? Find the torque on the loop.	[3]	1	3
Q.3(a)	State Biot-Savart's law. Draw a figure to explain the mathematics of Biot-Savart's law.	[2]	1	2
Q.3(b)	A conductor carries a current of 12 A along the y-axis as is shown in the figure. The length of conductor is 5 meters. Find the magnetic field due to this current carrying conductor at point S (0,0,7).	[3]	1	3



PTO

Q.4(a)	Write and explain the Laplace and Poisson's equations in the applications for electrostatic.	[2]	2	2
Q.4(b)	Current-carrying components in high-voltage power equipment can be cooled to carry away the heat caused by ohmic losses. A means of pumping is based on the force transmitted to the cooling fluid by charges in an electric field. Electrohydrodynamic (EHD) pumping is modelled in Figure. The region between the electrodes contains a uniform charge ρ_0, which is generated at the left electrode and collected at the right electrode. Calculate the pressure of the pump if $\rho_0 = 20$ mC/m^3 and $V_0 = 25$ kV. Find the expressions of electric field and voltage using this boundary conditions in terms of $\rho_0,\ V_0, d, \varepsilon$. Find E and V at z=4 m. $\varepsilon = 2\varepsilon_0, \mathrm{d} = 7\ \mathrm{m}$. Laplacian of V in cylindrical coordinates is	[3]	2	3

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



Q.5(a)	State Faraday's law. Explain with mathematical equations for application of Faraday's law for transformers and machines.	[2]	1	2
Q.5(b)	A conducting bar can slide freely over two conducting rails as shown in Figure. Calculate the induced voltage across MN in the bar. (a) If the bar is stationed at $x = -10$ cm and $\mathrm{B} = 4\sin 10^5 t$ $\mathrm{a_z}$ mWb/m^2 (b) If the bar slides at a velocity $u = -3$ $\mathrm{a_x}$ m/s and $\mathrm{B} = -6$ $\mathrm{a_z}$ mWb/m^2	[3]	1	3