U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

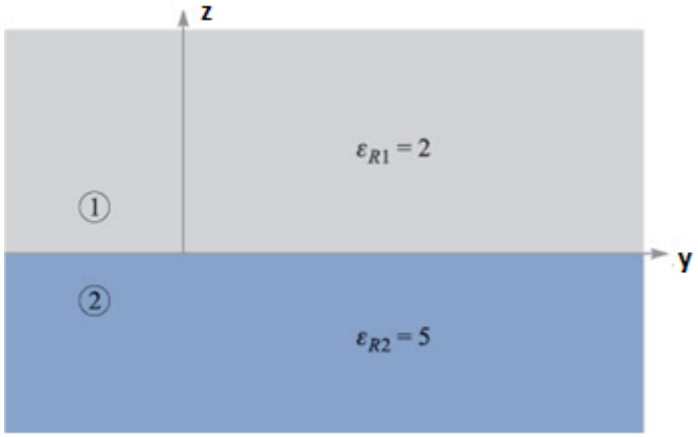
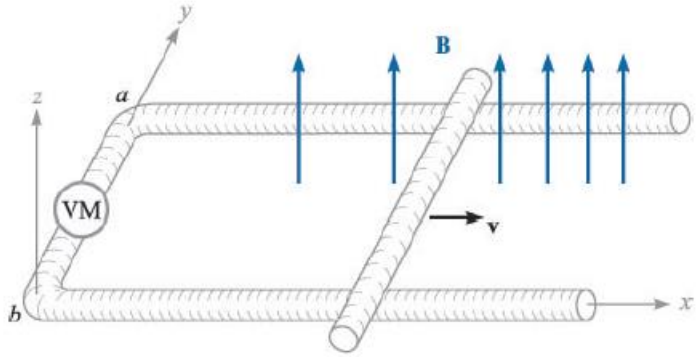
July 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Electronics and Telecommunication Engineering **Duration: 3 hrs.**
Course Code: 22ET5PCEM1 **Max Marks: 100**
Course: Electromagnetics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Four identical charges of 3 nC are located at $P_1(1, 1, 0)$, $P_2(-1, 1, 0)$, $P_3(-1, -1, 0)$, $P_4(1, -1, 0)$. Find **E** at P(1, 1, 1).	*CO2*	*PO1*	**07**
	b)	Derive an expression for Electric field at a point due to an infinite line charge, starting from Coulomb's Law.	*CO2*	*PO1*	**07**
	c)	A uniform volume charge density of $0.2\mu C/m^3$ is present throughout the spherical shell extending from r = 3cm to r = 5cm. If $\rho_v = 0$ elsewhere, find the total charge present within the shell.	*CO2*	*PO1*	**06**
		OR			
2	a)	State and prove divergence theorem.	*CO2*	*PO1*	**07**
	b)	Derive an expression for Electric field at a point due to an infinite sheet charge, starting from the expression for E due to an infinite line.	*CO2*	*PO1*	**07**
	c)	If $\mathbf{D} = 2r\mathbf{a}_r$ C/m^2, find the total electric flux leaving the surface of the cube $0 \leq x, y, z \leq 4$.	*CO2*	*PO1*	**06**
		UNIT - II			
3	a)	Derive an expression for energy density in an electrostatic field.	*CO2*	*PO1*	**07**
	b)	Derive an expression for continuity of current.	*CO2*	*PO1*	**07**
	c)	Find the amount of energy required to move a 6 C charge from the origin to P(3, 1, -1) in the field $\mathbf{E} = 2x\,\mathbf{a}_x - 3y^2\mathbf{a}_y + 4\mathbf{a}_z$ V/m along the straight-line path x = -3z, y = x + 2z.	*CO2*	*PO1*	**06**
		UNIT - III			
4	a)	For the figure shown in Fig 4a, find $\mathbf{D}_2$ and the energy density in each region.	*CO2*	*PO1*	**07**

			 Fig 4a			
	b)	Derive an expression for coaxial capacitor with inner and outer radii 'a' and 'b' respectively. The potential at ρ = a is V_0 and at ρ = b is 0.	*CO2*	*PO1*	**07**
	c)	Let $V = 2xy^2x^3$ and $\varepsilon = \varepsilon_0$. Given point P(1, 2, -1) i) Find V at P ii) **E** at P iii) Does V satisfy Laplace's equation?	*CO2*	*PO1*	**06**
		UNIT - IV			
5	a)	A current filament of $3\mathbf{a}_x$ A lies along the x axis. Find **H** in cartesian components at P(-1, 3, 2).	*CO2*	*PO1*	**07**
	b)	An infinite filament on the z-axis carries 20π mA in the $\mathbf{a}_z$ direction. Three uniform cylindrical current sheets are also present: 400 mA/m at ρ = 1 cm, -250 mA/m at ρ = 2 cm, and -300 mA/m at ρ = 3 cm. Calculate H_ϕ at ρ = 0.5, 1.5, 2.5 and 3.5 cm	*CO2*	*PO1*	**07**
	c)	Derive expression for tangential and normal components of magnetic field for a boundary separating magnetic materials μ_1 and μ_2.	*CO2*	*PO1*	**06**
		UNIT - V			
6	a)	Explain the significance of Maxwell's Equation in point form and integral form	*CO3*	*PO2*	**07**
	b)	The location of the sliding bar shown in Fig 6b is given by $x = 5t + 2t^3$ and the separation of the two rails is 20 cm. Let $B = 0.8x^2\ \mathbf{a}_z$ T. Find the emf at i) t = 0.4 s and ii) x = 0.6 m  Fig 6b	*CO3*	*PO2*	**07**

		c)	Derive an expression for Poynting Vector	*CO3*	*PO2*	**06**
			OR			
	7	a)	Consider $\mathbf{E}(z, t) = 1800 \cos(10^7\pi t - \beta z)\ \mathbf{a}_x$ V/m and $\mathbf{H}(z, t) = 3.8 \cos(10^7\pi t - \beta z)\ \mathbf{a}_y$ A/m. Find λ, μ_R and ε_R.	*CO3*	*PO2*	**07**
		b)	$\mathbf{E}_s$ in free space is given by the equation $10e^{-\beta x}\ \mathbf{a}_z + 15e^{-\beta x}\ \mathbf{a}_y$ V/m. Find i) $\mathbf{H}_s$ and ii) average power density in W/m^2.	*CO3*	*PO2*	**07**
		c)	Consider microwave equipment operating at 2.45 GHz. If the conductivity $\sigma = 1.2 \times 10^6$ S/m and $\mu_R = 500$ for the stainless-steel interior, find the depth of penetration.	*CO3*	*PO2*	**06**

****