U.S.N.										

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

Autonomous Institute Affiliated to VTU

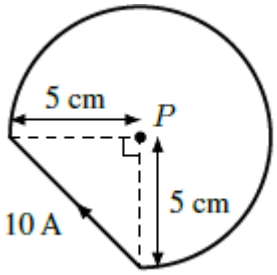
December 2023 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Electronics and Communication Engineering **Duration: 3 hrs.**
Course Code: 22EC4PCFAW **Max Marks: 100**
Course: Fields and Waves

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)		Two point charges $Q_A = -20\ \mu$C and $Q_B = 50\ \mu$C are located at A(-6,4,7) and B(5,8,-2) respectively in free space. (Distances given in meter). Determine the vector force exerted on Q_A by Q_B given $\varepsilon_o = 10^{-9}/36\pi$ F/m.	*CO1*	*PO1*	**7**
	b)		Obtain an expression for the Electric field intensity ($\vec{E}$) due to an infinite sheet charge of uniform density ρ_S.	*CO1*	*PO1*	**8**
	c)		Given a 60 μC point charge located at the origin, find the total electric flux passing through i) The closed surface defined by ρ = 26 cm and z = ± 26 cm. ii) The plane z = 26 cm.	*CO2*	*PO2*	**5**
			OR			
2	a)		Given the Electric flux density $\vec{D} = z\rho cos^2\phi\ \hat{a}_z$ C/m^2, find the total charge enclosed by the cylinder of radius 1 m with $-2 \leq z \leq 2$ m.	*CO1*	*PO1*	**5**
	b)		Obtain an expression for the Electric field intensity ($\vec{E}$) due to an infinite line charge of uniform density ρ_L using Gauss's law.	*CO1*	*PO1*	**7**
	c)		What are equipotential surfaces? A 15 nC point charge is located at the origin in free space. Calculate V_1 at point P_1(-2, 3, -1) in each of the following cases: i) V = 0 at (6, 5, 4) ii)V = 0 at infinity iii) V = 5 V at (2, 0, 4)	*CO2*	*PO2*	**8**
			UNIT - II			
3	a)		Derive an expression for magnetic field at a point due to infinite long straight conductor using Ampere's circuital law.	*CO1*	*PO1*	**6**
	b)		Find the energy stored in free space for the region 2mm $\leq$ r $\leq$ 3mm, $0^o \leq \theta \leq 90^o$ and $0^o \leq \phi \leq 90^o$ given the potential field $V = \frac{200}{r}$ V.	*CO2*	*PO2*	**7**

		c)	Using Laplace's equation, derive an expression for the potential in the space between the two plates of a parallel-plate capacitor. Also find the capacitance of the system.	*CO1*	*PO1*	**7**
			OR			
	4	a)	Analyse and evaluate the magnetic field intensity at point P in the figure below.  	*CO2*	*PO2*	**6**
		b)	Analyse the interface between a conductor and a dielectric and obtain the boundary conditions for electric field.	*CO 2*	*PO2*	**7**
		c)	Given the potential field $V = \frac{50 \sin\theta}{r^2}$ V in free space. (i) Determine whether V satisfies the Laplace's equation. (ii) Find the total charge stored inside the spherical shell 1 < r < 2 m.	*CO1*	*PO1*	**7**
			UNIT - III			
	5	a)	A point charge Q = 18 nC has a velocity of 5×10^6 m/s in the direction of $\hat{a}_V = 0.6\,\hat{a}_x + 0.75\hat{a}_y + 0.3\hat{a}_z$. Calculate the magnitude of the force exerted on the charge by the following fields: (i) $\vec{B} = -3\,\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z$ mT only (ii) $\vec{E} = -3\,\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z$ kV/m only (iii) $\vec{E}$ and $\vec{B}$ defined above acting together	*CO2*	*PO2*	**8**
		b)	Analyse the interface between two media of different permeability and obtain the boundary conditions for magnetic field.	*CO2*	*PO2*	**8**
		c)	Briefly explain the concept of displacement current density and state the corresponding Maxwell's equation.	-	-	**4**
			UNIT - IV			
	6	a)	What is loss tangent in the context of electromagnetic wave propagation? How can it be used to identify good dielectrics?	*CO1*	*PO1*	**7**
		b)	Analyse a plane wave travelling in sea water with parameters $\epsilon_r = 81$, $\mu_r = 1$ and σ = 4 S/m, having the electric field given by $\vec{E}(z,t) = 0.2\,e^{-z/\delta}\cos\left(4\pi\times10^5 t - \frac{z}{\delta} + 75°\right)\hat{a}_x$ V/m. Hence determine the skin depth, intrinsic impedance and Poynting vector.	*CO 2*	*PO2*	**7**
		c)	What is polarization of wave? Discuss the different types of polarization.	-	-	**6**

			UNIT - V			
	7	a)	Analyse an electromagnetic wave propagating from one medium to another of different permittivity and obtain the coefficients of reflection and transmission at normal incidence.	*CO2*	*PO2*	**10**
		b)	A uniform plane wave in air with $\vec{E}(x,t) = 8\cos(\omega t - 4x - 3z)\hat{a}_y$ V/m is incident on a dielectric slab (z ≥ 0) with parameters $\epsilon_r = 2.5, \mu_r = 1$ and $\sigma = 0$. Find i) The polarization of the wave ii) The angle of incidence iii) The reflected $\vec{E}$ field iv) The transmitted $\vec{H}$ field	*CO2*	*PO2*	**10**

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