U.S.N.										

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

Autonomous Institute Affiliated to VTU

August 2024 Semester End Main 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.

			UNIT - I	*CO*	*PO*	Marks
1	a)		Applying Gauss' law, develop an expression for electric field intensity due to infinite line charge.	*CO1*	*PO 1*	**6**
	b)		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.	*CO 1*	*PO 1*	**7**
	c)		Analyze and verify the divergence theorem for the region bounded by $\rho = 2, \emptyset = 0\ \&\ \pi, z = 0\ \&\ 5$ having flux density $\vec{D} = 6\rho \sin\left(\frac{\phi}{2}\right) \hat{a}_\rho + 1.5\rho \cos\left(\frac{\phi}{2}\right) \hat{a}_\phi$ C/m^2.	*CO 1*	*PO 2*	**7**
			(OR)			
2	a)		Calculate the electric field intensity at P(1,1,1) caused due to four identical charges 3nC each located at P_1 (1,1,0), P_2 (-1,1,0), P_3 (-1,-1,0) and P_4 (1,-1,0).	*CO 1*	*PO 1*	**7**
	b)		" The electric flux passing through any closed surface is equal to the total charge enclosed by that surface." Identify the law with reference to the above statement and illustrate the same with relevant examples.	*CO 1*	*PO 1*	**7**
	c)		Evaluate the electric flux density vector $\vec{D}$ in rectangular coordinates at point P (2, -3, -6) produced by each of the following: (i) A point charge Q_A = 55 mC located at Q(-2, 3, -6) (ii) An infinite line charge ρ_{LB} = 20 mC/m located on the x-axis	*CO 2*	*PO 2*	**6**
			UNIT - II			
3	a)		Analyze and develop an expression for the boundary conditions of electric field at the interface between a conductor and a dielectric.	*CO 2*	*PO 2*	**8**

		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.	*CO* 2	*PO* 2	6
		c)	Derive an expression for the equation of continuity of current in point form.	*CO 1*	*PO 1*	**6**
			(OR)			
	4	a)	Using Laplace's equation, analyse and obtain an expression for the potential distribution in the space between two concentric spherical shells and also evaluate the capacitance of the system.	*CO 2*	*PO 2*	**8**
		b)	Find the magnetic field intensity at (1.5, 2, 3) due to a current conductor carrying a current of 24 A along z-axis extending from z=0 to z=6.	*CO 1*	*PO 1*	6
		c)	Using Ampere's circuital law, determine the magnetic field intensity due to infinite long straight conductor.	*CO 1*	*PO 1*	**6**
			UNIT-III			
	5	a)	Analyse and articulate the fundamental principles embodied by Maxwell's equations in the differential form and integral form for time varying fields.	*CO 2*	*PO 2*	**10**
		b)	Analyse the interface between two media of different permeability and obtain the boundary conditions for magnetic field.	*CO 2*	*PO 2*	**10**
			UNIT - IV			
	6	a)	Using Maxwell's equations, develop a general wave equation by relating the space and time variations of electric and magnetic fields.	*CO 1*	*PO 1*	**10**
		b)	What is polarization of wave? Discuss the different types of polarization.	-	-	**5**
		c)	Deduce the equations for attenuation constant and the intrinsic impedance of electromagnetic wave propagating in a good conductor.	*CO 2*	*PO 2*	**5**
			UNIT- V			
	7	a)	Consider a homogeneous medium in which the refractive index varies linearly with frequency over a certain range given by $n(\omega) = \frac{n_0 \omega}{\omega_0}$. Determine the group velocity and phase velocity of a wave at the frequency of ω_0.	*CO 2*	*PO 2*	**10**
		b)	With relevant equations, analyse an electromagnetic wave propagating from one medium to another of different permittivity and obtain the coefficients of reflection and transmission at normal incidence.	*CO 2*	*PO 2*	**10**

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