17EC36

Visvesvaraya Technological University, Belagavi

MODEL QUESTION PAPER

3rd Semester, B.E (CBCS 2017-18 Scheme)EC/TC

Course: 17EC36- Engineering Electromagnetics, *Set no.2*

Time: 3 Hours **Max. Marks: 100**

Note: (i) Answer Five full questions selecting any one full question from each Module.
(ii) Question on a topic of a Module may appear in either its 1st or/and 2nd question.

		Module-1	Marks
1	a.	State and explain Coulomb's law in vector form. Mention the units of each parameter used in the expression.	06
	b.	Point charge $\mathbf{Q_1 = 300\mu C}$ located at **(1, -1, 3)**m experiences a force $\mathbf{F = 8a_x - 8a_y - 4a_z}$ **N** due to a charge$\mathbf{Q_2}$ at**(3, -3, 2)**m.Find $\mathbf{Q_2}$.	06
	c.	Find the total charge inside each of the volume indicated **a)** $\rho_v = 10z^2e^{-0.1x}\sin\pi y$, $-1 \le x \le 2$; $0 \le x \le 1$; $3 \le x \le 3.6$; **b)** $\rho_v = 4xyz^2$ $0 \le \rho \le 2$; $0 \le \phi \le \pi/2$; $0 \le z \le 3$;	08
		OR	
2	a.	Derive the expression for 'E' due to an **infinite** uniformly charged line of density ρ_lC/m at a point P.	08
	b.	Two uniform line charges of density **8 nC/m** are located in a plane **y = 0 at x = ± 4m**. Find 'E' at **P (0, 4, 10) m**.	06
	c.	Define Electric flux Density **'D'**. Find the **D** at **P(6, 8, -10**) caused by i) a point charge of **30 mC** at origin. ii) a uniform line charge of ρ_l **= 40 µC/m** on z-axis. iii) A uniform surface charge of density ρ_s **= 57.2 µC/m^2** on the plane **x =9.**	06
		Module-2	
3	a.	State and Prove Integral form of Gauss law.	06
	b.	A charge of **+Q** C is distributed uniformly throughout the volume of a sphere of radius **R.** Find E everywhere and plot variation of E with radius r.	06
	c.	Given that $\mathbf{D = (5r^2/4)a_r}$C/m^2 in spherical coordinates evaluate both sides of **divergence theorem** for the volume enclosed between **r = 1m** and **r = 2m.**	08
		OR	
4	a.	Derive the expression for scalar electric potential for a point charge at any point P.	06
	b.	Find the work done in moving a **5µC** charge from origin to **P(2, -1, 4)** through the electric field $\mathbf{E = 2xyz\,a_z + x^2z\,a_y + x^2y\,a_z}$ **V/m** via the path : Straight line segments **(0, 0, 0)** to **(2, 0, 0)** to **(2, -1, 0)** to **(2, -1, 4).**	08
	c.	Given Current density $J = 10\rho^2 z a_\rho - 4\rho\cos^2\phi a_\phi \; mA/m^2$ a. Find **J at P(3, 30˚, 2)** b. Determine the total current flowing outward through a circular band $\rho = 3$; $0 \le \phi \le 2\pi$; $2 \le z \le 2.8$	06
		Module-3	

5	a.	Derive the expressions for Poisson's and Laplace's equations.	04
	b.	Using Laplace Equation derive the expression for capacitance of a **cylindrical capacitor.** Assume the potential is a function of **ρ** only**.** The boundary conditions are $V = V_0$ at ρ=a and V = 0 at ρ =b, b > a.	08
	c.	Conducting planes at **ϕ= 10°** and **ϕ= 0°** in cylindrical coordinates have voltages **75V** and **0V** respectively. Obtain the expression for Electric flux density **D** in the region between the planes which contains a material for which $\varepsilon_r = 1.65$.	08
		OR	
6	a.	Using Biot-Savart's law Find an expression for the magnetic field intensity at any point due to a **finite length current element** of length **'L'** meters.	08
	b.	In cylindrical coordinates a magnetic field is $H = (2\rho - \rho^2)a_\phi A/m \quad for\ 0 \le \rho \le 1$ a. Determine the current density **J** b. What total current passes through a surface **z = 0, 0 ≤ ρ ≤ 1.**	06
	c.	Find the total magnetic flux crossing a surface **ϕ = π/2, 1 ≤ ρ ≤ 2and 0 ≤ z ≤ 5** due to vector magnetic potential $\mathbf{A} = (-\rho^2/4)\,\mathbf{a}_z$ web/m.	06
		Module-4	
7	a.	Derive Lorentz force equation and Derive the expression for the force on a differential current element placed in a magnetic field.	08
	b.	Derive the expression for the magnetic force between two differential current elements	06
	c.	Given $\mathbf{P_1(5, 2, 1)}$, $\mathbf{P_2(1, 8, 5)}$, $\mathbf{I_1dL_1 = -3\ a_y A.m}$ and $\mathbf{I_2dL_2 = -4\ a_z\ A.m}$. find the force on $\mathbf{I_1dL_1}$ due to $\mathbf{I_2dL_2}$and find the force on $\mathbf{I_2dL_2}$ due to $\mathbf{I_1dL_1}$.	06
		OR	
8	a.	Derive expressions for the boundary conditions at the interface between two magnetic media of different permeabilities for B, M, and H.	08
	b.	Let $\mu_1 = 5\ \mu H/m$ in region **A** where **x < 0** and $\mu_2 = 20\mu H/m$ in region **B** where **x > 0**. If there is a surface current density $\mathbf{K = 150\ a_y - 200\ a_z}$ A/m at **x = 0** and if $\mathbf{H = 300\ a_x - 400\ a_y + 500\ a_z\ A/m}$ find: i) $\mathbf{\lvert H_{tA}\rvert}$ ii) $\lvert H_{NA}\rvert$, iii) $\mathbf{\lvert H_{tB}\rvert}$, iv) $\lvert H_{NB}\rvert$.	08
	c.	Given a ferrite material which is operating in a linear mode with **B = 0.05 T** and μ_r = **50.** Calculate χ_m, **M** and **H.**	04
		Module-5	
9	a.	State and explain Faraday's law in point form and integral form.	06
	b.	What is the inconsistency of Ampere's law with continuity equation? How it was modified by Maxwell?	06
	c.	Given $\mathbf{E = E_m \sin(wt - \beta z)\ a_y\ V/m}$ in free space, Find D, B, H. sketch E & H at t = 0.	08
		OR	
10	a.	Starting from Maxwell's equations show that the intrinsic impedance of a perfect dielectric $\eta = \frac{\lvert E\rvert}{\lvert H\rvert} = \sqrt{\frac{\mu}{\varepsilon}}$ and show that its value in free space is **120π**. Also show that E & H are perpendicular to each other in free space.	10
	b.	A wave propagating in a lossless dielectric medium has the components: $\mathbf{E = 500\cos(10^7 t - \beta z)a_x\ V/m}$ $\mathbf{H = 1.1\cos(10^7 t - \beta z)a_y\ A/m}$ If the wave is travelling at $\boldsymbol{v = 0.5C}$, find μ_r, ε_r, **β, λ, z.**	10

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