CBCS SCHEME

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BEC401

Fourth Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

Electromagnetics Theory

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	State and explain Coulomb's law of force between two point charges in vector form.	6	L1	CO1
	b.	Given the two points C(-3, 2, 1) and D(5, 20°, -70°) find i) Spherical coordinates of c ii) The rectangular coordinates of D.	6	L2	CO1
	c.	Identical point charges of 3μc are located at the four corners of square of 5cm side. Find magnitude of force on any one charge.	8	L2	CO1
		OR			
Q.2	a.	Define electric field intensity. Derive an expression for electric field intensity due to infinite line charge.	8	L3	CO1
	b.	Define electric flux and flux density. Let a point charge Q_1 = 25nc be located at A(4, -2, 7) and charge Q_2 = 60nc be at B(-3, 4, -2). Find E at C(1, 2, 3) and find direction of $\overline{E}$.	12	L3	CO1
		Module – 2			
Q.3	a.	State and prove Gauss law.	6	L1	CO2
	b.	Evaluate both side of the divergence theorem for the defined plane with $1 \le x \le 2$, $2 \le y \le 3$ and $3 \le z \le 4$, if $D = 4xa_x + 3y^2a_y + 2z^3a_z$ C/m^2.	10	L3	CO2
	c.	Derive continuity of current equation.	4	L3	CO2
		OR			
Q.4	a.	Obtain the expression for the work done in moving a point charge in an electric field.	6	L1	CO2
	b.	Given that the field $D = \frac{5\sin\theta\cos\varphi}{r} a_\varphi$ c/m^2. Find: i) Volume charge density ii) The total electric flux leaving the surface of the spherical volume of radius 2m.	8	L3	CO2
	c.	Define potential difference. Derive the expression for potential field of a point charge.	6	L3	CO2

		Module – 3			
Q.5	**a.**	State and explain Biot Savarts law.	**8**	**L1**	**CO3**
	b.	From the point form of Gauss's law derive Poissons and Laplace's equation. Solve the laplaces equation for potential field in the homogeneous region between the two concentric conducting spheres with radii 'a' and 'b' such that $b > a$, if potential $v = 0$ at $r = b$ and $v = v_0$ at $r = a$. Also find capacitance between concentric spheres.	**12**	**L3**	**CO3**
		OR			
Q.6	**a.**	Define Stoke's theorem. Use this theorem to evaluate both sides of theorem for the field $H = 6xy\,a_x - 3y^2 a_y$ v/m and rectangular path around the region $2 \le x \le 5$, $-1 \le y \le 1$ and $z = 0$. Let the positive direction of ds be a_z.	**12**	**L2**	**CO3**
	b.	Define Ampere's law and derive expression for magnetic field intensity due to infinite long straight conductor using Biot-Savart law.	**8**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Derive an expression for Lorentz force equation.	**6**	**L3**	**CO4**
	b.	If $B = 0.05x a_y$ Tesla in a material for which $\chi_m = 2.5$, find : i) u_r ii) μ iii) H iv) M v) J v0) J_b.	**8**	**L3**	**CO4**
	c.	Derive the expression for force between two different current elements.	**6**	**L2**	**CO4**
		OR			
Q.8	**a.**	Discuss the magnetic boundary conditions as applicable to B and H at the interface between two different magnetic materials.	**10**	**L2**	**CO4**
	b.	Write short notes on : i) Magnetic circuits ii) Forces on magnetic materials.	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	List Maxwell's equations in free space for point form and integral form. Derive the modification of Ampere's circuit law to suit for time varying conditions.	**12**	**L2**	**CO5**
	b.	Let $\mu = 3 \times 10^{-5}$ H/m $\varepsilon = 1.2 \times 10^{-10}$ F/m and $\sigma = 0$ every where. If $H = 2\cos(10^{10}t - \beta x)a_z$ A/m. Use Maxwell's equation to obtain B, D and E.	**8**	**L3**	**CO5**
		OR			
Q.10	**a.**	State and prove Poynting theorem.	**10**	**L2**	**CO5**
	b.	A 15GHz plane wave travelling in a medium has an amplitude $E_0 = 20$V/m. Find phase velocity, propagation constant and impedance. Assume $\varepsilon_r = 2$ and $\mu_r = 5$.	**10**	**L3**	**CO5**

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