CBCS SCHEME

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BEC401

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Electromagnetic 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.	Point charges of 50 nC each are located at A (1 , 0, 0), B (-1,0,0) , C (0,1,0) and D (0, -1, 0) in free space. Find the total force on the charge located at A .	08	L3	CO1
	b.	Obtain an expression for electric field intensity at a distant point due to infinite long line charge.	08	L2	CO1
	c.	Define Electric flux density.	04	L2	CO1
		OR			
Q.2	a.	Find the total charge within the volume $0 \le \rho \le 0.1$, $0 \le \phi \le \pi$, $0 \le z \le 4$ If $\rho_v = \rho^2 z^2 \sin(0.6\phi)$	08	L3	CO1
	b.	Given a 60 μC point charge located at the origin, find the total electric flux passing through i) that portion of the sphere r = 26 cm bounded by $0 \le \theta \le \pi/2$ and $0 \le \phi \le \pi/2$ ii) The closed surface defined by $\rho = 26$ cm and $z = \pm 26$ cm.	08	L3	CO1
	c.	Define surface charge and volume charge density.	04	L1	CO1
		Module – 2			
Q.3	a.	State and prove Divergence theorem.	06	L2	CO2
	b.	Calculate volume charge density ρ_v if $\vec{D} = \frac{10\cos\theta\sin\phi}{r}\vec{a}_r \; c/m^2$	08	L3	CO2
	c.	Derive point form of continuity equation.	06	L2	CO2
		OR			
Q.4	a.	State and prove Gauss Law.	05	L2	CO2
	b.	Given the electric field $\vec{E} = 2x\vec{a}_x - 4y\vec{a}_y \; v/m$ Find the work done in moving a point charge 2c from (2, 0,0) to (0, 0, 0) and then from (0, 0,0) to (0, 2, 0).	07	L3	CO3
	c.	If $\vec{D} = \frac{5r^2}{4}\vec{a}_r \; c/m^2$, then evaluate both sides of the divergence theorem for the volume enclosed by r = 4 m, θ = π/4 radians	08	L3	CO3
		Module – 3			
Q.5	a.	Starting from point form of Gauss law deduce Poisson's and Laplace's equation.	06	L2	CO3
	b.	Using Laplace's equation obtain an expression for capacitance of parallel plate capacitor.	08	L3	CO3
	c.	State and explain Ampere's Law.	06	L1	CO3

		OR			
Q.6	**a.**	Derive an expression for magnetic field intensity at a distant point due to infinite long straight conductor using Biot – Savart's law.	**08**	**L2**	**CO3**
	b.	State and explain Stoke's theorem.	**06**	**L1**	**CO3**
	c.	Given $\vec{H} = [y\cos(\alpha x)]\vec{a}_x + (y + e^x)\ \vec{a}_z]$ A/M. Find current density vector over yz plane.	**06**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Derive the expression for force between the differential current elements.	**08**	**L2**	**CO4**
	b.	Obtain Lorentz force equation.	**06**	**L2**	**CO4**
	c.	A conductor 4 m long lies along the y– axis with a current of 10 A in the $\vec{a}_y$ direction. Find the force on the conductor if the field is $\vec{B} = 0.005\ \vec{a}_x$ Tesla.	**06**	**L3**	**CO4**
		OR			
Q.8	**a.**	Define Magnetization and Permeability.	**04**	**L1**	**CO4**
	b.	If $\vec{B} = 0.05 \times \vec{a}_y$ T in a material for which magnetic susceptibility $X_m = 2.5$. Find : i) μ_r ii) μ iii) $\vec{H}$ iv) $\vec{M}$ v) $\vec{J}$	**08**	**L3**	**CO4**
	c.	Discuss the boundary conditions at the interface between two media of different permeabilities.	**08**	**L4**	**CO4**
		Module – 5			
Q.9	**a.**	Write Maxwell's equations in point form and integral form for time varying fields.	**08**	**L2**	**CO5**
	b.	Find the frequency at which conduction current density and displacement current density are equal in a medium with $\sigma = 2 \times 10^4$ $\mho$ / m and $\epsilon_r = 81$	**06**	**L3**	**CO5**
	c.	Do the fields $\vec{E} = E_m \sin x \sin t\, \vec{a}_y$ and $\vec{H} = \frac{Em}{\mu_0} \cos x \cos t\, \vec{a}_z$ satisfy Maxwell's equation?	**06**	**L3**	**CO5**
		OR			
Q.10	**a.**	Derive a wave equation for a uniform plane wave in free space.	**08**	**L2**	**CO5**
	b.	State and prove poynting theorem.	**08**	**L2**	**CO5**
	c.	The depth of penetration in a certain conducting medium is 0.1 m and frequency of the electromagnetic wave is 1.0 MHz. Find the conductivity of the medium.	**04**	**L3**	**CO5**

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