CBCS SCHEME

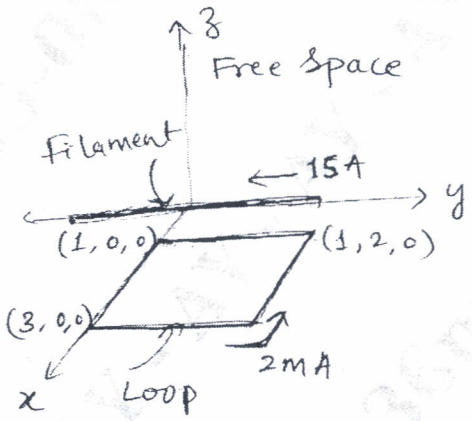
USN | 1 | A | Y | 2 | 2 | E | C | 1 | 1 | 9 | BEC401

Fourth Semester B.E/B.Tech. Degree Examination, June/July 2025
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
1	a.	Derive an expression for electric field intensity due to infinite the charge.	8	L2	CO1
	b.	Define Coulomb's law in the vector from and explain.	5	L1	CO1
	c.	Transform the vector field $W = 10\bar{a}_x - 8\bar{a}_y + 6\bar{a}_z$ to cylindrical co-ordinate system at point P(10, –8, 6).	7	L3	CO1
		OR			
2	a.	Define position vector and distance vector with an illustration in Cartesian system.	5	L1	CO1
	b.	A change of 1μc is at A(2, 0, 0), what charge must be placed at print B(–2, 0, 0), which will make 'y' component of total force per unit charge is zero at point C(1, 2, 2). Assume that the media is free space.	7	L3	CO1
	c.	Electric charge lies in the plane at z = –2m in the form of a square sheet described by $-2 \le x \le +2$m and $-2 \le y \le +2$m with charge density P_s of $2(x^2 + y^2 + 4)^{3/2}\eta$ c/m^2. Determine electric field intensity $\bar{E}$ at the origin.	8	L3	CO1
		Module – 2			
3	a.	If $\bar{E} = -8xy\bar{a}_x - 4x^2\bar{a}_y + \bar{a}_z$ V/m, the charge of 6C is to be moved from B(1, 8, 5) to A(2, 18, 6). Find the work done. Selected path is $y = 3x^2 + z$ and $Z = x + 4$.	9	L3	CO2
	b.	State and prove Gauss law.	5	L2	CO2
	c.	Derive the expression for current continuity equation.	6	L2	CO2
		OR			
4	a.	Obtain $\bar{E}$ and $\bar{D}$ for infinite sheet of charge using Gauss law.	8	L2	CO2
	b.	Let $\bar{D} = 5r^2\bar{a}_r$ m C/m^2 for $r < 0.08$m and $\bar{D} = 0.1/r^2\bar{a}_r$ m C/m^2 for $r > 0.1$m, find : i) Volume charge density for r = 0.06m, ii) Volume charge density for r = 0.1m. Assume that $\bar{D}$ is in spherical system.	6	L3	CO2
	c.	The current density vector is given by $\bar{J} = \frac{2}{r}\cos\theta\bar{a}_r + 20e^{-2r}\sin\theta.\bar{a}_\theta$, find : i) $\bar{J}$ at $(r = 3m, \theta = 0^0, \phi = \pi)$ ii) Total current passing through the sphere with r = 3m, $0 \le \theta \le 20°$ and $0 \le \phi \le 2\pi$ in $\bar{a}_r$ direction.	6	L3	CO2
		Module – 3			
5	a.	Find $\bar{E}$ at P(3, 1, 2) for the field of two co-axial conducting cylinders with v = 50V at r = 2m and v = 20V at r = 3 m using Laplace's equation.	9	L3	CO3
	b.	Calculate the value of $\bar{J}$ if $\bar{H} = \frac{1}{\sin}\bar{a}_\theta$ at P(2, 30°, 20°).	5	L3	CO3
	c.	Deduced Poisson's and Laplace's equation using Gauss law in point form. Write Laplacian operation on 'V' for different co-ordinate system.	6	L2	CO3

		OR			
6	a.	Derive the expression for magnetic field $\bar{H}$ due to infinite long straight line using Biot – Savart law.	10	L2	CO3
	b.	A Co-axial cable with radius of inner conductor 'a', inner radius of outer conductor 'b' and its outer radius 'c'. The outer conductor carries current + I and inner conductor carries current – I. Determine and sketch variation of $\bar{H}$ against 'r' for : i) $r < a$ ii) $a < r < b$ iii) $b < r < c$ and iv) $r > c$.	10	L3	CO3
		Module – 4			
7	a.	In a certain region, the magnetic flux density in a magnetic material with $X_m = 6$ is given as $\bar{B} = 0.005y^2\bar{a}_x T$ at $y = 0.4m$, find $\bar{J}, \bar{J}_b$ and $\bar{J}_T$.	8	L3	CO4
	b.	Derive Lorentz force equation and explain.	5	L2	CO4
	c.	Derive an equation for the force between the two differential current elements.	7	L2	CO4
		OR			
8	a.	A square loop of wire in $z = 0$ plane carrying 2mA in the field of an infinite filament on the y-axis as shown in the Fig.Q8(a). Find the total force on the loop.  Fig.Q8(a)	7	L3	CO4
	b.	Obtain the Tangential component of $\bar{B}$ and $\bar{H}$ is the boundary of two medium having the permeability of μ_1 and μ_2.	8	L2	CO4
	c.	Compare electric and magnetic circuits.	5	L2	CO4
		Module – 5			
9	a.	Explain inconsistency of current continuity equation in detail.	7	L2	CO5
	b.	Derive general wave equation of $\bar{E}$ and $\bar{H}$ for the media with parameters μ, ϵ and σ.	8	L2	CO5
	c.	A circular loop conductor lies in $z = 0$ plane and has a radius of 0.1 m and resistance of 5Ω. Given $\bar{B} = 0.2 \sin 10^3 t$ Tesla, determine the current in the loop.	5	L3	CO5
		OR			
10	a.	Derive Maxwell's equations in integral and point form for static electric and magnetic fields using Faraday's law, Ampere's circuital law and Coulomb's law.	8	L2	CO5
	b.	A 9375MHz uniform plane wave is propagating in polystyrene. If the amplitude of electric field intensity is 20 V/m and the material is assumed to be lossless, find Attenuation Constant (α), phase constant (β), Wavelength (λ), Velocity of propagation (v), intrinsic impedance (η), propagation constant (γ) and amplitude of the magnetic field. For polystyrene $\mu_r = 1$ and $\epsilon_r = 2.56$.	6	L3	CO5
	c.	State and explain Poynting theorem.	6	L2	CO5

* * * * *