Reg. No. | | | | | | | | | | | | | |

B. E / B. TECH.DEGREE EXAMINATIONS, MAY 2023

Third Semester

EE18302 – ELECTROMAGNETIC THEORY

(Electrical and Electronics Engineering)

(Regulation 2018)

TIME:3 HOURS **MAX. MARKS: 100**

CO 1 Implement vector calculus in electromagnetic field.

CO 2 Understand the fundamentals of electrostatics & magnetostatics.

CO 3 Analyse electromagnetic fields and potentials

CO 4 Derive different forms of Maxwell's equation.

CO 5 Solve electromagnetic wave equations and analyse electromagnetic paramaters.

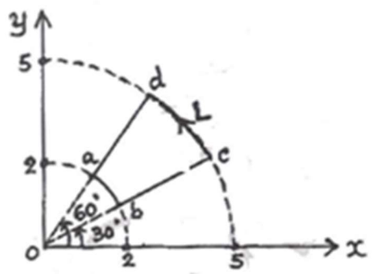
PART- A (10x2=20Marks)

(Answer all Questions)

		CO	RBT LEVEL
1	Given two vectors $\vec{P} = 4\overrightarrow{a_x} + 3\overrightarrow{a_y} + 2\overrightarrow{a_z}$ and $\vec{Q} = 3\overrightarrow{a_x} - 2\overrightarrow{a_z}$. Determine the angular separation between them.	**1**	**3**
2	State the coulomb's law and Write the mathematical expression.	**1**	**1**
3	Find the potential at a distance 100mm from a positive point charge of 10nC.	**2**	**3**
4	Write the expression for energy density in electrostatics.	**2**	**2**
5	State Ampere circuital law.	**3**	**1**
6	Define magnetic vector potential.	**3**	**1**
7	Distinguish transformer and motional EMF.	**4**	**2**
8	What is displacement current density?	**4**	**1**
9	What is intrinsic impedance? Given its expression for free space?	**5**	**1**
10	Mention any two properties of uniform plane wave?	**5**	**2**

PART- B (5x 14=70Marks)

(Restrict to a maximum of TWO subdivisions)

		Marks	CO	RBT LEVEL
11(a)	An infinite line charge with uniform charge density ρ_L extending along the z-axis. Find the electric field at an arbitrary point P(x,y,z), at a distance of ρ from the z-axis.	**(14)**	**1**	**4**
	(OR)			
11(b)	If $\vec{A} = \rho \cos\phi \, \overrightarrow{a_\rho} + \sin\phi \, \overrightarrow{a_\phi}$ evaluate $\oint A \, . \, dl$ around the path shown in the figure below. Confirm this by using Stoke's theorem. 	**(14)**	**1**	**4**
12(a)	**(i)** Derive an expression for the capacitance of concentric spheres with inner radius 'a' and outer radius 'b'.	**(8)**	**2**	**3**
	(ii) Derive the expression for Laplace's and Poisson's equations.	**(6)**	**2**	**3**
	(OR)			
12(b)	Consider the interface separating dielectric 1 (ε_{r1}) and dielectric 2 (ε_{r2}), and derive the relationships of the tangential components and normal components of Electric field intensity and electric flux density across the interface. Show that the angles between the normal to the boundary and the permittivity on either side of the boundary satisfy the following relation $$\frac{\tan\theta_1}{\tan\theta_2} = \frac{\varepsilon_1}{\varepsilon_2}$$	**(14)**	**2**	**3**
13(a)	Derive an expression for the magnetic field intensity at point 'P' in a medium of Permeability 'μ' due to an infinitely long current-carrying conductor at a distance 'r' meters from the point.	**(14)**	**3**	**3**
	(OR)			
13(b)	State and explain Ampere's circuital law and show that the field strength at the end of a long solenoid is one-half of that at the center	**(14)**	**3**	**3**
14(a)	Derive and explain Maxwell's equations both in integral and point forms	**(14)**	**4**	**3**

(OR)

14(b)	**(i)**	Derive the expression for transformer and motional EMF.	**(7)**	**4**	**3**
	(ii)	Compare the relation between circuit theory and field theory.	**(7)**	**4**	**3**
15(a)		Derive wave equations in phasor form and thereby determine the following, (i) propagation constant, ii) attenuation constant, iii) phase constant, iv) Intrinsic impedance, and v) wavelength.	**(14)**	**5**	**4**

(OR)

15(b)		State and prove Poynting's theorem and derive the expression for average power.	**(14)**	**5**	**4**

PART- C (1x 10=10Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16	Consider a sphere of radius 'a' with uniform charge ρ_0 C/m^3. Determine Electric flux density inside and outside of the sphere using Gauss's law. Plot the variation of $\vec{D}$ against the distance r from the centre of the conductor.	**(10)**	**1**	**4**

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Q. Code: 901176