Course Code: 23EE0207 **R23**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY

(AUTONOMOUS)
(Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu)
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Puttur -517583, Chittoor District, A.P. (India)

QUESTION BANK (DESCRIPTIVE)

Subject with Code: Electromagnetic Field Theory(23EE0207) **Course & Branch**: B.Tech - EEE

Year & Sem: II-B.Tech & I-Sem **Regulation:** R23

UNIT –I

Vector Analysis, Coordinate Systems, Vector Calculus & Electrostatics

1	a	Define stokes theorem.	[L1][CO1]	[2M]
	b	Describe the relationship between potential gradiant and electric field.	[L2][CO1]	[2M]
	c	Describe the applications of Gauss law in electrostatics.	[L2][CO1]	[2M]
	d	Define Divergence Theorem.	[L1][CO1]	[2M]
	e	List the properties of Vectors	[L1][CO1]	[2M]
2	a	**Tw**o points A (2,2,1) and B (3,-4,2) are given in the cartesian systems. Obtain the vector from A to B and a unit vector directed from A to B.	[L3][CO1]	[5M]
	b	The Three fields are given by $A=2a_x -a_z$, $B= 2 a_x-a_y+2a_z$, $C= 2a_x-3a_y +a_z$. Find the scalar and vector triple product.	[L3][CO1]	**[5**M]
3	a	If $B= y a_x + (x+z) a_y$ and a point Q is located at (-2,6,3) express B in cylindrical coordinates	[L3][CO1]	**[5**M]
	b	Transform the vector field $W=10 a_x -8 a_y +6 a_z$ to cylindrical co-ordinate system at point P (10, -8, 6).	[L3][CO1]	**[5**M]
4		Determine the divergence of these vector fields: i) $P=x^{-2}yz\ a_x +xz\ a_z$, ii) $Q= r \sin \phi\ a_r +r^2\ z\ a_\phi + z \cos \phi\ a_z$ and iii) $T= (1/r^2) \cos \theta\ a_r + r \sin \theta \cos \phi\ a_\theta+\text{Cos}\theta\ a_\phi$	[L3][CO1]	[10M]
5		Find the gradient of the following scalar fields: i) $V= e^{-z} \sin 2x \cosh y$, ii) $U= r^2 z \cos \phi$ and iii) $W= 10r \sin^2\theta \cos\phi$	[L3][CO1]	[10M]
6		Determine the curl of the vector fields: i).$P=x^2yz\ a_x +xz\ a_z$, ii) $Q= r \sin \phi\ a_r +r^2\ z\ a_\phi + z \cos \phi\ a_z$ and iii) $T= (1/r^2) \cos \theta\ a_r + r \sin \theta \cos \phi\ a_\theta+\text{Cos}\theta\ a_\phi$	[L3][CO1]	[10M]
7	a	State and explain Coulomb's law indicating clearly the units of quantities in the equation of force?	[L2][CO1]	**[5**M]
	b	Determine the force between the two charge $Q_1=4*10^{-4}$ C at A(2,3,4) , $Q_2=-2*10^{-4}$ C at B(3,0,3) in vacuum	[L3][CO1]	**[5**M]
8	a	State and prove Gauss's law and write limitations of Gauss's law?	[L2][CO1]	**[5**M]
	b	The Electric flux density is given as $D= (r/4) a_r$ n C/m^2 in free space. Calculate: The Electric field intensity at r=0.25 m , The total charge within a sphere of r=0.25 m	[L3][CO1]	**[5**M]
9	a	Find E at (0,0,2) m due to charged circular disc in x-y plane with ρ_S=20 n C/m^2 and radius 1m.	[L3][CO1]	[3M]
	b	An infinitely long uniform line charge is located at y=3, Z=5. If ρ_L = 30 n C/m, find the filed intensity E at i) origin , ii) P(0,6,1) and iii) P (5,6,1)	[L3][CO1]	[5M]
	C	Derive the Maxwell's First and Second Equation	[L4][CO1]	[2M]
10	a	Determine whether or not the following potential fields satisfy the Laplace's equation $V=x^2-y^2+z^2$ & ii) $V= r \cos\phi +z$	[L3][CO1]	**[5**M]
	b	Derive Laplace's and Poisson's Equation.	[L4][CO1]	**[5**M]

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UNIT –II

CONDUCTORS, DIELECTRICS AND CAPACITANCE

1	a	Define dielectrics?	[L1][CO2]	[2M]
	b	Define dielectric strength	[L1][CO2]	[2M]
	c	Describe the expression for energy density in electrostatic field.	[L1][CO2]	[2M]
	d	Describe the boundary conditions at the interface between two perfect dielectrics.	[L1][CO2]	[2M]
	e	Define electric dipole.	[L1][CO2]	[2M]
2		Two pint charges 1.5nC at (0,0,0.1) and -1.5nC at (0,0,-0.1) are in free space. Treat the two charges as a dipole at the origin and find the potential at p(0.3,0,0.4)	[L3][CO2]	[10M]
3	a	Derive the continuity equation. What is its physical significance?	[L4][CO2]	[5M]
	b	Derive the point form of ohms law?	[L2][CO2]	[5M]
4		Explain the boundary conditions of two perfect dielectrics materials?	[L4][CO2]	[10M]
5		Explain the boundary conditions between conductor and free space?	[L4][CO2]	[10M]
6	a	In cylindrical coordinates $J=10\ e^{-100r}\ a_\phi\ A/m^2$. Find the current crossing through the region $0.01<r<0.02$ m and $0<z<1$ m and intersection of this region with the ϕ = constant plane.	[L3][CO2]	[5M]
	b	An aluminum conductor is 2000 ft long and has a circular cross section with a diameter of 20 mm. If there is a DC voltage of 1.2 V between the ends . Find a) The current density b) The current , C power dissipated form the l=knowledge of circuit theory. Assume $\sigma=3.82 *10^7$ mho/m for aluminum.	[L3][CO2]	[5M]
7	a	Find the magnitude of D and P for a dielectric material in which E=0.15 mV/m and $\chi=4.25$.	[L3][CO2]	[5M]
	b	Find the polarization in dielectric material with $\varepsilon_r=2.8$ if $D=3*10^{-7}\ C/m^2$.	[L3][CO2]	[5M]
8		Explain the phenomenon of polarization when a dielectric slab is subjected to an electric field?	[L4][CO2]	[10M]
9	a	Derive the expression for parallel plate capacitor and capacitance of a co-axial cable?	[L4][CO2]	[5M]
	b	A parallel plate capacitor has an area of 0.8 m^2 separation of 0.1 mm with a dielectric for which $\varepsilon_r = 1000$ and a field of 10^6 V/m. Calculate C and V	[L3][CO2]	[5M]
10		Let $A=120\ Cm^2$, d=5 mm and $\varepsilon_r=12$ for a parallel plate capacitor i) Calculate the capacitance ii) After connecting a 40 V battery across the battery, Calculate E, D, Q and the total stored energy iii) The source is now removed and the dielectric is carefully withdrawn from between. Again, Calculate E, D, Q and the energy iv) What is voltage between the plates.	[L3][CO2]	[10M]

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UNIT –III

MAGNETO STATICS, AMPERE'S LAW AND FORCE IN MAGNETIC FIELDS:

1	a	Define magnetic moment	[L1][CO3]	[2M]
	b	Define lorentz force?	[L1][CO3]	[2M]
	c	Define magnetic field strength	[L1][CO3]	[2M]
	d	State Biot –Savarts law.	[L1][CO3]	[2M]
	e	Give the expression for torque experienced by a current carrying loop situated in a magnetic field	[L1][CO3]	[2M]
2		Using Biot-savart's law. Find $\vec{H}$ *and* $\vec{B}$ due conductor of finite length?	[L2][CO3]	[10M]
3	a	Explain maxwell's Third equation?	[L2][CO3]	[5M]
	b	State and explain ampere's circuital law?	[L2][CO3]	[5M]
4		Evaluate both sides of the stokes theorem for the filed H=6xy a_x -3y^2 a_y A/m and the rectangular path around the region 2<x<5, -1<y<1 , Z=0 . Let the positive direction of ds be a_z.	[L3][CO3]	[10M]
5	a	Find the flux passing the portion of the plane $\phi=\pi/4$ defined by 0.01<r<0.05 m and 0<z<2 m. A current filament of 2.5 A is along the z axis in the a_z direction in free space.	[L3][CO3]	[5M]
	b	In cylindrical coordinates B= (2.0/r) a_ϕ tesla. Determine the magnetic flux ϕ crossing the plane surface defined by 0.5<r<2.5 m and 0<z<2m.	[L3][CO3]	[5M]
6		A Point charge of Q=-1.2 C has a velocity V=(5 a_x +2 a_y -3a_z)m/s. Find the magnitude of the force exerted on the charge if i) E= -18 a_x +5 a_y -10 a_z V/m and ii) B=-4 a_x +4 a_y +3 a_z T, iii) Both are present simultaneously	[L4][CO4]	[10M]
7	a	A magnetic field B= 3.5*10^{-2} a_z exerts a force on a 0.3 m long conductor along x axis. IF a current of 5 A flows in -a_x direction, determine what force must be applied to hold conductor in position.	[L3][CO4]	[5M]
	b	Determine the force per meter length between two long parallel wires A and B separated by distance 5 cm in air and carrying currents of 40 A in the same direction.	[L3][CO4]	[5M]
8		A rectangular loop in Z=0 plane has corners at (0,0,0), (1,0,0),(1,2,0) and (0,2,0). The loop carries a current of 5 A in a_x direction. Find the total force and torque on the loop produced by the magnetic field B=2 a_x+2a_y-4a_z wb/m^2.	[L4][CO4]	[10M]
9	a	Describe the Lorentz law of force?	[L2][CO4]	[5M]
	b	Derive an expression for the force between two long straight parallel current carrying conductors.	[L4][CO4]	[5M]
10	a	Write the expression for magnetic field H at the center of a circular coil carrying a current of I amperes. The radius of the coil is a 'm'.	[L4][CO4]	[5M]
	b	Define Magnetic dipole and derive Magnetic torque and Magnetic moment between two magnetic dipoles	[L2][CO4]	[5M]

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UNIT –IV

SELF AND MUTUAL INDUCTANCE

1	a	Distinguish between solenoid and toroid.	[L1][CO5]	[2M]
	b	Define self inductance.	[L1][CO5]	[2M]
	c	State Lenz law.	[L1][CO5]	[2M]
	d	Describe the expression for energy stored in a magnetic field?	[L2][CO5]	[2M]
	e	Describe the energy density in magnetic field?	[L2][CO5]	[2M]
2		Derive the expression for self-inductance of solenoid	[L4][CO5]	[10M]
3		Derive the expression for self-inductance of toroid	[L4][CO5]	[10M]
4		Derive the expression for self-inductance of coaxial cable	[L4][CO5]	[10M]
5	a	Calculate the inductance of a solenoid of 200 turns wound tightly on a cylindrical tube of 6 cm diameter. The length of the tube is 60 cm and the solenoid is in air.	[L3][CO5]	**[5**M]
	b	Find inductance per unit length of a co-axial cable if radius of inner and outer conductors is 1 mm and 3 mm respectively. Assume relative permeability unity.	[L3][CO5]	**[5**M]
6		Calculate the inductance of a 10 m length of coaxial cable filled with a material for which μ_r = 80 and radii inner and outer conductors are 1 mm and 4 mm respectively.	[L3][CO5]	[10M]
7		The core of a toroid is of 12 cm^2 area and is made up of material with μ_r = 200. If the mean radius of the toroid is 50 cm, Calculate the number of turns needed to obtain an inductance of 2.5 H	[L3][CO5]	[10M]
8		Derive the expression for Mutual inductance between a long, straight wire and Rectangular Loop Laying in same Plane.	[L4][CO5]	[10M]
9		A Straight long wire is situated parallel to one side of a square coil. Each side of the coil has a length of 10 cm. The distance between straight wire and the centre of the coil is 20 cm. Find Mutual Inductance of the system.	[L3][CO5]	[10M]
10	a	Derive the expression for energy stored and Energy density in magnetic field.	[L4][CO5]	[5M]
	b	A current of 2A is flowing through an inductor of 100 mH. What is the energy stored in the inductor.	[L3][CO5]	[5M]

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UNIT –V

TIME VARYING FIELDS

1	a	Define skin depth?	[L1][CO6]	[2M]
	b	Define displacement current?	[L1][CO6]	[2M]
	c	State Faraday's law of electromagnetic induction?	[L1][CO6]	[2M]
	d	Write Maxwell equations in time varying fields?	[L1][CO6]	[2M]
	e	Define pointing vector?	[L1][CO6]	[2M]
2		Write Maxwell's equation in good conductors for time varying fields and static fields both in differential and integral form?	[L4][CO6]	[10M]
3		Explain faradays law of electromagnetic induction and there from derive maxwell's equation in differential and integral form?	[L4][CO6]	[10M]
4		Derive the equation of Continuity for time varying fields?	[L4][CO6]	[10M]
5		Derive an expression for motional and transformer induced emf?	[L4][CO6]	[10M]
6		What is displacement current? Explain physical significance of displacement current?	[L2][CO6]	[10M]
7		Derive expressions for integral and point forms of poynting Theorem?	[L4][CO6]	[10M]
8		Explain faradays law of electromagnetic induction and derive the expression for induced e.m.f.	[43][CO6]	[10M]
9		A Parallel plate capacitor with plate area of 5 cm^2 and plate separation of 3mm has a Voltage of 50 sin 10^3 t volts applied to its plates. Calculate the displacement current Assuming $\varepsilon=2\varepsilon_0$	[L3][CO6]	[10M]
10		An area of 0.65 m^2 in the plane Z=0 encloses a filamentary conductor. Find the induced voltage if B= 0.05 cos 10^3 t (a_y+a_z)/$\sqrt{2}$ tesla.	[L3][CO6]	[10M]

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