



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 gradient 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	Two 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]	[5M]
3	a	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]	[5M]
	b	Give the Cartesian Co-ordinates of the vector field $H=20a_r -10a_\phi + 3 a_z$ at a point P(x=5, y=2, z=-1)	[L3][CO1]	[5M]
4		Determine the divergence of these 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) $T= (1/r^2) \cos \theta a_r + r \sin \theta \cos \phi a_\theta + \cos \theta a_\phi$	[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) $T= (1/r^2) \cos \theta a_r + r \sin \theta \cos \phi a_\theta + \cos \theta a_\phi$	[L3][CO1]	[10M]
7	a	State and explain Coulomb's law indicating clearly the units of quantities in the equation of force?	[L2][CO1]	[5M]
	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]	[5M]
8	a	State and prove Gauss's law and write limitations of Gauss's law?	[L2][CO1]	[5M]
	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]	[5M]
9	a	Find E at (0,0,2) m due to charged circular disc in x-y plane with $\rho_s=20$ 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 $\rho_L = 30$ n C/m, find the field 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 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]	[4M]
	b	Derive the Laplace and Poisson's Equations	[L4][CO1]	[3M]

	c	Given the Potential $V=10(x^2+xy)$ and a point P(2,-1,3) on a conductor to free space boundary . Find V, E,D at a point P	[L4][CO1]	[3M]
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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	a	Derive the potential and EFI due to an Electric Dipole	[L4][CO2]	[5M]
	b	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]	[5M]
3	a	Derive the continuity equation. What is its physical significance?	[L4][CO2]	[5M]
	b	Derive the conduction and convection current densities.	[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 $\phi = \text{constant}$ 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 $\epsilon_r = 2.8$ 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 Spherical	[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 $\epsilon_r = 1000$ and a field of 10^6 V/m. Calculate C and V	[L3][CO2]	[2M]
	c	A Conducting sphere of radius 5cm has a total charge of $1\mu\text{C}$. The sphere is surrounded by an inhomogeneous dielectric sphere $5 < r < 10\text{cm}$ in which relative permittivity varies as $\epsilon_r = 0.1/r$. A second conducting spherical surface is at $r=10\text{cm}$. Calculate the Potential difference and capacitance between the conductors.	[L3][CO2]	[3M]
10	a	Derive the expression for capacitance as a co-axial cable	[L3][CO2]	[4M]
	b	Derive the Expression for Energy stored and Energy density in a capacitor	[L4][CO2]	[3M]
	c	A Pair of 200mm long concentric cylindrical conductors of radii 50 mm and 100mm is filed with a dielectric with $\epsilon=10\epsilon_0$. A voltage is applied between the conductors with establishes $E=10^6/r$ a _r . Calculate Capacitance, Voltage applied and Energy Stored.	[L4][CO2]	[3M]

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	a	Using Biot-savart's law. Find $\vec{H}$ and $\vec{B}$	[L2][CO3]	[5M]
	b	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.	[L4][CO4]	[5M]
3	a	Explain maxwell's Second 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	Describe the Lorentz law of force?	[L2][CO4]	[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	Derive the force on a current element in a magnetic field.	[L4][CO4]	[5M]
	b	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]
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	Derive an expression for the force between two long straight parallel current carrying conductors.	[L4][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]
10		Define Magnetic dipole and derive Magnetic torque and Magnetic moment between two magnetic dipoles	[L2][CO4]	[10M]

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]	[5M]
	b	A very long solenoid with 2x2 cm cross section has an iron core $\mu_r=1000$ and 4000 turns/metre. If it carries a current of 500mA, find a self-inductance per metre	[L3][CO5]	[5M]
6	a	Calculate the inductance of a 10 m length of coaxial cable filled with a material for which $\mu_r = 80$ and radii inner and outer conductors are 1 mm and 4 mm respectively.	[L3][CO5]	[5M]
	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]	[5M]
7	a	The core of a toroid is of 12 cm ² area and is made up of material with $\mu_r = 200$. 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]	[5M]
	b	An air core toroid with rectangular cross section has 700 turns with inner radius of 1 cm and outer radius of 2cm and height is 1.5cm find the inductance.	[L3][CO5]	[5M]
8		Derive the expression for Mutual inductance between a long, straight wire and Rectangular Loop Laying in same Plane.	[L4][CO5]	[10M]
9	a	A rectangular loop has a length of 0.6 m and width of 0.3 m. The nearest side is located 10 cm from a long straight conductor. Calculate the mutual inductance between the conductor and the loop.	[L3][CO5]	[5M]
	b	A long straight conductor carries a current of 25 A . A rectangular loop of dimensions 0.5 m × 0.2 m is placed with its nearest side 8 cm from the conductor. Determine: - The mutual inductance. - The magnetic flux linkage with the loop.	[L3][CO5]	[5M]
10	a	Derive the expression for energy stored and Energy density in magnetic field.	[L4][CO5]	[5M]
	b	An inductor of inductance 5 H carries a current of 4 A. Calculate The energy stored in the magnetic field. The energy density if the magnetic field occupies a volume of 0.02 m ³ .	[L3][CO5]	[3M]
	c	The magnetic flux density inside an iron core is 1.2 T. The permeability of the core material is $\mu=1500\mu_0$. Determine the energy density stored in the magnetic field.	[L3][CO5]	[2M]

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 $\epsilon=2\epsilon_0$	[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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