Course Code: 19EE0207 **R19**

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QUESTION BANK (DESCRIPTIVE)

Subject with Code:Electromagnetic Fields (19EE0207) **Course & Branch**: B.Tech - EEE

Year & Sem: II-B.Tech & II-Sem **Regulation:** R19

UNIT –I
INTRODUCTION TO VECTOR CALCULUS

1	a	Convert point P(1,3,5) from cartesian to cylindrical and spherical co-ordinates system.	[L4][CO1]	**[6M]**
	b	Given the two points A (X=2, Y=3, Z=-1) and B= (r=4, θ=25 and ϕ=120°). Find the spherical co-ordinates of A and cartesian co-ordinates of B	[L4][CO1]	**[6M]**
2		Point P and Q are located at (0,2,4) and (-3,1,5) calculated: (1). The Position vector P, (2). The distance vector from P and Q, (3). The distance between P and Q and (4). A vector parallel to PQ with magnitude of 10.	[L1][CO1]	**[12M]**
3.		Express vector B in cartesian and cylindrical systems. Given $B= 10/r\ a_r + r\cos\theta\ a_\theta + a_\phi$. Find the B at (-3,4,0) and (5,π/2, -2)	[L4][CO1]	**[12M]**
4.	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)	[L1][CO1]	**[6M]**
	b	Express $B= r^2\ a_r + \sin\theta\ a_\phi$ in the cartesian co-ordinates. Hence obtain B at P (1,2,3)	[L4][CO1]	**[6M]**
5		If $B= y\ a_x + (x+z)\ a_y$ and a point Q is located at (-2,6,3) express.1 The Point Q in cylindrical and spherical co-ordinates and 2) B in spherical coordinates.	[L4][CO1]	**[12M]**
6	a	Given point P (-2,6,3) and $A=y\ a_x +(x+z)\ a_y$. Express A in Cylindrical coordinates.	[L4][CO1]	**[6M]**
	b	Transform the vector A= 3i-2j-4K at P (x=2, y=3, Z=3) to cylindrical coordinates	[L4][CO1]	**[6M]**
7	a	Given the two coplanar vectors $A= 3\ a_x + 4\ a_y- 5\ a_z$ and $B= -6a_x +2\ a_y +4\ a_z$. Obtain the unit vector normal to the plane containing the vector A and B	[L4][CO1] 4	**[6M]**
	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.	[L4][CO1]	**[6M]**
8		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) $T= (1/r^2)\cos\theta\ a_r + r\sin\theta\cos\phi a_\theta+\text{Cos}\theta a_\phi$	[L4][CO1]	**[12M]**
9		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) $W= 10r\sin^2\theta\cos\phi$	[L4][CO1]	**[12M]**
10		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) $T= (1/r^2)\cos\theta\ a_r + r\sin\theta\cos\phi a_\theta+\text{Cos}\theta a_\phi$	[L4][CO1]	**[12M]**

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UNIT –II
STATIC ELECTRIC FIELD

1	a	State and explain Coulomb's law indicating clearly the units of quantities in the equation of force?	[L1][CO2]	**[6M]**
	b	State and prove Gauss's law and write limitations of Gauss's law?	[L2][CO2]	**[6M]**
2		Three concentrated charges of 0.25 μC are located at the vertices of an equilateral triangle of 10 cm side . Find the magnitude and direction of the force on one charge due to other two charges.	[L4][CO2]	**[12M]**
3.	a	Determine the Electric filed intensity at P(-0.2, 0, -2.3) m due to a point charge of 5 nc at Q (0.2,0.1, -2.5) m in air.	[L4][CO2]	**[6M]**
	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)	[L4][CO2]	**[6M]**
4.	a	Line charge density ρ_L= 24 n C/m is located in free space on the line y=1 and Z=2 m	[L4][CO2]	**[6M]**
	b	Find E at the point P(6,-1,3) , b) What point charge Q_a should be located at A (-3,4,1) to make y component of total E zero at point P?	[L4][CO2]	**[6M]**
5	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.	[L4][CO2]	**[6M]**
	b	A circular disc of 10 cm radius is charged uniformly with total charge of 100μc . Find E at a point 20cm on its axis.	[L4][CO2]	**[6M]**
6		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	[L4][CO2]	**[12M]**
7		Given that A= 30 e^{-r} a_r-2 z a_z in the cylindrical co-ordinates. Evaluate both sides of the divergence theorem for the volume enclosed by r=2, z=0 and Z=5	[L4][CO2]	**[12M]**
8	a	An electric potential is given by V=(60 sinθ /r^2) v . Find V and E at P(3,60°,25°)	[L4][CO2]	**[6M]**
	b	In free space V= x^2y(z+3) . Find E at (3, 4, -6) and The charge within the cube 0<x,y,z<1.	[L4][CO2]	**[6M]**
9	a	The potential field in free space is given by V=(50/r) , a<r< b (spherical) show that ρ_v=0 for a<r<b and find the energy stored in the region a<r<b	[L4][CO2]	**[6M]**
	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)	[L4][CO2]	**[6M]**
10	a	What is the relation between electric flux density and electric field intensity	[L1][CO2]	**[4M]**
	b	Define dipole moment?	[L1][CO2]	**[2M]**
	c	Define an electric dipole?	[L1][CO2]	**[2M]**
	d	State vector form of coulombs law?	[L1][CO2]	**[2M]**
	e	Derive Maxwell second equation?	[L1][CO2]	**[2M]**

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UNIT –III

CONDUCTORS, DIELECTRICS AND CAPACITANCE

1	a	Derive the continuity equation. What is its physical significance?	[L1][CO3]	**[6M]**
	b	Derive the point form of ohms law?	[L1][CO3]	**[6M]**
2		Explain the boundary conditions of two perfect dielectrics materials?	[L1][CO3]	**[12M]**
3		Explain the boundary conditions between conductor and free space?	[L1][CO3]	**[12M]**
4	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	[L4][CO3]	**[6M]**
	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 .	[L4][CO3]	**[6M]**
5	a	Find the magnitude of D and P for a dielectric material in which E=0.15 mV/m and $\chi=4.25$	[L4][CO3]	**[6M]**
	b	Find the polarization in dielectric material with $\varepsilon_r=2.8$ if $D=3*10^{-7}\ C/m^2$	[L4][CO3]	**[6M]**
6		Explain the phenomenon of polarization when a dielectric slab is subjected to an electric field?	[L4][CO3]	**[12M]**
7	a	Derive the expression for parallel plate capacitor and capacitance of a co-axial cable?	[L4][CO3]	**[6M]**
	b	A parallel plate capacitor has an area of 0.8 m^2 separation of 0.1 mm with a dielectric for which ε_r = 1000 and a field of 10^6 V/m. Calculate C and V	[L4][CO3]	**[6M]**
8		Find V at P (2,1,3) for the field of two coaxial conducting cones, with V=50 V at $\theta=30$ and V=20 V at $\theta=50$.	[L4][CO3]	**[12M]**
9		Two parallel conducting disc are separated by distance 5 mm at z=0 and z=5 mm .If V=0 and V=100 v at z=5 mm, find the charge densities on the disc.	[L4][CO3]	**[12M]**
10	a	Determine whether or not the following potential fields satisfy the Laplace's equation $V=x^2-y^2+z^2$ ii) $V= r\cos\phi +z$	[L2][CO3]	**[6M]**
	b	Derive Laplace's and Poisson's Equation	[L1][CO3]	**[6M]**

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UNIT –IV

STATIC MAGNETIC FIELDS

1		Using Biot-savart's law. Find $\vec{H}$ *and* $\vec{B}$ due conductor of finite length?	[L1][CO4]	**[12M]**
2	a	Explain maxwell's second equation?	[L1][CO4]	**[6M]**
	b	State and explain ampere's circuital law?	[L1][CO4]	**[6M]**
3		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.	[L4][CO4]	[12M]
4	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.	[L4][CO4]	**[6M]**
	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.	[L4][CO4]	**[6M]**
5		In cylindrical co-ordinates A=50 r^2 a_z wb/m is a vector magnetic potential in a certain region of free space. Find H, B, J and using J find the total current I crossing the surface 0<r<1 , 0<ϕ<2π and Z=0.	[L4][CO4]	[12M]
6	a	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	[L4][CO4]	**[6M]**
	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.	[L4][CO4]	**[3M]**
	c	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.	[L4][CO4]	**[3M]**
7		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]	**[12M]**
8		Derive the expression for self-inductance of solenoid, toroid and coaxial cable	[L1][CO4]	**[12M]**
9	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.	[L4][CO4]	**[6M]**
	b	Find inductance per unit length of a co-axial cable if radius of inner and outer conductors are 1 mm and 3 mm respectively. Assume relative permeability unity.	[L4][CO4]	**[6M]**
10		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.	[L4][CO4]	**[12M]**

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UNIT –V

TIME VARYING FIELDS AND MAXWELL'S EQUATIONS

1		Write Maxwell's equation in good conductors for time varying fields and static fields both in differential and integral form?	[L1][CO5]	**[12M]**
2		Explain faradays law of electromagnetic induction and there from derive maxwell's equation in differential and integral form?	[L1][CO5]	**[12M]**
3		Derive the equation of Continuity for time varying fields?	[L1][CO5]	**[12M]**
4		Derive an expression for motional and transformer induced emf?	[L1][CO5]	**[12M]**
5		What is displacement current? Explain physical significance of displacement current?	[L1][CO5]	**[12M]**
6		Derive expressions for integral and point forms of poynting Theorem?	[L1][CO5]	**[12M]**
7		Explain faradays law of electromagnetic induction and derive the expression for induced e.m.f	[L1][CO5]	**[12M]**
8	a	Define skin depth?	[L1][CO5]	**[2M]**
	b	Define displacement current?	[L1][CO5]	**[2M]**
	c	State Faraday's law of electromagnetic induction?	[L1][CO5]	**[2M]**
	d	Write Maxwell equations in time varying fields?	[L1][CO5]	**[4M]**
	e	Define pointing vector?	[L1][CO5]	**[2M]**
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 $\varepsilon=2\varepsilon_0$	[L4][CO5]	**[12M]**
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.	[L4][CO5]	**[12M]**

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