INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad - 500 043

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

Course Name	:	Electro Magnetic fields
Course Code	:	A30403
Class	:	II B. Tech I Sem
Branch	:	EEE
Year	:	2016 – 2017
Course Faculty	:	Ms.S.Ranjitha

OBJECTIVE : Impart knowledge on the basics of static electric and magnetic field and the associated laws and to give insight into the propagation of EM waves and also to introduce the methods in computational electromagnetics

S.No	QUESTION	BLOOMS TAXONOMY LEVEL	COURSE OUTCOME
	UNIT-I ELECTROSTATICS		
	SHORT ANSWER TYPE QUESTIONS		
1	Define coulombs law?	Remembering	1
2	find the electric field E, if the force on a stationary charge Q is F?	Understanding	1
3	Define unit vector?	Remembering	2
4	Specify the importance of divergence and stokes theorems?	Understanding	2
5	Define gauss law?	Remembering	2
6	Give the expression for the potential difference of two concentric conducting sphere of radius a and b?	Understanding	1
7	List the applications of gauss law?	Understanding	1
8	Define electric flux and give the expression?	Understanding	2
9	Give the relation between electric flux and flux density ?	Understanding	1
10	State the divergence theorem and give the expression ?	Understanding	1
11	State the stokes theorem and give the expression ?	Understanding	1
12	Define electric potential ?	Understanding	2
13	What e is the first Maxwell's equation ?	Analysis	1
14	Give the relation between V and E?	Understanding	1
15	What is the value of curl of E for a static field?	Understanding	1
	LONG ANSWER QUESTIONS		

1	Define divergence and divergence theorem of a vector A and write the equations?	Remembering	1
2	Determine the divergence of $T = \frac{1}{r^2}\cos\theta\, a_r + r\sin\theta\cos\emptyset\, a_\theta + \cos\theta\, a_\emptyset$?	Understanding	2
3	Define dielectric constant, dielectric strength and relaxation time in electrostatics?	Remembering	1
4	Derive equation of continuity?	Understanding	2
5	Define curl of a vector and state Stoke's theorem?	Remembering	2
6	Determine the curl of $Q = \blacklozenge\sin\emptyset\, \blacklozenge_\rho + \blacklozenge^2\blacklozenge\blacklozenge_\phi + \blacklozenge\cos\emptyset\, \blacklozenge_z$?	Understanding	1
7	Write a Laplacian equation on Cartesian, cylindrical and spherical coordinates?	Understanding	2
8	Explain conduction current and derive the expression for conduction current density?	Understanding	1
9	State coulomb's law and write the equation for F that exist between two unlike charges**?**	Understanding	2
10	Derive the expression for electric field on point charge Q due to the point charge Q_1?	Understanding	1
11	The electric field in a spherical co-ordinate is given by E=(rρ/5ε)a$_r$. Show that closed ∫E.dS=∫(▼.E)dv.	Understanding	1
12	Check validity of the divergence theorem considering the field D=2xy ax+x^{2}ay c/m^2 and the rectangular parallelepiped formed by the planesx=0,x=1,y=0,y=2 &z=0,z=3	Understanding	2
13	Explain three co-ordinate system.	Understanding	1
14	Define divergence, gradient, curl in spherical co-ordinate system with mathematical expression	Understanding	1
15	Prove that divergence of a curl of a vector is zero ,using stoke's theorem	Understanding	1

<div align="center">**ANALYTICAL QUESTIONS**</div>

1	(i) Explain Coulomb's law and deduce the vector form of force equation between two point charges. (ii) Write short notes on principle of superposition of fields as applied to charge distribution.	Analyze	1
2	State and prove Gauss's law. Write applications of Gauss's law. Describe any two applications of Gauss's law.	Analyze	2
3	(i) Write shot notes on three co-ordinates systems. (ii) Given the points A(2,-1,2), B (-1,1,4) & C (4,3,-1). Find a) Angle between R_{AB} and $R_{AC.}$ b) Area of triangle ABC, c) Unit vector perpendicular to ABC.	Apply	2

4	i)Determine the electric field intensity of an infinite straight line charge carrying uniform line charge density of ρ_L C/m. ii) Obtain the expression for electric field intensity on the axis of a uniformly charged circular disc.	Analyze	2
5	i)Express Electric flux density due to a point charge Q placed at origin. Hence obtain the relation between **D** & **E.** ii) Derive the electric field due to an infinite uniformly charged sheet.	Analyze	1
6	Construct an expression for electric field intensity at point P due to an electric dipole.	Apply	1
7	Four point charges each of 10µC are placed in free space at the points (1,0,0), (-1,0,0), (0,1,0) & (0,-1,0)m respectively. Calculate the force on a point charge of 30µC located at a point(0,0,1)m.	Apply	2
8	If $V=2x^2y+20z-(4/(x^2+y^2))$ Volts, Find **E** and **D** at P(6,-2.5,3)	Apply	1
9	If $D=10y^2\ \hat{a}_x+10x^2y\ \hat{a}_y+15\ \hat{a}_z C/m^2$, find the total charge enclosed within the region 0 <x,y,z< 2 by evaluating one or more surface integrals	Apply	1
10	Derive both sides of Divergence theorem for the region defined 0≤ r≤2, 0≤φ≤π/2 for the given flux density $D=(2cos\theta/r^3\ \hat{a}_r+(sin\theta/r^3)\ \hat{a}_\theta C/m^2$.	Evaluate	1

UNIT II

CONDUCTORS AND DIELECTRICS

SHORT ANSWER TYPE QUESTIONS

1	Give the expression for energy due to point Q in electricfield ?	Understand	3
2	What is the condition that the electrostatic field is conservative ?	Understand	3
3	What is mean by dipole moment?	Remember	4
4	Give the expression for the energy density for electrostatic fields?	Understand	3
5	Find the value of $a_\theta.a_\phi$?	Understand	4
6	Define convention current density?	Remember	3
7	Define conduction current density?	Understands	4
8	List the names of few conductors along with its conductivity?	Remember	3
9	Define polarization?	Remember	4
10	Give the expression continuity equation ?	understand	4
11	Give the expression for relaxation time?	Remember	3
12	Writ e boundary conditions for conducting media?	Understands	4
13	Writ e boundary conditions for dielectric media?	Understands	4
14	Define poission and laplace equations?	Remember	3
15	Define capacitance between two parallel plates?	Understand	3

LONG ANSWER QUESTIONS

1	Define current density. Write the relation between current and current density.	Understand	3
2	What is polarization? Write mathematical equation for polarization.	Understand	4
3	Describe dielectric strength. Write its value for the air with unit.	Remember	3
4	Why the electrostatic potential is continuous at boundary?	Understand	4
5	Tell about capacitance? Write the capacitance equation of a	Remember	3
6	State Uniqueness theorem.	Remember	4
7	Show continuity equation in integral and differential form. What do you	Remember	4
8	Identify equation of Ohm's law in point form.	Understand	4
9	Describe the boundary conditions for the conductor - free space boundary in electrostatic and interface between two dielectrics.	Understand	3
10	Summarize properties of conductor and dielectric materials.	Remember	3
11	Calculate the values of D and P for a certain linear, homogeneous, isotropic dielectric material having relative permittivity of 1.8 and electric field intensity of $4000a_yV/m$	Understand	4
12	Solve the energy stored in a 10 μF capacitor which has been charged to a voltage of 400v.	Remember	3
13	Show that the potential field given below satisfies the Laplace's equation $V=2x^2-3y^2+z^2$.	Understand	4
14	Estimate the value of capacitance between two square plates having cross sectional area of 1 sq.cm separated by 1 cm placed in a liquid whose dielectric constant is 6 and the relative permittivity of free space is 8.854 pF/m.	Apply	3
15	Formulate Poisson's equation from Gauss's law.	Apply	3

ANALYTICAL QUESTIONS

1	Discuss briefly about the nature of dielectric materials. List out the properties of dielectric materials	Apply	3
2	Derive the boundary conditions of the normal and tangential components of electric field at the interface of two media with different dielectrics	Apply	3
3	Obtain the equation of continuity in integral and differential form	Apply	4
4	Deduce the expression for joint capacitance of two capacitors C_1 and C_2 when connected in series and parallel	Apply	4

5	**(i)** Examine the capacitance of a parallel plate capacitor. **(ii)** Show the expression of the capacitance for a spherical capacitor consists of 2 concentric spheres of radius 'a' & 'b'	Analyze	4
6	Given the potential field, $V = (50\ \mathrm{Sin}\theta / r^2)$ V, in free space, determine whether V satisfies Laplace's equation.	Apply	3
7	A cylindrical capacitor consists of an inner conductor of radius 'a' & an outer conductor whose inner radius is 'b'. The space between the conductors is filled with a dielectric permittivity ε_r & length of the capacitor is L. Determine the capacitance.	Analyze	4
8	Find the total current in a circular conductor of radius 4 mm if the current density varies according to J = $(10^4/r)$ A/m^2.	Apply	3
9	The region y<0 contains a dielectric material for which ε_{r1}=2.5, while the region y>0 is characterized by ε_{r2}=4. Let $\boldsymbol{E_1}$=-30 $\hat{a}_x$ + 50 $\hat{a}_y$ + 70 $\hat{a}_z$ V/m. Find a)E$_{N1}$, b) |E$_{tan1}$|, c)E1, d) θ1.	Apply	4
10	i)Obtain the expression for the cylindrical capacitance using Laplace's equation. ii)Analyse the expressions for the energy stored and energy density in a capacitor.	Evaluate	4
11	A capacitor with two dielectrics as follows: Plate area 100 cm^2, dielectric 1 thickness = 3 mm, ε_{r1}=3 dielectric 2 thickness= 2 mm, ε_{r2}=2. If a potential of 100 V is applied across the plates, evaluate the capacitance and the energy stored Estimate the capacitance of a conducting sphere of 2 cm in diameter, covered with a layer of polyethylene with ε_1=2.26 and 3 cm thick.	Apply	3
12	Show the expression of the capacitance for a spherical capacitor consists of 2 concentric spheres of radius 'a' & 'b'	Apply	4
13	Given the potential field, $V = (50\ \mathrm{Sin}\theta / r^2)$ V, in free space, determine whether V satisfies Laplace's equation.	Apply	4
14	A cylindrical capacitor consists of an inner conductor of radius 'a' & an outer conductor whose inner radius is 'b'. The space between the conductors is filled with a dielectric permittivity ε_r & length of the capacitor is L. Determine the capacitance.	Analyze	4
15	Calculate the capacitance of a parallel plate capacitor having a mica dielectric, ε_r=6, a plate area of 10inch^2, and a separation of 0.01inch.	Apply	3

UNIT III
STATIC MAGNETIC FIELDS
SHORT ANSWER TYPE QUESTIONS

1	Define Biot severt law and give the expression?	Understand	5
2	Define amperes circuit law and give the expression?	Remember	5
3	List the applications of amperes circuit law?	Understand	6
4	What is 2nd Maxwell's equation ?	Evaluate	5
5	What is 3nd Maxwell's equation?	Analyze	6
6	Define magnetic flux density? Specify the units?	Analyze	5
7	Define magnetic scalar potential and give the expression?	Remember	5
8	Define magnetic vector potential and give the expression?	Understand	5
9	What is the value of permeability for free space and specify the units?	Evaluate	5
10	Lis t the types of forces exerted by the magnetic field?	Understand	5
11	What is lenz law?	Analyze	5
12	What is the Lorentz force equation for a static charge ?	Understand	5
13	What is the Lorentz force equation for a DC charge?	Understand	5
14	What is mean by magnetic dipole moment?	Evaluate	4
15	List the boundary conditions for Magnetic fields?	Understand	5

LONG ANSWER QUESTIONS

1	State Biot-Savart's law and obtain the expression for magnetic field intensity	Understand	5
2	Let A = (3y-z) $âx$ + 2xz $ây$ Wb/m in a certain region of freespace. a) Show that $\nabla . A$ =0. b) At P (2,-1, 3) find A, B, H and $J.$	Remember	5
3	Describe and give the applications of Ampere's circuit law	Analyze	5
4	Develop an expression for magnetic field intensity due to a linear conductor of infinite length carrying current I at adistance, point P. Assume R to be the distance between conductor and point P. Use Biot-Savart's Law.	Understand	5
5	Interpret the point form of Ampere's circuital law.	Understand	5
6	Express magnetic field intensity H in all the regions if cylindrical conductor carriers a direct current I and its radius is 'R' m.	Understand	5
7	Draw the magnetic field pattern in and around a solenoid.	Understand	5
8	A long straight wire carries a current I = 1 amp. At what distance is the magnetic field H= 1 A/m.	Understand	5

9	A ferrite material has μr = 50 operating with sufficiently low flux densities and B=0.05 Tesla. Find magnetic field intensity.	Analyze	6
10	Point out the Laplace's equation for scalar magnetic potential.	Remember	5
11	Find magnetic flux density in vector form for the given vector magnetic potential A =10/(x^2+y^2+z^2) $\hat{a}_x$	Understand	5
12	Calculate magnetic field intensity at the center of square loop of side 5m carrying 10A of current.	Remember	5
13	Can a static magnetic field exist in a good conductor? Explain	Remember	5

ANALYTICAL QUESTIONS

1	At a point P(x, y, z) the components of vector magnetic potential A are given as Ax =4x+3y+2z, Ay =5x+6y+3z and Az =2x+3y+5z. Determine B at point P and state its nature.	Analyze	6
2	Find the magnetic field at a point P(0.01, 0, 0)m if current through a co-axial cable is 6 A. which is along the z-axis and a=3mm, b=9mm, c=11mm	Evaluate	6
3	The magnetic flux density is given as 4cos (πy/2) e-5z $\hat{a}_x$ wb/m2.Determine the magnetic flux crossing the plane surface where x=0,0<y<1, and z=0	Evaluate	5
4	Using Biot-Savart's law, express the magnetic field intensity on the axis of a circular loop carrying a steady current I.	Analyze	5
5	Develop an expression for magnetic field intensity due to a linear conductor of infinite length carrying current I at a distance, point P. Assume R to be the distance between conductor and point P. Use Biot-Savart's Law.	Evaluate	5
6	A circular loop located on x2+y2=4, z=0 carries a direct current of 7A along $\hat{a}_\phi$. Find the magnetic field intensity at (0,0,-5).	Analyze	6
7	A Conductor in the form of regular polygon of 'n' sides inscribe in a circle of radius R. Show that the expression for magnetic fluxdensity is B = (μ0nI/2πR) tan (π/n) at the center, where I is the current. Show also when 'n' is indefinitely increased then the expression reduces to B= (μ0I/2R).	Evaluate	6
8	Analyze the magnetic field intensity of a hollow conducting cylinder carrying current I along positive z direction. Assume that the inner radius is 'a' and the outer radius is 'b'	Analyze	6
9	Let A = (3y-z) $\hat{a}_x$ + 2xz $\hat{a}_y$ Wb/m in a certain region of freespace. a) Show that ∇ . A =0. b) At P (2,-1, 3) find A, B, $H$and J.	Apply	6
10	A solid non-magnetic conductor of circular cross section has its axis on the z axis and carry a uniformly distributed total current of 60A in the $\hat{a}_z$ direction. If the radius is 4mm, Find Bφ at r=5mm.	Evaluate	5
11	Generate the expression of H for a solenoid having N turns of finite length d.	Analyze	6
12	Formulate the single valued potential function if there is no current enclosed by the specified path.	Evaluate	6
13	Point out the Laplace's equation for scalar magnetic potential.	Evaluate	5

UNIT IV
MAGNETIC FORCES AND MATERIALS
SHORT ANSWER TYPE QUESTIONS

1	What is lenz law?	Remember	7
2	What is the Lorentz force equation for a static charge ?	Apply	8
3	What is the Lorentz force equation for a DC charge?	Apply	7
4	What is mean by magnetic dipole moment?	Remember	7
5	List the boundary conditions for Magnetic fields?	Analyze	7
6	Define inductance?	Apply	7
7	Define mutual inductance?	Remember	10
8	What Neumann's formula for mutual inductance?	Understand	9
9	List any two differences between self and mutual inductance?	Understand	8
10	Define magnetic energy?	Apply	7
11	Define magnetic energy due to mutual inductance?	Understand	8
12	What are the different types of magnetic materials?	Remember	10
13	List any two differences between magnetic materials?	Remember	10
14	List any two differences between electrostatic fields and magneto static fields	Understand	8
15	Define faraday law?	Remember	10

LONG ANSWER QUESTIONS

1.	What is Lorentz force equation for a moving charge? Give its applications.	Understand	9
2.	Estimate the inductance of a toroid formed by surfaces ρ=3cm and ρ=5cm, z=0 and z=1.5cm wrapped with 5000 turns of wire and filled	Understand	9
3.	A loop with magnetic dipole moment 8×10^{-3} $\hat{a}_z$ Am^2 lies in a uniform magnetic field of B= 0.2 $\hat{a}_x$ +0.4 $\hat{a}_z$ Wb/m2. Calculate torque.	Understand	8
4.	A solenoid has an inductance of 20 mH. If the length of the solenoid is increased by two times and the radius is decreased to half of its original	Apply	7
5.	Find the permeability of the material whose magnetic susceptibility is 49.	Understand	8
6.	How mutual inductance between two coils do is related to their self-inductances.	Remember	10
7.	An inductive coil of 10mH is carrying a current of 10A. Analyze the energy stored in the magnetic field.	Remember	10
8.	What is magnetization? Explain the classification of magnetic materials with example	Understand	7
9.	Write short notes on energy stored in magnetic fields	Remember	7

10.	Recall magnetic boundary conditions with neat sketch.	Apply	7
11.	Demonstrate the expression for self-inductance of infinitely long solenoid.	Understand	7
12.	Find the equation of force on a differential current element.	Understand	8
13.	Show the inductance of the solenoid with N turns and L meter length carrying a current of I amperes	Remember	8
14.	Discuss the importance of Lorentz force equation.	Understand	10
15.	Classify the different types of magnetic materials.	Understand	10
16.	Give the expression for the torque experienced by a force in vector form.	Understand	10
17.	Compare self-inductance and mutual inductance.	Understand	9
18.	Express the inductance of a toroid for the coil of N turns.	Remember	8
19.	How mutual inductance between two coils do is related to their self-inductances.	Understand	9
20.	An inductive coil of 10mH is carrying a current of 10A. Analyze the energy stored in the magnetic field.	Understand	9
21.	A solenoid has an inductance of 20 mH. If the length of the solenoid is increased by two times and the radius is decreased to half of its original value, find the new inductance.	Understand	9
	ANALYTICAL QUESTIONS		
1.	In medium 1, B= 1.2 $\hat{a}_x$+0.8 $\hat{a}_y$+0.4 $\hat{a}_z$ T. where μ_{r1}=15 and μ_{r2}=1. Determine B_2 and H_2 in other medium and also calculate the angle made by the fields with the normal where Z axis is normal to the boundary. Also find the ratio of $\tan\theta_1/\tan\theta_2$.	Apply	7
2.	A loop with magnetic dipole moment 8×10^{-3} $\hat{a}_z$ Am^2 lies in a uniform magnetic field of B= 0.2 $\hat{a}_x$ +0.4 $\hat{a}_z$ Wb/m2. Calculate torque.	Analyze	7
3.	A conductor 6m long lies along z-direction with a current of 2A in $\hat{a}_z$ direction. Find the force experienced by conductor if B=0.08 $\hat{a}_x$(T)	Apply	7
4.	Discuss why flux density is called as a solenoidal vector in a closed surface.	Analyze	7
5.	Define magnetic dipole moment.	Apply	8
6.	Describe self-inductance.	Analyze	7
7.	Tell about mutual inductance.	Apply	7
8.	Recall is relative permeability of material?	Analyze	7
9.	Summarize the expression for energy stored in an inductor.	Apply	8
10.	Define magnetic dipole moment.	Analyze	**7**

UNIT V

TIME VARYING FIELDS AND MAXWELL'S EQUATIONS

SHORT ANSWER TYPE QUESTIONS

1	State Faraday's law of electromagnetic induction.	Remember	9
2	Define Lenz's Law.	Understand	9
3	What is the significance of displacement current?	Analyze	9
4	Write Maxwell's equation in point form or differential form and in integral form.	Understand	9
5	Give the situations, when the rate of change of flux results in a non- zero value.	Understand	9
6	Discuss the condition under which conduction current is equal to the displacement current.	Understand	9
7	Summarize point form of Maxwell's equation in phasor form.	Remember	9
8	Distinguish between conduction current and displacement current.	Remember	9
9	What is motional electric field?	Understand	9
10	Identify Maxwell's equation as derived from Ampere's law.	Understand	9
11	What is the emf produced by moving loop in time varying field?	Understand	9
12	What is time harmonic field?	Remember	9
13	What is significance of displacement current density?	Understand	9
14	Write the Maxwell's equation from faradays law	Understand	9
15	Write the Maxwell's equation in differential form	Remember	9

LONG ANSWER QUESTIONS

1	State and explain Faraday's law for time varying field?	Understand	9
2	Show that $\nabla \times E_m = \nabla \times (u \times B)$ for time varying fields?	Remember	9
3	Define magnetic flux density? Why magnetic flux density is zero in a closed surface?	Understand	9
4	Show that $\nabla \times H = J + \frac{\partial D}{\partial t}$?	Remember	9
5	State and explain ampere's circuit law?	Understand	9
6	Obtain the expression for magnetic field intensity due to infinite line current	Remember	9
7	What is transformer emf? Show that $\nabla \times E = \frac{-\partial B}{\partial t}$	Remember	9
8	Write integral form of all MAXWELL'S equations?	Understand	9

9	State and explain Faraday's law for time varying field?	Remember	9
10	Derive general field relations for time varying electric and magnetic fields using Maxwell's equation?	Understand	9
11	Derive an expression for displacement current density Jd, and also give the physical interpretation of Maxwell's equation	Remember	9
12	Generate Ampere's law for time varying fields. Also list the Maxwell's equations in integral and point form for free space conditions	Remember	9
13	Derive the Maxwell's equation in differential and integral forms	Remember	9
	ANALYTICAL QUESTIONS		
1	In a charge free non- magnetic dielectric region, the magnetic field is given by H= 5cos (109t-4y) $\hat{a}z$ A/m. Solve for dielectric constant of the medium and also the displacement current density	Analyze	8
2	With necessary explanation, derive the Maxwell's equation in differential and integral forms	Analyze	
3	The magnetic field intensity in free space is given as H=H0sinΘ yt A/m. Where Θ=ωt-βz and β is a constant quantity. Determine the displacement current density	Analyze	8
4	Given E=Eo z2 e-t $\hat{a}x$ in free space. Verify whether, there is a magnetic field so that both Faraday's law and Ampere's law are satisfied simultaneously.	Apply	9
5	In a material for which σ=5.0 S/m and μr= 1, the electric field intensity is E=250sin1010t V/m. Find the conduction and displacement current densities, and the frequency at which both have equal magnitudes	Analyze	9
6	Electric flux density in a charge free region is given by D=10x $\hat{a}x$+5y $\hat{a}y$ +Kz $\hat{a}z$ C/m2, find the constant K.	Apply	9
7	In a free space, H =0.2cos (ωt-βx) $\hat{a}z$ A/m. Find the total power passing through a circular disc of radius 5 cm	Apply	9
8	Illustrate the integral and point form of Maxwell's equations from Faraday's law and Ampere's law	Analyze	9
9	Distinguish between conduction current and displacement current.	Analyze	9

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