DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

III SEMESTER

EE 8391 ELECTROMAGNETIC THEORY

Regulation – 2017

Academic Year 2018 – 19

UNIT I - ELECTROSTATICS – I

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

PART – A

Q.No	Questions		BT Level	Competence
1.	Points P and Q are located at (0,2,4)and (-3,1,5).Manipulate the distance vector from P to Q.		BTL 3	Applying
2.	State Stoke's Theorem.		BTL 1	Remembering
3.	List the sources of electromagnetic fields.		BTL 1	Remembering
4.	Apply in matrix form the unit vector transformation from the rectangular to cylindrical coordinate system		BTL 3	Applying
5.	Two vectorial quantities = 4 + +5 and = -2 +2 are known to be oriented in two unique directions. Determine the angular separation between them.		BTL 2	Understanding
6.	State the conditions for a vector A to be (a) solenoidal (b) irrotational.		BTL 1	Remembering
7.	State Divergence Theorem.		BTL 1	Remembering
8.	State the vector form of electric flux density.		BTL 1	Remembering
9.	Define divergence and its physical meaning.		BTL 1	Remembering
10.	What are the practical applications of electromagnetic fields?		BTL 3	Applying
11.	Mention the criteria for choosing an appropriate coordinate system for solving a field problem easily. Explain with an example.		BTL 4	Analysing
12.	When a vector field is solenoid and irrotational.		BTL 6	Creating
13.	Give the practical examples of diverging and curl field.		BTL 2	Understanding
14.	Obtain the unit vector in the direction from the origin towards the point P (3,-3,2).		BTL 5	Evaluating
15.	Give the differential displacement and volume in spherical co-ordinate system.		BTL 2	Understanding
16.	How can a vector field be expressed as the gradient of scalar field?		BTL 5	Evaluating
17.	Determine the curl of = yz + xz		BTL 4	Analysing
18.	Verify the vector =4 -2 + 2 , =-6 +3 -3 are parallel to each other.		BTL 6	Creating

19.	Find the unit vector extending from the origin toward the point P(3,- 1,-2)		BTL 4	Analysing
20.	Determine the electric field intensity in free space if $\overline{D} = 30\vec{a}_x \ C/m^2$		BTL 2	Understanding
PART – B				
1.	i)Show that over the closed surface of a sphere of radius B,ds =0 ii)Show that the vector E = (6 xy + z^3) a_x+ (3x^2 - z) a_y+ (3xz^2 – y) a_z is Irrotational and find its scalar potential.	**(4)** **(9)**	BTL 3	Applying
2.	Express the vector B in Cartesian and cylindrical systems. Given B= $\cos\theta\,\overrightarrow{a_\rho} + \overrightarrow{a_\phi}$ .then find B at (-3, 4, 0) and (5, π/2,-2).	**(13)**	BTL 2	Understanding
3.	i)Generalize the classification of vector fields. ii) If B = y $\vec{a}_x$ + (x + z) $\vec{a}_y$ and a point Q is located at (-2, 6, 3), express (1) the point Q in cylindrical and spherical coordinates; (2) in spherical **coordinates**.	**(5)** (8)	BTL 6	Creating
4.	Analyse the divergence of these vector fields. i)P = x^2 yz $\vec{a}_x$ +xz ii)Q = ρ $\sin\phi\ \vec{a}_{\rho+}$ iii) T =	(13)	BTL 4	Analysing
5.	i) Given point P(-2,6,3) and = y + (x + z) , express P and $\vec{A}$ in cylindrical coordinates. ii) State and prove divergence theorem.	**(6)** **(7)**	BTL 2	Understanding
6.	i) Find the electric field at a point P(0,0,6) due to a point charge Q1 of 0.35 µC placed at (0,5,0) and Q2 of -0.6 µC placed at (5,0,0). ii) Prove the identity $\nabla(\nabla.H) -$ Where the H is a vector.	**(7)** **(6)**	BTL 3	Applying
7.	i) State and describe divergence theorem. ii) Show that in Cartesian coordinates for any vector A, $\nabla.(\nabla^2 A) = \nabla^2(\nabla.A)$	**(9)** (4)	BTL 1	Remembering
8.	i) With neat diagram, explain the spherical system with co-ordinates(R,Θ,ϕ). ii) Apply Coulomb's law to find the electric field intensity at any point P due to a straight,uniformly charged wire of linear charge density +λ C/m.The point P is at a distance of 'h' m above the wire.	**(13)**	BTL 4	Analysing

9.	Write short notes on gradient, divergence, curl and stokes theorem.	**(13)**	**BTL 1**	**Remembering**
10.	i) Verify the divergence theorem for a vector field $+(3y+z)a_y+(3z-x)a_z$ in the region bounded by the cylinder $+y^2$=9 and the planes x=0,y=0,z=2 ii) A novel printing technique is based upon electrostatic deflection principal. Justify.	**(9)** **(4)**	**BTL 1**	**Remembering**
11.	i) If $\overline{B}$ = y $\overline{a_x}$ + (x + z) $\overline{a_y}$ and a point Q is located at (-2,6,3),express a) The point Qin cylindrical and spherical co ordinates. b) $\overline{B}$ in spherical co ordinates. ii) Derive coulomb's law of force.	**(9)** **(4)**	**BTL 2**	**Understanding**
12.	i)By means of Gauss's law . Determine the electric field intensity at a point P distant 'h' m from an infinite line of uniform charge C/m. ii) Explain the divergence of a vector field and Divergence theorem.	**(6)** **(7)**	**BTL 4**	**Analysing**
13.	i)Quote and prove Coulomb's Law. ii) Discover an expression for electric field intensity field intensity due to a uniformly charged line of length 'l'.	**(7)** **(6)**	**BTL 1**	**Remembering**
14.	Given that =(x^2+ y^2) - 2xy evaluate both sides of stokes theorem for a rectangular path bounded by the lines x=+a, -a, y=0,z=b	**(13)**	**BTL 5**	**Evaluating**
PART C				
1.	Given that in cylindrical coordinates evaluate both sides of divergence theorem for the volume enclosed by r =2, z=0 and z=5.	**(15)**	**BTL 5**	**Evaluating**
2.	Given that $5r^2/4\overline{a_r}$ C/m$^{2.}$ Evaluate both the sides of divergence theorem for the volume enclosed by r= 4m and θ =π/4	**(15)**	**BTL 5**	**Evaluating**
3.	Design & validity of the divergence theorem considering the field D=2xy $\overline{a_x}$+$x^2\overline{a_y}$ C/	**(15)**	**BTL 6**	**Creating**
4.	Analyse the electric field intensity produced by a point charge distribution at P(1,1,1) caused by four identical 3nc point charges located at P1(1,1,0), p2(-1,1,0),P3(-1,-1,0) and P4(1,-1,0)	**(15)**	**BTL 4**	**Analysing**
UNIT II - ELECTROSTATICS – II				
Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization - Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.				
PART – A				

Q.No	Questions		BT Level	Competence
1.	Define electrical potential.		BTL 1	Remembering
2.	Mention the properties of electric flux lines		BTL 1	Remembering
3.	State the electrostatic boundary conditions at the interface between two dielectrics.		BTL 1	Remembering
4.	State the properties of electric flux lines.		BTL 1	Remembering
5.	A dielectric slap of flat surface with relative permittivity 4 is disposed with its surface normal to a uniform field with flux density 1.5c/m^2. The slab is uniformly polarized. Determine polarization in the slab.		BTL 3	Applying
6.	A parallel plate capacitor has a charge of 10^{-3}C on each plate while the potential difference between the plates is 1000v. Evaluate the value of capacitance.		BTL 5	Evaluating
7.	What is the practical significance of Lorentz Force?		BTL 1	Remembering
8.	Define electric dipole moment.		BTL 1	Remembering
9.	Write Poissons equation for a simple medium.		BTL 6	Creating
10.	What is conservative field?		BTL 6	Creating
11.	Define dielectric strength.		BTL 2	Understanding
12.	What is meant by dielectric breakdown?		BTL 2	Understanding
13.	A uniform line charge with ρl =5 µC/m lies along the x-axis. Find at (3, 2, 1).		BTL 5	Evaluating
14.	Prepare the electric field intensity at a distance of 20 cm from a charge of 2 in vacuum.		BTL 3	Applying
15.	Demonstrate the boundary conditions between two dielectric media.		BTL 2	Understanding
16.	State the properties of electric flux lines.		BTL 2	Understanding
17.	Define energy density.		BTL 3	Applying
18.	Write the equation for capacitance of coaxial cable.		BTL 4	Analysing
19.	Give the significant physical differences between Poisson's and Laplace,s equations.		BTL 4	Analysing
20.	Evaluate the electric field intensity in free space if D=30 C/m^3.		BTL 4	Analysing
	PART – B			
1.	Deduce an expression for the capacitance of parallel plate capacitor having two identical media.	**(13)**	BTL 4	Analysing
2.	(i) State and derive electric boundary condition for a dielectric to dielectric medium and a conductor to dielectric medium. (ii)Derive the expression for energy density in electrostatic field.	**(6)** **(7)**	BTL 1	Remembering

3.	(i) State and explain coulomb's law and deduce the vector form of force equation between two point charges. (ii) At an interface separating dielectric medium $1(\varepsilon r_1)$ and dielectric medium $2(\varepsilon r_2)$ show that the tangential component of is $\bar{E}$ continuous across the boundary, whereas the normal component of $\bar{E}$ is discontinuous at the boundary.	**(2)** **(11)**	**BTL 1**	**Remembering**
4.	i) A circular disc of radius 'a' m is charged uniformly with a charge density of ρs C/m^2. Find the electric potential at a point P distant 'h' m from the disc surface along its axis. ii) Find the value of capacitance of a capacitor consisting of two parallel metal plates of 30cm x 30cm surface area, separately by 5mm in air. What is the total energy stored by capacitor is charged to a potential difference of 1000v? What is the energy density?	**(6)** **(7)**	**BTL 4**	**Analysing**
5.	i) Find the potential at r A = 5 m with respect to r B = 15 m due to point charge Q=500 Pc at the origin and zero reference at infinity. ii) Find the capacitance of a parallel plate capacitor with dielectric εr_1 = 1.5 and εr_2 = 3.5 each occupy one half of the space between the plates of area 2 m^2 and d= 10^{-3} m.	**(6)** **(7)**	**BTL 3**	**Applying**
6.	Find the potential at any point along the axis of a uniformly charged disc of σ c/m^2. The disc has radius of 'a' m.	**(13)**	**BTL 4**	**Analysing**
7.	Interpret the expression for energy stored and energy density in electro static fields.	**(13)**	**BTL 3**	**Applying**
8.	i) In spherical coordinates V= -25 V on a conductor at r = 2 cm and V= 150 V at r = 35 cm. The space between the conductor is a dielectric of εr = 3.12.Find the surface charge densities on the conductor. ii) Define Laplace and Poisson's equation.	**(10)** **(3)**	**BTL 2**	**Understanding**
9.	Point charges 1 m C and -2 m C are located at (3, 2,-1) and (-1, -1,4) respectively. Calculate the electric force on a 10nC charge located at (0,3,1) and the electric field intensity at the point.	**(13)**	**BTL 2**	**Understanding**
10.	The relative permittivity εr of linear, homogeneous, isotropic dielectric material is 3.6 and the material is covering the space between z=0 and z=1. If v = -6000z volts in the material. Find (1)E,(2)P,(3)ρ_v.	**(13)**	**BTL 5**	**Evaluating**
11.	i) A positive point charge 100* C is located in air at x=0,0.01m and another such charge at x=0,y=-0.1m.What is the magnitude and direction of E? ii) Obtain an expression for the capacitance of a parallel plate capacitor with two dielectrics of relative permittivity and respectively interposed between the plates.	**(4)** **(9)**	**BTL 1**	**Remembering**

12.	i) Explain briefly the polarization in dielectrics. ii) Derive Laplace's and Poisson's equation from Gauss's law for a linear material medium. State the importance of these equations.	**(13)**	**BTL 1**	**Remembering**
13.	Distinguish between electric potential and electric potential difference. Two point charges -4 micro coulomb and 5micro coulomb are located at (2,-1,3)and (0,4,-2) respectively. Find the potential at (1,0,1) assuming zero potential at infinity.	**(13)**	**BTL 2**	**Understanding**
14.	i) Two point charges -4μC and 5μC are located at (2,-1,3) and (0,4,-2) respectively. Find the potential at(1,0,1) assuming zero potential at infinity. ii) A Parallel plate capacitor has a plate separation t. The capacitance with air only between the plates is C. When a slab of thickness t' and relative permittivity ε' is placed on one of the plates, the capacitance is C' show that $\frac{C'}{C} = \frac{\varepsilon'}{(t' + \varepsilon'(t - t'))}$	**(13)**	**BTL 6**	**Creating**

PART C

1.	A capacitor consists of squared two metal plates each 100 cm side placed parallel and 2 mm apart. The space between the plates is filled with a dielectric having a relative permittivity of 3.5. A potential drop of 500 V is maintained between the plates. Evaluate (i) The capacitance, (ii) The charge of capacitor, (iii) The electric flux density, (iv) The potential gradient.	**(15)**	**BTL 5**	**Evaluating**
2.	Analyse the vector V= Y+10Z+2) find V, E, D and ρ_v at (1,2,3).	**(15)**	**BTL 4**	**Analysing**
3.	Step by Step , develop a condition between (i) Conductor and Dielectric (ii) Dielectric and Dielectric	**(15)**	**BTL 4**	**Analysing**
4.	Solve one dimensional LAPLACE equation to obtain the field inside a parallel plate capacitor, and also Evaluate the expression for the surface charge density at two plates.	**(15)**	**BTL 5**	**Evaluating**

UNIT III - MAGNETOSTATICS

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

PART – A

Q.No	**Questions**		**BT Level**	**Competence**
1.	Distinguish between magnetic scalar potential and magnetic		**BTL 4**	**Analysing**

2.	What is Lorentz law of force?		BTL 1	Remembering
3.	Write the expression for magnetic field H at the centre of a circular coil carrying a current of I amperes. The radius of the coil is a 'm'.		BTL 6	Creating
4.	Determine the value of magnetic field intensity at the centre of a circular loop carrying a current of 10 A .The radius of the loop is 2 m.		BTL 3	Applying
5.	Expression for the magnetic force between an electromagnet and an armature to be attracted.		BTL 2	Understanding
6.	Establish the inductance per unit length of a long solenoid of N turns and having a length ' L 'mtrs. Assume that it carries a current of I amperes.		BTL 3	Applying
7.	State Ampere's circuital law.		BTL 1	Remembering
8.	State Biot savarts law.		BTL 1	Remembering
9.	What is the total force acting on a moving charge,Q in the presence of both electric and magnetic fields.		BTL 3	Applying
10.	Define the terms: magnetic moment and magnetic permeability.		BTL 1	Remembering
11.	What is vector magnetic potential?		BTL 1	Remembering
12.	Define Magnetostaic energy density.		BTL 1	Remembering
13.	Design the BH curve for classifying magnetic materials.		BTL 5	Evaluating
14.	Estimate the mutual inductance of the two inductively coupled coils with self inductance of 25mH and100 mH.		BTL 2	Understanding
15.	Illustrate self inductance and mutual inductance.		BTL 2	Understanding
16.	A current of 3A flowing through an inductor of 100mH. Interpret the energy stored in the inductor?		BTL 4	Analysing
17.	Distinguish between diamagnetic, paramagnetic and ferromagnetic materials.		BTL 4	Analysing
18.	Sketch Gauss law for the magnetic field.		BTL 5	Evaluating
19.	What is the practical significance of Lorentz's Force?		BTL 2	Understanding
20.	Compare magnetic scalar potential and magnetic vector potential		BTL 6	Creating
PART – B				
1.	State and explain Ampere's circuit law and show that the field strength at the end of a long solenoid is one half of that at the centre.	(13)	BTL 1	Remembering
2.	a) State and explain Bio-savarts law. b) Derive an expression for the force between two long straight parallel current carrying conductors.	(6) (7)	BTL 1	Remembering
3.	Derive a general expression for the magnetic flux density **B** at any point along the axis of a long solenoid. Sketch the variation of B from point to point along the axis.	(13)	BTL 2	Understanding
4.	i)Obtain an expression for the magnetic field intensity due to straight finite conductor carrying current I amperes using Biot Savart's law ii)State and Prove Ampere's law	(8) (5)	BTL 2	Understanding

5.	i) Show by means of Biot Savarts law that the flux density produced by an infinitely long straight wire carrying a current I at any point distant a normal to the wire is given by $\mu_0 \ \mu_r I/2\pi a$. ii) State and Prove magnetic boundary conditions	(5) (8)	BTL 2	Understanding
6.	i) Derive Biot Savart's law and ampere law using the concept of magnetic vector potential. ii) The core of a toroid is of 12 cm^2 area and is made of material with μ_r=200. If the mean radius of the toroid is 50cm. Calculate the number of turns needed to obtain an inductance of 2.5H.	(6) (7)	BTL 1	Remembering
7.	i) Quote the expression for the magnetic field intensity inside and outside a co- axial conductor of inner radius 'a' and outer radius 'b' and carrying a current of I ampers in the inner and outer conductor. ii) Calculate the self inductance of infinitely long solenoid	(7) (6)	BTL 1	Remembering
8.	i) Quote the expression for the magnetic vector potential in the cases of an infinitely long straight conductor in free space. ii) Consider the boundary between two media. Show that the angles between the normal to the boundary and the conductivities on either side of the boundary satisfy the relation. =	(6) (7)	BTL 3	Applying
9.	Obtain the expression for energy stored in the magnetic field and also derive the expression for magnetic energy density.	(13)	BTL 3	Applying
10.	i) Derive and explain the expression for coefficient of coupling in terms of mutual and self inductance of the coils. ii) An iron ring with a cross sectional area of 8cm^2 and a mean circumference of 120cm is wound with 480 turns of wire carrying a current of 2 A. the relative permeability of the ring is 1250. Calculate the flux established in the ring.	(7) (6)	BTL 4	Analysing
11.	i) Categorize the classification of magnetic materials in detail and draw a typical magnetization (B-H) curve. ii) What is 'Magnetization'? Explain the classification of magnetic materials.	(7) (6)	BTL 4	Analysing
12.	i) Obtain an expression for magnetic flux density and magnetic field intensity at any point along the axis of a circular coil. ii) Distinguish between scalar and vector magnetic potential .	(10) (3)	BTL 4	Analysing
13.	i) An air co-axial transmission line has a solid inner conductor of radius 'a' and a very thin outer conductor of inner radius 'b'.Organise the inductance per unit length of the line. ii) Compare the different magnetic materials	(9) (4)	BTL 5	Evaluating
14.	i) Prepare an expression for magnetic field intensity and magnetic flux density at any point due to finite length conductor. ii) Prepare an expression for inductance and torque on a long solenoid coil.	(9) (4)	BTL 6	Creating
PART C				

1.	Evaluate the loop inductance per km of a single phase transmission circuit comprising two parallel conductor spaced 1 m apart and with diameters o.5 cm and 0.8 cm respectively	**(15)**	**BTL 5**	**Evaluating**
2.	By means of Biot-Savart's law ,derive an expressionfor the magnetic field intensity at any point on the line through the centre at a distance 'h'from the centre and perpendicular to the plane of a circular loop of radius 'p'and carrying current 'I'	**(15)**	**BTL 5**	**Evaluating**
3.	An iron ring,0.2 m in diameter and 10cm*cm sectional area of the core ,is uniformly wound with 250 turns of wire.The wire carries a current of 4A.The wire carries a current of 4A.The relative permeability of iron is 500.Determine the value of self inductance and the stored energy.	**(15)**	**BTL 5**	**Evaluating**
4.	A solenoid consisting of 1000 turns of wire wound on a former of length 100 cm and diameter 3 cm is placed coaxially within another solenoid of the same length and number of turns but with a diameter of 6cm.Evaluate the mutual inductance and the coupling coefficient of the arrangement	**(15)**	**BTL 5**	**Evaluating**

UNIT IV - ELECTRODYNAMIC FIELDS

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

PART – A

Q.No	Questions		BT Level	Competence
1.	State the Faraday's law.		BTL1	**Remembering**
2.	State the Faraday's law for the moving charge in a constant magnetic field		BTL1	**Remembering**
3.	State Lenz's law		BTL1	**Remembering**
4.	Define displacement current density.		BTL1	**Remembering**
5.	What are electric field and the power flow in the co-axial cable?		BTL1	**Remembering**
6.	Define reluctance and permeability		BTL1	**Remembering**
7.	Write the Maxwell's equation from ampere's law both in integral and point forms.		BTL2	**Understanding**
8.	Write down the Maxwell's equation from electric gauss's law in integral and point forms.		BTL2	**Understanding**
9.	Illustrate mutual inductance and self inductance.		BTL3	**Applying**
10.	Write down the Maxwell's equation from magnetic gauss's law in integral and point form.		BTL2	**Understanding**
11.	Write the Maxwell's equations from Gauss's law in integral form.		BTL2	**Understanding**

12.	Estimate Maxwell's equations in integral form.		BTL4	**Analysing**
13.	Differentiate transformer and motional emf		BTL2	**Understanding**
14.	Find the characteristics impedance of the medium whose relative permittivity is 3 and relative permeability is 1		BTL3	**Applying**
15.	Calculate the emf induced in a conductor of length 1m moving with a velocity of 100m/s perpendicular to a field of 1 Tesla		BTL3	**Applying**
16.	Distinguish between conduction and displacement currents		BTL4	**Analysing**
17.	Explain why .B=0		BTL5	**Evaluate**
18.	Judge ∇.D=0		BTL6	**Creating**
19.	In material for which =5.0 s/m, ϵ_r=1 and (v/m).Find conduction &displacement current densities		BTL6	**Creating**
20.	Moist soil has conductivity of 10^{-3} S/m and ε_r =2.5, estimate the displacement current density if E=6.0 $*10^{-6}$ sin 9.0 * 10^{-9} t (V/m)		BTL2	**Understanding**
PART – B				
1.	Derive the Maxwell's equations both in integral and point forms.	**(13)**	BTL5	**Evaluate**
2.	(i) Explain the relation between field theory and circuit theory in detail. (ii) Asinusoidal plane wave is transmitted through a medium whose electric field strength is 10KV/m and relative permittivity of the medium is 4.Determine the mean rms power flow/unit area.	**(6)** **(7)**	BTL4	**Analysing**
3.	(iii) Explain the concept of emf induction in static and time varying magnetic field. (iv) In a material for which σ =5.0S/m and ε_r= 1 with .Find J_c and J_D and also the frequency at which they equal magnitudes.	**(8)** **(5)**	BTL4	**Analysing**
4.	Derive the set of Maxwells equations in integral form from fundamental laws for a good conductor.	**(13)**	BTL5	**Evaluate**
5.	Explain how the circuit equation for a series RLC circuit is derived from the field relations	**(13)**	BTL4	**Analysing**

6.	(i) A parallel plate capacitor with plate area of 5cm*cm and plate separation of3 mm has a voltage of 50 $\sin 10^3$t V applied to its plates. Calculate the displacement current assuming ε=2 . (ii) The magnetic circuit of an iron ring with mean radius of 10cm has a uniform cross section of 10^{-3} m^2. The ring is wound with two coils. If the circuit is energised by a current A in the first coil with 200 turns	**(7)** **(6)**	BTL3	**Applying**
7.	i) Explain the relation between field theory and circuit theory and thus obtain an expression for ohm's law. ii)) Compare and explain in detail conduction and displacement currents.	**(7)** **(6)**	BTL5	**Evaluate**
8.	Describe the relationship between field theory and circuit theory.	**(13)**	BTL2	**Understanding**
9.	Show that the ratio of the amplitudes of the conduction current density and displacement current density is $\sigma/\omega\varepsilon$, for the applied E= Em cos Assume μ =μ_0, what is the amplitude ratio, if the applied field is E= Em $e^{-t/\tau}$ .where is real?	**(13)**	BTL4	**Analysing**
10.	An iron ring with a cross –sectional area of 3 cm*cm and a mean circumference of 15 cm is wound with 250 turns of wire carrying a current of 0.3 A.The relative permeability of the ring is 1500.Calculate the flux established in the ring.	**(13)**	BTL2	**Understanding**
11.	Derive Maxwell's equation in both point and integral form for conducting medium and free space	**(13)**	BTL2	**Understanding**
12.	State and derive the Maxwell's equations for free space in integral form and point form for time varying field	**(13)**	BTL3	**Applying**
13.	(i) A circular loop of wire is placed in a uniform magnetic field of flux density 0.5wb/m^2. The wire has 200turns and frequency of rotation of 1000 revolution/minute. If the radius of the coil is 0.2m, determine (1) the induced emf, when the plane of the coil is 60^o to the flux lines and (2) the induced emf when the plane of the coil is perpendicular to the field. (ii) Explain in detail about the difference between conduction and displacement currents.	**(7)** **(6)**	BTL5	**Evaluate**
14.	Derive the set of Maxwell's equations in integral form from fundamental laws for a free space.	**(13)**	BTL6	**Creating**
	PART C			
1.	State Faraday's law. What are the different ways of emf generation? Explain with governing equation and suitable example for each	**(15)**	**BTL 5**	**Evaluating**
2.	Obtain the expression for energy stored in the magnetic field and also develop the expression for magnetic energy density	**(15)**	**BTL 6**	**Creating**

3.	State and prove boundary conditions by the application of Maxwell's equations	**(15)**	**BTL 5**	**Evaluating**
4.	Show that the ratio of the amplitudes of the conduction current density and displacement current density is $\sigma/\omega\varepsilon$. Find the current amplitude ratio if the applied field is $E_m e^{-\frac{t}{\lambda}}$ where λ is real.	**(15)**	**BTL 5**	**Evaluating**

UNIT V - ELECTROMAGNETIC WAVES

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

PART – A

Q.No	Questions		BT Level	Competence
1.	Define intrinsic impedance.		BTL2	**Understanding**
2.	Describe the properties of uniform plane wave		BTL2	**Understanding**
3.	State the Poynting Theorem.		BTL2	**Understanding**
4.	Discuss the Brewster angle.		BTL5	**Evaluate**
5.	Can a magnetic field exist in a good conductor if it is static (or) time varying? Explain.		BTL4	**Analysing**
6.	What is the relationship between E and H or brief about intrinsic impedance for a dielectric medium		BTL2	**Understanding**
7.	What are Helmholtz equations or represent equation of electromagnetic wave in the phasor form?		BTL1	**Remembering**
8.	A plane wave travelling in air is normally incident on a block of paraffins with ε_r =2.3. Find the reflection coefficient.		BTL3	**Applying**
9.	What is phase velocity?		BTL1	**Remembering**
10.	If a plane wave is incident normal from medium 1 to medium 2, write the reflection and transmission coefficients.		BTL4	**Analysing**
11.	Develop the values of velocity and intrinsic impedance for free space.		BTL2	**Understand**
12.	Determine the velocity of a plane wave in a lossless medium having a relative permittivity 2 and relative permeability of unity.		BTL3	**Applying**
13.	Define skin depth or depth of penetration of a conductor.		BTL1	**Remembering**
14.	Determine the skin depth of copper at 60 Hz with 5.8 X 10^7 s/m. Given μ= 1.		BTL3	**Applying**
15.	Define linear, elliptical and circular polarization?		BTL1	**Remembering**
16.	Define snell's law of refraction.		BTL1	**Remembering**
17.	Mention the Practical Importance of Skin Depth.		BTL1	**Remembering**
18.	Describe the propagation constant.		BTL2	**Understanding**

19.	Determine voltage reflection coefficient at the load end of a transmission.		BTL3	**Applying**
20.	State the properties of uniform plane wave.		BTL6	**Creating**
PART – B				
1.	Deduce the equation of the propagation of the plane electromagnetic waves in free space.	**(13)**	BTL5	**Evaluate**
2.	State and prove Poynting theorem	**(13)**	BTL3	**Applying**
3.	Deduce the expression for electromagnetic wave equation for conducting and perfect dielectric medium.	**(13)**	BTL5	**Evaluate**
4.	A 6580 MHz uniform plane wave is propagating in a material medium of ε_r =2.25. If the amplitude of the electric field intensity of lossless medium is 500V/m. Calculate the phase constant ,propagation constant, velocity, wave length and intrinsic impedance.	**(13)**	BTL3	**Applying**
5.	(i) Deduce the wave equations for conducting medium. (ii) Discuss group velocity, phase velocity and propagation constant of electromagnetic waves.	**(6)** **(7)**	BTL5	**Evaluate**
6.	Write the short notes on the following : i)Plane waves in lossless dielectrics ii) Plane waves in free space. iii) Plane waves in good conductors.	**(7)** **(6)**	BTL3	**Applying**
7.	i) The electric field intensity associated with a plane wave travelling in a perfect dielectric medium is given by E_x (z,t)=10 cos (2π X 10^7 t-0.1πz)V/m. What is the velocity of propagation? ii) Derive the Poynting theorem and state its significance.	**(13)**	BTL4	**Analysing**
8.	(i) Derive pointing theorem from Maxwells equation and explain . (ii) A uniform plane wave propagation in a medium has $(10^9 t - \beta z) a_y$ V/m. If the medium is characterized by ε_r =1 ,μ_r=20 and σ =3S/m, Evaluate α, β and H.	**(6)** **(7)**	BTL5	**Evaluate**
9.	Obtain an expression for electromagnetic wave propagation in lossy dielectrics	**(13)**	BTL6	**Creating**
10.	i) State pointing theorem and thus obtain an expression for instantaneous power density vector associated with electromagnetic field ii) A plane wave travelling in air normally incident on a block of paraffin with =2.2 .Find the reflection coefficient	**(9)** **(4)**	BTL2	**Understanding**

11.	Describe the concept of electromagnetic wave propagation in a linear, isotropic, homogeneous, lossy dielectric medium.	**(13)**	BTL2	**Understanding**
12.	i) Find the velocity of a plane wave in a lossless medium having ε_r =5 and μ_r=1. ii) Show that the total power flow along a coaxial cable will be given by the surface integration of the pointing vector over any closed surface.	**(3)** **(10)**	BTL3	**Applying**
13.	Define polarization. What are the different types of wave polarization? Explain them with mathematical expression.	**(13)**	BTL1	**Remembering**
14.	A uniform plane wave in a medium having 10^{-3} s/m, 80 $_0$ and $_0$ is having a frequency of 10 KHz. i) Verify whether the medium is good conductor ii) Calculate the following, 1) Attenuation constant 2) Phase constant 3) Propagation constant 4) Intrinsic impedance 5) Wave length 6) Velocity of propagation	**(13)**	BTL3	**Applying**
	PART C			
1.	A free space- silver interface has E(incident)=100V/m on the free space side. The frequency is 15MHz and the silver constants are ε_r –μ_r =1 ,σ =61.7MS/m. Evaluate E(reflected) and E(transmitted) at the interface.	**(15)**	BTL6	**Creating**
2.	A plane wave travelling in +z direction in free space (z<0) is normally incident at z=0 on a conductor (z>0) for which σ=61.7MS/m, μ_r =1.the free space E wave has a frequency f=1.5MHz and an amplitude of 1.0V/m at the interface it is given by E(0,t) =1.0sin 2πft a_y (V/m).Analyse the wave and predict magnetic wave H(z,t) at z>0.	**(15)**	BTL4	**Analysing**
3.	Assume that E and H waves, travelling in free space, are normally incident on the interface with a perfect dielectric with =3.Evaluate the magnitudes of incident, reflected and transmitted E and H waves at the interface.	**(15)**	BTL5	**Evaluating**
4.	A plane wave propagating through a medium =8 , μ_r =2 has E=0.5 t – $\beta z)\vec{a_z}$ v/m. Determine i) wave impedance, ii)Wave velocity iii)β iv) H field .	**(15)**	BTL3	**Applying**