PRATHYUSHA ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

EC 8451- ELECTRO MAGNATIC FIELDS

UNIT-I INTRODUCTION

PART-A

1. Define dot and vector product of any two vectors.
2. Find the dot and vector product of the following vectors.
   (i)A =2i+3j-4k & B=-i+4j+2k
   (ii)A= 4 a_x+a_y-3a_z & B=2a_x+4a_y+a_z
3. Write down the expression for x,y,z in terms of spherical co-coordinator r,Φ,and θ.
4. Write down the expression for differential volume element in terms of spherical co-ordinates.
5. Express the value of differential volume in differential length in all co-ordinate systems
6. Define a unit vector.
7. What is divergence of curl of vector?
8. Find the divergence & curl of following vectors.
   (i) F= x^2yi - y^2j + z^2xk
   (ii) F=p sinΦ a_p+p^2 z$a_Φ$+z cos Φ a_z
   (iii)F=1/r^2 cos θ a_r+rsinθ cosθ $a_θ$ +cosθ $a_Φ$
9. What is the physical significance of divergence of D?
10. Express the divergence of vector in three co-ordinate systems .
11. What is Del operator? How it is used in curl, gradient and divergence.
12. what are the condition for two vectors a & b to be (i) parallel and ii) perpendicular.
13. Find the distance from a(r=5, θ =20° and Φ =120°) And B (r=2, θ =80°, Φ =30°) in spherical co-ordinates.
14. Show that two vectors A=6i+j-5k and B=3(i-j+k) are perpendicular to each other.
15. Points P & Q are located at (1,-2,4) & (-5,4,2) Determine (i) The position vector of P
(ii) The distance between P & Q .
16. Define Helmholtz's Theorem
17. Define Stoke's Theorem.
18. State Divergence Theorem.
19. Comment on the divergence of the vector field.
20. Comment on the curl of the vector field.
21. What is the conservative field?
22. What is non conservative field?

23. Under what conditions will the field intensity be solenoidal and irrotational.
24. Define Lamellar field.
25.State the null identities of the vector.

PART B:

1.Write the condition for a vector to be solenoid & irrational (i) Show that
$H=(3y^4+z^{2)}a_x+4x^3z^2a_y+3x^2y^2a_z$ is solenoidal.

2. Show that the vector $2xy\ a_x +(x^2+2yz)\ a_y + (y^2+1)\ a_z$ is irrotational.
5. State and prove divergence theorem.
6. State and prove stoke's theorem.
7. Using divergence theorem, evaluate $\iint_S F.nds$ Where $F=2xy\ i +y^2\ j+4yz\ k$ and S is the surface of the cube bounded by x=0,x=1;y=0,y=1;z=0,z=1;
8.Check the validity of the divergence theorem considering the field
$D=2xy\ a_x + x^2\ a_y\ C/m^2$ and rectangular parallellopiped formed by the planes x=0,x=1;y=0,y=2;z=0,z=3;
9. Given $A=2r\cos\Phi\ I_r+r\ I_\Phi$ in cylindrical co-ordinates for the contour shown in the figure verify stoke's theorem.
19. A vector field $D=[5r^2/4]Ir$ is given in spherical co-ordinates. Evaluate both sides of divergence theorem for the volume enclosed between r=1&r=2.
25. Prove the divergence of curl of a vector is zero using stokes theorem.(MAY 06)
26. Define divergence, gradient, curl in spherical coordinate system with mathematical expression (NOV 04)
27.Write the infinitesimal length,surface and volume of cylindrical and spherical coordinate systems.

UNIT II- ELECTROSTATICS

PART A:

1. Write the Poisson's and laplace equation.
2. Define current density.
3. Write the point form of continuity equation and explain its significance.
4. State point form of ohm's law.
5. Define polarization in dielectrics.
6. Write the expression for energy density in electrostatic fields.
7. Express the value of capacitance for a co-axial cable.
8. Write down the expression for capacitance b/w (a) two parallel plates (b) Two co-axial cylinder.
9. Compare dieletrics and conductors.
10. Determine the capacitance of the parallel plate capacitor composed of tin foil sheets,25cm square for plates separated through a glass dielectric0.5cm thick with relative permittivity 6.
11. Define dielectric strength.
12. State the Laplace's equations in Cartesian, cylindrical and spherical coordinates.
13. What are the basic properties of conductors?
14. State the applications of Poisson's and Laplace's equations
15. Define dielectric breakdown.
16. .Define potential difference& absolute potential.

17. State the conditions of gauss law
18. What are the equipotential surfaces?give two example
19. Why electric field inside a conductor is zero.
20. Show that E= -▼V
21. Show by using gauss law:D= ε_0 E.
22. What are the features of Coloumb's law.
23. What is a Electric Dipole & Electric Dipole Moment?
24. What are electric field intensity and electric potential?
25. Define volume charge density.
26. State Gauss Law.
27. Write the relation between potential and electric field.

PART B:

1.Derive an expression for electric field intensity due to charges distributed uniformly on an infinite line with charge density $\rho_l c/m$

2. Derive an expression for electric field intensity due to an infinite uniformly charged sheet with charge density $\rho_s c/m^2$

3. Derive an expression for electric field intensity on the axis of a uniformly charged circular disc with charge density $\rho_s c/m^2$

4. Derive an expression for potential at any point along the axis of uniformly charged disc.

5.Explain the principle of superposition.

6. Derive an expression for electric field intensity and potential due to electric dipole

7. Derive an expression for electric field intensity due to charges distributed uniformly on an finite line with charge density $\rho_l c/m$.

8.Determine the variation of electric field and potential from point to point due to (i)a single spherical shell of charge with radius R_1 (ii)Two concentric spherical shells of charge of radii R_1 (inner)& R_2.(outer)

9.Solve one dimensional laplace equation to obtain the field inside a parallel plate capacitor and also find the expression for the surface charge density at two plates.

10. Derive the boundary conditions of the normal and tangential components of electric field at the inter face of two media with different dielectric properties.

11. Derive Laplace and Poisson's equations . Derive the point form of ohm's law.

12.Explain the nature of dielectric materials.

13.Derive an expression for the capacitance of a parallel plate capacitor having two dielectric media.

14.Obtain the expression for the energy density and energy stored in a capacitor.

15.Drive an expression for energy stored and energy density in an electrostatic field.

16.Derive an expression for the capacitance of two wire transmission line.

17. Derive an expression for capacitance of a spherical capacitor consisting of two concentric shells of radii a and b.

18. Derive an expression for capacitance of co-axial cable with two dielectrics $\varepsilon_1 and \varepsilon_2$

19.The capacitance of the conductor formed by the two parallel metal sheets, each 100cm2,in area separated by a dielectric 2mm thick is ,2 x 10^{-10} micro farad .a potential of 20kv is applied to it .find
(i) Electric flux
(ii) Potential gradient in kV/m
(iii) The relative permittivity of materials
(iv) Electric flux density.
20. (i)Derive an expression for capacitance of capacitors C1 and C2 connected in series and parallel
(ii)Given that potential V=10sinθcosΦ/r2 .find the electric flux density D at (2,π/2,0)
21. Derive the magnetic boundary conditions at the interface between two magnetic medium.
22. Find the inductance of conductors with uniform current distribution in co-axial transmission line.
23.Starting from field equations and point form of ohms law establish kirchoff's current law.
24.Derive continuity equation of current
25. State and prove gauss law .and explain applications of gauss law.
26. A uniform line charge ρ_L =25Nc/m lies on the x=3m and y=4m in free space
find the electric field intensity at a point (2,3,15)m.
27.A circular disc of radius'a' m is charged uniformly with a charge density of σ c/ m^2.find the electric field at a point 'h' m from the disc along its axis.
28. A circular disc of 10 cm radius is charged uniformly with a total charge 10^{-10}c.find the electric field at a point 30 cm away from the disc along the axis.
29. Derive an expression for the electric field due to a straight uniformly charged wire of length 'L' meters and with a charge density of +λ c/m at a point P which lies along the perpendicular bisector of wire.
30. State and explain Coloumb's law.

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UNIT III -MAGNETOSTATICS

PART A:

1. What is Lorentz force equation
2. Write the force between two current elements
3. Define torque. Write the torque on aloop
4. Distinguish b/w dia, para, and Ferro magnetic materials.
5. Write down the magnetic boundary conditions.
6. Define magnetic dipole and magnetization.
7. Define magnetic susceptibility.
8. Define self inductance and mutual inductance.
9. Define co-efficient coupling.
10. Define MMF and reluctance.
11. Mention 4 similarities b/w electric circuit and magnetic circuit.
12. Define magnetic flux density.
13. State Ampere's circuital law.
14. State Biot-savart law.
15. Define Magnetic Scalar potential.
16. Define Magnetic vector potential.
17. Write down the eqn for general , integral and point from of ampere's law

18. What is field due to toroid & solenoid.
19. Write the exp for magnetic field at the centre of the circular coil.
20. What is the relation between B and H?
21. Write down the magnetic boundary conditions.
22. Give the force on a current element.
23. Define magnetic moment.
24. What is torque? Write the expression for Torque in vector form
25. Give 4 similarities between electro static field and magnetic field.
26. State Gauss's law for magnetic field.
27. Define magnetic diplole.
28. Define magnetization.

PART B:

1. Derive an expression for a torque on a closed rectangular loop placed on uniform magnetic field.)
2. Derive an expression for the force between the two parallel wires carrying current in the same direction.
3. Find the magnetic flux density at a point on the axes of a circular loop of radius 'b' carries a direct current I.
4.Explain the force acting on a moving charge .
5. (i)State and prove ampere circuital law.
(ii) Derive differential form of ampere circuital law.
6.Derive an expression for Magneticfield intensity due to a finite wire carrying current I
06)
7.Derive an expression for Magnetic field intensity due to infinite wire carrying current I
8.Derive an expression for Magnetic field intensity on the axis of a circular loop carrying a current
9. What is scalar magnetic potential? And also derive the expression for vector magnetic potential.
10.A magnetic field $\vec{H} = 3\cos\vec{a}_x + z\cos\vec{a}_y, A/m, \; for\, z \geq 0$
$= 0 \; for\, z \leq 0$
is applied to a perfectly conducting surface in xy plane.Find the current density on the conductor surface.
11.A single phase circuit comprises two parallel conductors A & B, 1 cm diameter and spaced 1m apart. The conductors carry current of +100 and -100 amps respectively. Determine the field intensity at the surface of each conductor and also in the space mid way between A and B.
12.A rectangular loop (8x4)m, carrying 10A is placed on z=0 plane. Find the field intensity at (4,2,0)m.
13.Derive the expression for magnetic flux density at any point along the axis of the solenoid.
14.Determine the force per unit length between two long parallel wires A and B separated by 5cm in air and carrying a current of 40 amps in the same direction.
15. Derive the expression for the inductance of solenoid.
16. Explain the nature of magnetic materials.(or)How do you classify the materials based on their magnetic behavior.

17.Derive an expressions for energy stored and energy density in magnetic field.
18.Derive an expressions for self inductance of two wire transmission line
19.An iron ring with a cross sectional area of 3cm square and mean circumference of 15 cm is wound with 250 turns wire carrying a current of 0.3A.The relative permeability of ring is 1500.calculate the flux established in the ring
20.A solenoid 25cm long ,1cm mean diameter of the coil turns a uniformly Distributed windings of 2000turns .the solenoid is placed in uniform field of 2 tesla flux density. a current of 5a is passed through the winding. Determine the
(i) Maximum torque on the solenoid
(ii) Maximum force on the solenoid
(iii) Compute the magnetic moment on the solenoid.
21. Derive an expression for co-efficient of coupling.
22.Evaluate the inductance of a solenoid with 2500 turns wound uniformly over a length of 0.5m on a cylindrical paper tube 4cm in dia.The medium is air.
23.Consider a co-axial cable with conducting cylinders of radii a(internal) and b(external).derive the expression for inductance of transmission line per unit length.
24. Derive an expressions for energy stored and energy density in an inductor.
25.Discuss the phenomenon of hysterises associated with ferromagnetic materials
26.Derive the expression for torque on a square loop.

UNIT V-TIME VARYING FIELDS AND MAXWELLS EQUATION

PART A:

1. Define a wave.
2. Write down the wave eqn fro E & H in a non-dissipative medium.
3. Write down the wave eqn fro E & H in a conducting medium.
4. Write the Maxwell's equation from Ampere's law both in integral and point forms.
5. Write the Maxwell's equation from faraday's law both in integral and point forms.
6. Write down the Maxwell's equation from electric Gauss's law in integral and point form.
7. Write down the Maxwell's equation from magnetic Gauss's law in integral and point form.
8. Write the Maxwell's equations for harmonically varying fields in point form .
9. Write down the Maxwell's equation in point from .
10. Write down the Maxwell's equation in integral form.
11. .State Faradays Law.
12. Discuss the conditions under which conduction current is equal to displacement current.
13. What is displacement current. Compare displacement current with current due to flow of charges. (NOV 05)/(MAY 07)
14. What is transformer emf?
15. What is motional emf?
16. Draw the electromagnetic spectrum.

PART B:

1.Derive the expression for transformer and motional emf.
2. Derive the electro magnetic wave equation in conducting medium for .
(i) Electric field (ii) magnetic field.(or)Derive the general wave equation. (NOV 06)
3. Derive the electro magnetic wave equation in free space for
(i) Electric field (ii) magnetic field.
5. Derive and explain the Maxwell's equations in point and integral form using Amperes circuital law ,faraday's law and Gauss Law.
9. In a material for which σ=5 s/m and ε_r =1 and E=250 sin 10_{10}t (V/m).find the conduction and displacement current densities.
10. Find the total current in a circular conductor of radius 4mm if the current density Varies according to $J=10^4/R$ A/m^2
11. The magnetic field intensity in free space is given as H=H0sinθ ay t A/m. where $\theta=\omega t-\beta z$ and β is a constant quantity. Determine the displacement current density
12.Explain about displacement and displacement current density. Also find the displacement current density for the field $E=300\sin 10^9$ V/m(NOV 06)
13.The conduction current flowing through a wire with conductivity $\sigma = 3\times10^7\ s/m$ and relative permittivity $\varepsilon_r = 2$ is given by $I_c = 3\sin \omega t$ mA. If $\omega = 10^8$ rad/sec, Find the displacement current

UNIT V-PLANE ELECTROMAGNETIC WAVES

PART A

1. Mention the properties of uniform plane wave.
2. Define attenuation and phase constant.
3. Define intrinsic impedance or characteristics impedance.
4. Calculate the characteristics impedance for free space .
5. Define poynting vector.
6. Write down the expression for instantaneous power flow of electro magnetic field and instantaneous poynting vector.
7. Write down the expression for average power flow in electromagnetic and average pointing vector.
8. What is complex poynting vector?
9. State slepian vector.
10. State poynting theorem.

PART B

1. Explain wave propagation in good dielectrics.
2. Explain wave propagation in good conductors.
3. Derive the expression for attenuation and phase constant .
4. State poynting theorem and derive an expression for poynting vector.

5. Obtain the instantaneous , average and complex pointing vector.
6. Explain normal incidence of Electromagnetic wave at a plane conducting boundary.
7. Explain normal incidence of Electromagnetic wave at a plane dielectric boundary

EC 8451- ELECTRO MAGNATIC FIELDS
ASSIGNMENT 1

1. a) Find the divergence & curl of following vectors.
   (i) $F= x^2yi-y^2j+z^2xk$
   (ii) $F=p \sin \Phi a_p+p^2 za_q+z \cos \Phi a_z$
   (iii)$F=1/r^2 \cos \theta a_r+r\sin\theta \cos\theta a_\theta +\cos\theta a_\theta$

b). Show that two vectors A=6i+j-5k and b=3(i-j+k) are perpendicular to each other

2. Points P & Q are located at (1,-2,4) & (-5,4,2) Determine (i) The position vector of P (ii) The distance between P & Q.

3. a)Write the condition for a vector to be solenoid & irrational (i) Show that
   $H=3y^4+z^2a_x+4x^3z^2a_y+3x^2y^2a_z$ is solenoid.
   b) Show that the vector $2xy\ ax +(x^2+2yz)\ ay + (y^2+1)\ az$ is irrotational.

4. Using divergence theorem, evaluate $\iint_S F.nds$ Where $F=2xy\ i +y^2\ j+4yz\ k$ and S is the surface of the cube bounded by x=0,x=1;y=0,y=1;z=0,z=1;

5.Check the validity of the divergence theorem considering the field $D=2xy\ a_x + x^2\ a_y\ C/m^2$ and rectangular parallelepiped formed by the planes x=0,x=1;y=0,y=2;z=0,z=3;

6.If $V= 20/(x^2+y^2)$ Find E and D.

7.In spherical coordinate let $\rho= 10^{-6}/ r\ cm^3$ find the (a) total charge in the region described by $10<= r <= 20m$, $28^0<=\theta <= 31^0$, $0.9\pi<=\Phi<=0.96\pi$

8. Given $D= 3r/ (r^2+1)\ a_x\ c/m^2$ in spherical coordinate find the charge density.

9. A point charge of 10 micro coulomb is located at (1,2,3) and another point charhe of -3 micro coulomb is located at (3,0,2) in vacuum find the force between them.

10. A capacitor consists of squared two metal plates each 100cm 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 500V is maintained between the plates. Calculate i) The capacitance ii) The charge of capacitor iii) the electric flux density iv) the potential gradient.

11. A dielectric slab of flat surface with relative permittivity 4 is disposed with its surface normal to a uniform field with flux density of 1.5 c/m^2 . The slab occupies a volume of 0.08 m^3 and is uniformly polarized. Determine i) The polarization of the slab ii) The total dipole moment of the slab.

12.Find the radius of an isolated sphere capable of being charged to 1million volt potential before sparking into the air. Given that brake drum voltage if air is 30kv/cm .

EC 8451- ELECTRO MAGNATIC FIELDS
ASSIGNMENT 2

1. Two narrow coils A & B have a common axis and are placed 10cm apart. Coil A has 10 turns of radius 5cm with a current of 1A passing through it. Coil B has a single turn of radius 7.5cm. If the magnetic field at the centre of the coil A is zero, what current should be passed through B.

2. A toroid is wound with 300 turns in a ebonite ring having a cross sectional area of $4cm^2$ and a mean circumference of 35cm. (i) Calculate the inductance of the coil. ii) Emf induced when the current is reduced at a rate of 200 A/S. If the toroid has secondary winding of 80 turns wound over the ebonite ring and inside the first winding, iii) calculate the mutual inductance iv) What will be the induced Emf in the secondary winding when the current of 10A in the first winding is reversed in 1sec.

3.A straight 1m 1m long conductor is situated in a direction perpendicularly to the uniform magnetic field of 0.8 Tesla. If the conductor carries a steady current of 150A find i) the mechanical force on the conductor ii) the power required to move the conductor against the force at a uniform speed of 10 m/s. iii) The emf generated under this condition.

4. A solenoid has 2000 turns of copper wire wound on a former of length 1m and diameter of 4 cm. It is placed co-axially within another solenoid with same length and number of turns but with a diameter of 7 cm. Determining the mutual inductance between two solenoids and also coefficient of coupling.

5. In free space $E(z,t)= 10^3 \sin(\omega t-\beta z).a_y$ V/m. Obtain H (z,t) and find the propagation constant γ for the given frequency f=95.5 Mhz

6. The electric field of a 1 MHz plane wave traveling in the positive z direction in air point along the x direction. If the peak value of E is 1.2 π (mv/m) obtain the expression for E(z,t), H (z,t).

7.A plane traveling electro magnetic wave has H= 0.008 A/m in free space . Compute energy density and velocity of this wave in glass. Take Relative permittivity of glass is 3.