Chendu College of Engineering & Technology

(Approved by AICTE, New Delhi and Affiliated to Anna University)
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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

SUBJECT NAME: ELECTROMAGNETIC FIELDS **YEAR/SEM:** II/IV

SUBJECT CODE: EC6403

UNIT- I
STATIC ELECTRIC FIELDS
PART-A (2 Marks)

1. Describe the different sources of electric and magnetic fields?
2. What is a scalar quantity and vector quantity? **(Nov 2010)**
3. Find the dot product of the vectors A and B if A =2ax-3ay+4az, B= -ax+2ay+2az. **(Nov 2010)**
4. Write down expression for x, y, z in terms of spherical co-ordinates r, θ and Φ.
5. Represent point P (0, 1and 1) m given in Cartesian co-ordinates into spherical co-ordinates. **(Nov 2010) (May 2010)**
6. Represent point P (2, 3and 1) m given in Cartesian co-ordinates into cylindrical co-ordinates. **(Nov 2010)**
7. Give the relation between three co ordinate systems. **(Nov 2010)**
8. State divergence theorem. **(May 2009) (Nov 2006) (May 2012) (May 2011) (Nov 2010) (MAY 2010)**
9. How is the unit vectors defined in three co ordinate systems?
10. State coulombs' law? **(Nov 2009) (May 2008) (Nov 2011) (Nov 2010)**
11. State gauss law?
12. Write expression for differential length in cylindrical and spherical co- ordinates.
13. What is physical significance of divergence of D?
14. Express the divergence of a vector in the three system of orthogonal Co-ordination.
15. Define dipole and dipole element? **(Nov 2010)**
16. Define electric flux and flux density? **(May 2012)**
17. Define electric field and electric intensity? **(May 2010)**
18. Distinguish electric potential and potential difference? **(May 2012)**
19. State point form of ohms law? **(Nov 2014)**
20. State stokes theorem **(May 2010) (Nov 2014) (Nov 2009) (May 2006) (Nov 2010)**
21. Define electric scalar potential **(May 2010)**
22. What is an electric dipole? And write down the potential due to an electric dipole. **(Nov 2010) (Nov 2012) (May 2012)**
23. Why gauss law cannot be applied to determine the electric field due to finite line charge? **(Nov 2010)**
24. What is the relation between intensity of electric field and electric flux density?
25. A vector field is given by the expression F = (1/R0 in spherical co ordinates. Determine f in Cartesian form at a point x=1, y=1, z=1 unit. **(May 2009)**
26. Determine the Gradient of the scalar field $F = 5r^2 + r \sin\theta$ **(May 2012)**
27. What is Gradient? **(May 2014) (May 2012)**
28. A point charge 2nc is located at the origin. What is the value of potential at P (1, 0, and 0) m?
29. What are the different sources of electromagnetic fields? **(May 2012)**

PART-B (16 Marks)

1. State and explain Curl, Gradient and Divergence also find the potential due to an electric dipole (16) **(Nov 2014)**
2. Check validity of the divergence and curl theorem considering the field D=2xy ax+x2ay c/m^2 and the rectangular parallel piped formed by the planes x=0,x=1,y=0,y=2 &z=0,z=3. (16) **(Nov 2010)**
3. Explain three co-ordinate systems. (16)

4. A uniform line charge ρL =25Nc/m lies on the x=3m and y=4m in free space. Find the electric field intensity at a point (2, 3and 15) m. b. Given that potential V=10sinθcosΦ/r2 find the electric flux density D at (2, π/2,0) (16) **(Nov 2008)**
5. State and prove Gauss law and explain applications of Gauss law. (16) **(May 2009) (Nov 2006) (Nov 2014) (**Nov **2011)**
6. Define the potential difference and electric field. Give the relation between potential and field intensity. Also Derive an expression for potential due to infinite uniformly charged line and also derive potential due to electric dipole. (16) **(Nov 2010) (May 2014) (May 2012) (Nov 2009)**
7 .A vector field D = [5r2/4] It is given in spherical co-ordinates. Evaluate both sides of divergence theorem for the volume enclosed between r=1&r=2. (16)
8. Given A= 2r cosΦ+Riφ in cylindrical co-ordinates .for the contour x=0 to 1, y= 0 to1, verify Stokes's theorem (16)
9. State and explain **(Nov 2008) (May 2009) (May 2014)**
   a) Stokes theorem
   b) Divergence theorem
   c) The electric flux density
10. Find the electric field due to n-charges, and also establish the relation between potential and electric field (16) **(Dec** 2009**)**
11. Derive an expression for the electric field intensity at any point due to a uniformly charged sheet with density r_s c/ $_m^2$ **(Apr 2011) (Nov** 2011**)**
12. Derive the expression for potential due to an electric dipole at any point P. Also find electric field intensity at the same point (10) **(Dec** 2010**)**
13. A circular disc of radius 'a' m is charged uniformly with a charge density of σ c/ m2.find the Electric field at a point 'h' m from the disc along its axis. (16)
14. Given two points A(x=2, y=3, z= -1) and B(r=4, θ=25, ϕ= 120) find both spherical coordinates and Cartesian coordinates for A and B. Also find curl H for (2rcosϕar – 4r sin ϕ + 3az). **(May 2010)**
15. A circular disc of radius a meter is charged uniformly with a charge of σ c/m. Find the electric field intensity at a point h meter from the disc along its axis. **(May 2010)(May 2009)(May 2014)**
16. State gauss law for the electric and magnetic fields. Derive its integral and differential forms. Make at least two conclusions?
17. A positive charge Qv c/m^3 occupies the volume of a sphere. At a point in the interior at a distance of r from the centre, a small probe of charge of +q is inserted. What is the force acting on the probe charge?

UNIT II
CONDUCTORS AND DIELCTRIC
PART-A (2 Marks)

1. Write the Poisson's and Laplace equations in all the three coordinates. Also mention its difference. **(Nov 2012) (Nov 2010) (May 2009) (May 2007) (Nov 2011)**
2. Obtain Poisson's equation from Gauss's law
3. What is displacement current?
4. What is magnetic dipole moment?
5. Define magnetization. **(May 2010) (Nov 2011)**
6. Define magnetic susceptibility.
7. What is the relation between relative permeability and susceptibility?
8. State the boundary conditions at the interface between two perfect dielectrics. **(May 2010) (Nov 2010)**
9. Write down the magnetic boundary conditions.
10. Write the point form of Ohm's law. **(Nov 2014)**
11. Define dielectric strength? **(May 2010)**
12. Define B-H curve for classifying magnetic materials. **(Nov 2010) (May 2011)**
13. Write the current continuity equation **(Nov 2008) (May 2012) (May 2011)**
14. Classify the magnetic materials. **(Nov 2008)**

15. Write the expression for energy stored in an inductor. **(Nov 2012)**
16. Write the boundary condition for the electric field **(May 2014)**
17. What are the basic properties of a good conductor? **(Nov 2009)**
18. What are the different types of magnetic materials?
19. Define magnetic flux?
20. Define mmf?
21. Define Reluctance and permeance?
22. Define self inductance. Define Mutual inductance. **(May 2009) (Nov 2010)**
23. Write the expression for the energy density in electrostatic field?
24. Express the value of capacitance for a coaxial cable?
25. What is meant by displacement current? **(Nov 2010)**
26. State the boundary conditions at the interface between two perfect dielectrics?
27. State the principle of superposition of fields?
28. Why the electrostatic potential is continuous at a boundary?

PART-B (16 Marks)

1. Derive the boundary conditions of the normal and tangential components of electric field at the Inter face of two media with different dielectrics. (16) **(Nov 2008) (May 2014) (Nov 2014)**
2. a. Derive an expression for the energy stored and energy density in a capacitor. **(Nov 2014) (May 2009)**
3. Drive an expression for energy stored and energy density in an Electrostatic field (16) **(Nov 2014)**
4. a. Derive an expression for the capacitance of two wire transmission line. (8) b. Derive an expression for capacitance of co-axial cable. (8) **(May 2009) (Nov 2006)**
5. Find the expression for the cylindrical capacitance using Laplace equation. (16) **(Nov 2014)**
6. Derive the boundary conditions of the normal and tangential components of magnetic field at the inter face of two media with different dielectrics. (16) **(Nov 2014)**
7. a. Derive the expression for co-efficient of coupling. (8) b. Prove Laplace's and Poisson's equations. (8) Also using the concept of magnetic vector potential, derive Biot Savart's law and amperes law? **(May 2010)(May 2012)**
8. a. Derive the expression for co-efficient of coupling. (8) Also using the concept of magnetic vector potential, derive Biot Savart's law and amperes law? **(May 2010)(May 2012)**
9. a. Derive an expression for the capacitance of a spherical capacitor with conducting shells of radius a and b. **(May 2009) (Nov 2006)**
10. Derive the expression for the continuity equation of current in differential form and also derive the expression for inductance of a solenoid with N turns and l metre length carrying a current of I amperes. **(Nov 2011)**
11. Derive the expression for the inductance of a toroidal coil (solenoid) with N turns, carrying current I and the radius of the toroid R. Also considering a toroidal coil derive an expression for energy density. (16) **(Nov 2012) (May 2012) (April 2009) (Nov 2010)**
12. 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 **(May 2009)**
13. Derive the expression for potential energy stored in the system of n-point charges. (16) **(Dec 2009)**
14. Derive an expression for Poisson and Laplace equations and also Derive an expression for the inductance of solenoid **(May** 2010**) (Nov 2010) (May 2014)**
15. Derive the boundary conditions at an interface between two magnetic Medias. **(May 2010) (May 2009) (Dec 2006)**
16. A small loop wire lays a distance z above the center of a large loop. The planes of the two loops are parallel, and perpendicular to the common axis. Suppose current I flows in the big loop. Find the flux through the little loop. Find the mutual inductance. (16) **(May 2014)**
17. Solve the Laplace equation for the potential field in the homogenous region between the two concentric conducting spheres with radius a and b and v=0 at r=b and $v=v_o$ at r=a; Find the capacitance between the two concentric spheres. (8) **(Apr 2011)**

18. A metallic sphere of radius 10cm has a surface charge density of 10nc. Calculate the energy stored in the system. And also state and explain the electric boundary conditions between two dielectrics with permittivity's e1 and e2 (16) **(Nov 2011)**
19. Derive the expression for the energy of a point charge distribution. Three point charges -1nc, 4nc, 3nc are located at (0, 0, and 0) (0, 0, and 1) (1, 0, and 0) respectively, Find the energy in the system. **(May 2010)**
20. Find the permeability of the material whose magnetic susceptibility is 49 also find, if the inner and outer conductors of a co axial cable are having radii a and b respectively If the inner conductor is carrying current I and outer conductor is carrying the return current I in the opposite direction. Derive the expressions for the internal and external inductance (16) **(April 2011)**

UNIT III
STATIC MAGNETIC FIELD
PART-A (2 Marks)

1. Define Lorentz law of force. **(Nov 2010)(Nov 2008) (May 2012)**
2. State Biot-Savart Law. **(MAY 2010)(May 2009) (May 2006) (May 2014) (Nov 2009) (May 2008) (Nov 2011)**
3. State Ampere's circuital law. **(Nov 2009) (Nov 2007) (May 2011) (Nov 2010)**
4. What is the difference between scalar and vector magnetic potential. **(Nov 2010)**
5. Define Magnetic Moment. **(May 2009)**
6. What is magnetic dipole moment?
7. Define magnetic vector potential. **(Nov 2014)**
8. Define flux density or energy density in a magnetic circuit? **(May 2012)**
9. What is the relation between magnetic flux density and field intensity?
10. Write down the magnetic boundary conditions? **(Nov 2010)**
11. Give the force on a current element carrying 10A if the separation of two parallel plates is 1m? **(Nov 2010)**
12. Define magnetization vector? **(Nov 2011)**
13. Write Lorentz equation for F = Q (E + (V X B)) **(May 2010)**
14. What is solenoid? **(Nov 2008)**
15. Define magnetic field intensity **(Nov 2012) (May 2012)**
16. A Current of 3A flowing through an inductor of 100mH. What is the energy stored in inductor? **(May 2010)**
17. Give the torque experienced by a current carrying loop placed in a magnetic field? **(May 2010)**
18. What is the relation between relative permeability and susceptibility? **(May 2012)**
19. Can a magnetic field exist in a good conductor if it is static or time varying? Explain.
20. Write down the equation for general integral and point form of Ampere's law?
21. What is field due to toroid and solenoid?
22. Define magnetic moment?
23. Give torque on closed circuits?
24. State gauss law for magnetic field?
25. Give the similarities between electrostatic and magnetic field?
26. Define magnetic dipole?
27. Define magnetic susceptibility?
28. What are the major classifications of magnetic materials?

PART- B (16 Marks)

1. Derive the expression for magnetic field intensity and magnetic flux density due to finite and infinite line. (16) **(May 2010) (Nov 2010) (May 2012)**

2. Derive the expressions for magnetic field intensity and magnetic flux density due to circular coil. (16) **(Nov2010) (Nov 2009)**
3. a. Derive an expression for force between two current carrying conductors (8) b. 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. (8)
4. a. Derive the expression for torque developed in a rectangular closed circuit carrying current I in a uniform field. (8) b. State Ampere's circuital law and explain any two applications of Ampere's Circuital law. (8) **(May 2010)**
5. a. Derive the magnetic field intensity developed in a triangular closed circuit carrying current I in a uniform field. (8) b. State Ampere's circuital law and explain any two applications of Ampere's Circuital law. (8) **(Nov 2014)**
6. a. Derive the magnetic field intensity developed in a circular loop carrying steady current I in a uniform field. Using Ampere circuital law derive the magnetic field intensity due to a co-axial cable carrying a steady current I (16) **(April 2011)**
7. a. Derive the magnetic field intensity developed in a square loop carrying current I in a uniform field. Also State Lorentz force equation for a moving charge and explain its applications. (16) **(Nov 2011)**
8. Derive the expression for coefficient of coupling in terms of mutual and self inductances
9. Derive the expression for curl H=J? (Nov 2008) **(May 2014)**
10. Explain the concepts of scalar magnetic potential and vector magnetic potential? Find the maximum torque on an 85 turns rectangular coil with dimension (0.2x0.3) m carrying a current of 5 Amps in a field B = 6.5T **(May 2010) (Nov 2008) (May 2012) (Apr 2011)**
11. State and explain ampere circuital law **(May 2009) (May 2014)**
12. Obtain an expression for magnetic vector potential **(May 2009) (Nov 2012) (May 2010) (Dec 2010)**
13. Derive an expression for magnetic field intensity due to a linear conductor of infinite length carrying current I at a distant point P. Assume R to be the distance between conductor and point P, Use Biot Savarts law. And also derive the expression for magnetic field intensity on the axis of circular wire of radius 'a' carrying current I (16) **(Dec 2010)**
14. An iron ring with a cross sectioned of 3 cm2 and a mean circumference of 15 cm is wound with 250 turns wire carrying a current of 0.3A. The relative permeability of the ring is 1500. Calculate the flux established in the ring?
15. Find the magnetic field at the centre of a square loop which carries a steady current I. let R is the distance from centre to side. Find the field at the centre of the n-sided polygon carrying a steady current I. Again, let R be the distance from the centre to any side. Find the formula in the limit n tends to infinity. Find the magnetic field a distance h above the center of a circular loop of radius R, Which carries a steady current I. (16) **(May 2014) (Nov 2012)**
16. Using Ampere circuital law determine the magnetic field intensity due to a infinite long wire carrying a current I, also if a differential current element Idz is located at the origin of free space, obtain the expression for vector magnetic field potential due to the current element and hence find the magnetic field intensity at the point. (r, pi, z) **(Nov 2011)**

UNIT- IV
MAGNETIC FORCES AND MATERIALS
PART-A (2 Marks)

1. Define uniform Wave. And also mention its properties. **(May 2009) (May 2007) (Nov 2014) (May 2012)**
2. What is Brewster angle? **(May 2010) (Nov 2008)(Nov 2014) (Nov 2012) (Nov 2009) (May 2008)**
3. Define skin depth/effect? **(May 2010) (May 2014) (May 2011) (Nov 2011)**
4. Write down the wave equation for E and H in free space. **(Nov 2008)**
5. Write down the wave equation for E and H in a conducting medium.

6. Define intrinsic impedance or characteristic impedance. **(Nov 2010)**
7. What is lossy dielectric medium and uniform medium? **(May 2010)**
8. Calculate the characteristic impedance of free space.
9. Define propagation constant.
10. Define Polarization of uniform plane wave. **(Nov 2010) (May 2012)**
11. For a loss dielectric material having μr=1, ε r=48, σ=20s/m. calculate the propagation constant at a Frequency of 16 GHz
12. Define Circular Polarization. **(Nov 2010)**
13. Define Elliptical and Linear polarization.
14. Write Helmholtz equation? **(May 2012)**
15. Write down the expression for instantaneous power flow in electromagnetic field and instantaneous Pointing vector? **(Nov 2012)**
16. Find the velocity of a plane wave in a lossless medium having a relative permittivity of 5 and relative Permeability is unity?
17. An EM has Ex and Hx as components of electric and magnetic fields respectively.
18. Find the direction of power of flow. **(May 2012)**
19. What are the different types of polarization? **(Nov 2009)**
20. Write down the complex pointing vector in rectangular coordinates?
21. State Slepian vector?
22. Define surface impedance.
23. Can a magnetic field exist in a good conductor if it is static or time varying? Explain.
24. In a time varying situation how do you define a good conductor and lossy dielectric?
25. Write the two dimensional wave equations for a wave travelling in z direction **(May 2012)**
25. Determine the voltage reflection coefficient at the load end of a transmission **(Dec 2012)**

PART-B (16 Marks)

1. A plane wave propagating through a medium with εr=8, μr=2 has E=0.5 sin (108t-βz) az v/m. Determine
   (i) β
   (ii) The loss tangent
   (iii) Wane impedance
   (iv) Wave velocity
   (v) Magnetic field (16) **(Nov 2008)**
2. Derive a wave equation for non dissipative medium making use of Maxwell equations and field Vectors E and H. (16) **(May 2014) (Nov 2012)**
3. A plane sinusoidal electromagnetic wave traveling in space has Emax=150μV/m.
   (i)Find the accompanying Hmax
   (ii)Propagation is in X direction and H is oriented in Y direction. What is the direction of E.
   (iii) Compute the average power transmitted. (16)
4. Define wave. Derive the free space electromagnetic wave equation. (16)
5. Discuss about the plane waves in lossy dielectrics. (16)
6. Discuss about the plane waves in lossless dielectrics. (16)
7. Briefly explain about the wave incident? (i) Normally on perfect conductor? (ii) Obliquely to the surface of perfect conductor? (16)
8. Derive wave equations in phasor form and also derive for α, β, γ ?
9. Explain about the propagation of EM waves in good conductor?
10. Derive the transmission and reflection coefficients for the electromagnetic waves. Discuss the above for an open line and a short circuited line?
11. Derive the general wave equations? And also discuss the wave motion in good conductors? (16) **(April 2010)**

12. Analyze the wave behavior at boundaries under oblique incidence and derive the Brewster's angle. Also prove that a linearly polarized wave can be resolved into a right hand circularly polarized wave and a left hand circularly polarized wave of equal amplitude. **(May 2014)** (16)
13. With reference to electromagnetic waves, explain the following
    a) Linear polarization
    b) Circular polarization
    c) Elliptical polarization and also derive the expression for standing wave. Find the location of nodes and antinodes in E and H fields. (16) **(Nov 2012)**
14. A plane wave is incident normally on a perfect conductor. Derive the expressions for standing wave; also find the location of nodes and antinodes in E and H fields. Sketch the standing wave pattern **(Nov 2012)**
15. Verify whether the medium is good conductor. Also calculate the following: Attenuation constant, Phase constant, Propagation constant, intrinsic impedance, Wavelength and Velocity of propagation. (16) **(May 2012)**
16. A uniform plane wave in free space is normally incident on a dielectric having relative permittivity 4 and relative permeability 1, Calculate frequency and wave length of incident and transmitted waves, Magnetic field of incident wave, Transmission coefficient and the expression for the electric field of the transmitted wave, Expression for the magnetic field of the transmitted wave. (16) **(Nov 2012)**
17. Describe the concept of plane wave propagation in good conductors. Also explain with relevant expressions, the concept of reflection of plane waves by a perfect dielectric at both normal and oblique incidence. (16) **(Nov 2014)**
18. Explain reflection of uniform plane waves with normal incidence at a plane dielectric boundary. Also explain the types of polarization of uniform plane wave. (16) **(May 2009) (Apr 2011)**
19. Obtain the wave equation for conducting medium (16) **(Dec 2009) (Dec 2006) (Nov 2011)**
20. Obtain the expression for the reflection by a perfect dielectric normal incidence **(Dec 2009) (May 2009) (April 2010)**
21. From Maxwell's equation, derive the electromagnetic wave equation in conducting medium for E and H fields. And also explain different types of polarizations of uniform plane waves. (16) **(Nov 2010) (Apr 2011)**

UNIT- V
TIME VARYING FIELDS AND MAXWELL'S EQUATIONS
PART-A (2 Marks)

1. State Faraday's law of induction. **(May 2009) (Nov 2012) (May 2012)**
2. State Lenz's law
3. What is motional electric field?
4. Write Maxwell's equation in point and integral form. **(Nov 2010) (Nov 2009) (Nov 2011)**
5. What is significance of displacement current density? **(May 2010)**
6. What is motional emf?
7. What is the emf produced by moving loop in time varying field?
8. What is conduction and displacement current density? **(Nov 2009)**
9. State Pointing Theorem. **(May 2010) (Nov 2008) (May 2009) (May 2008)(Nov 2014) (May 2011)**
10. What is time harmonic field?
11. Give time harmonic Maxwell's equation in point form. Assume time factor $e^{-i\omega t}$.
12. Give the expression for lifting force of an electromagnet.

13. Write the Maxwell's equation from faradays law? **(Nov 2010) (Nov 2014)**
14. Write the Maxwell's equation in differential form. **(Nov 2008)**
15. What is the energy stored expression in a magnetic field?
16. Compare energy stored in inductor and capacitor?
17. What is the mutual inductance of two inductively tightly coupled coils with self inductance of 25mH and 100 mH ?
18. State the flux rule for a nonrectangular loop moving through a no uniform magnetic field. **(May 2014)**
19. Give the situations when the rate of change of flux results in a non-zero value. **(May 2011)**
20. Write the Maxwell's equations from ampere circuital law both in integral and point form?
21. Explain why Del dot B is zero?
22. Explain why curl E is zero?
23. Tabulate the Maxwell's equation for conducting and free space medium?
24. What is the electric field and power flow in the co axial cable? **(Nov 2011)**
25. Write the expression for total current density **(May 2012)**

PART-B (16 Marks)

1. Derive the Maxwell's equation in differential and integral forms (16) **(May 2010) (Nov 2008) (May 2014) (Nov 2014) (May 2009)**
2. Derive Maxwell's four equations in point form and in differential form (16) **(Dec 2009)**
3. A. What is the physical significance of the pointing vector? And explain it in detail? Derive the expression for total power flow in coaxial cable? (16) **(Nov 2012) (Nov 2014)**
4. Derive general field relations for time varying electric and magnetic fields using Maxwell's equation? **(May 2010)**
5. On the basis of the analysis of the transmission line compare circuit theory and field theory
6. With necessary explanation, derive the Maxwell's equation in differential and integral forms
7. What do you mean by displacement current? Write down the expression for the total current density?
8. Explain briefly about the motional emf and derive an expression for it?
9. Discuss the pointing vector and pointing theorem? Also derive the ampere circuital law. **(Nov 2008) (May 2014) (Nov 2012)(May 2011)(Nov 2011)**
10. Define faradays laws. What are the different ways of emf generation? Explain with governing equation and suitable example for each? Also derive the differential and integral form of faradays law. **(May 2010) (May 2014) (May 2012)**
11. Define Brewster angle and derive its expression?
12. Derive the relationship between electric and magnetic fields?
13. Explain complex, average and instantaneous poynting vector. (16) **(May 2012) (Dec 2009)**
14. Explain the following terms: Motional emf and transformer emf, also find the amplitude of displacement current density in the air near car antenna where the field strength of FM signal is $E = 80 \cos (6.227 \times 10^8 t - 2.092y)\, a_z$ **(May 2009)**
15. Derive the modified form of ampere circuital law in integral and differential forms. **(May 2010)**
16. Generate Ampere's law for time varying fields. Also list the Maxwell's equations in integral and point form for free space conditions **(Nov 2010)**
17. Derive an expression for displacement current density J_d, and also give the physical interpretation of Maxwell's equation. **(Nov 2011)**