SYED AMMAL ENGINEERING COLLEGE

(Approved by the AICTE, New Delhi, Govt. of Tamilnadu and Affiliated to Anna University, Chennai)
Established in 1998 - An ISO 9001:2008 Certified Institution
Dr. E.M.Abdullah Campus,Ramanathapuram – 623 502.
Phone: 304001, 304002 (04567) Fax: 304123(04567)
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Department of Electronics and communication Engineering

EC6403 - ELECTROMAGNETIC FIELDS

QUESTION BANK

Syllabus:

OBJECTIVES

- To impart knowledge on the basics of static electric and magnetic field and the associated laws.
- To give insight into the propagation of EM waves and also to introduce the methods in computational electromagnetics.
- To make students have depth understanding of antennas, electronic devices, Waveguides is possible.

UNIT I STATIC ELECTRIC FIELD 9

Vector Algebra, Coordinate Systems, Vector differential operator, Gradient, Divergence, Curl, Divergence theorem, Stokes theorem, Coulombs law, Electric field intensity, Point, Line, Surface and Volume charge distributions, Electric flux density, Gauss law and its applications, Gauss divergence theorem, Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

UNIT II CONDUCTORS AND DIELECTRICS 9

Conductors and dielectrics in Static Electric Field, Current and current density, Continuity equation, Polarization, Boundary conditions, Method of images, Resistance of a conductor, Capacitance, Parallel plate, Coaxial and Spherical capacitors, Boundary conditions for perfect dielectric materials,Poisson‟s equation, Laplace‟s equation, Solution of Laplace equation, Application of Poisson‟s and Laplace‟s equations.

UNIT III STATIC MAGNETIC FIELDS 9

Biot-Savart Law, Magnetic field Intensity, Estimation of Magnetic field Intensity for straight and circular conductors, Ampere‟s Circuital Law, Point form of Ampere‟s Circuital Law, Stokes theorem, Magnetic flux and magnetic flux density, The Scalar and Vector Magnetic potentials, Derivation of Steady magnetic field Laws.

UNIT IV MAGNETIC FORCES AND MATERIALS 9

Force on a moving charge, Force on a differential current element, Force between current elements, Force and torque on a closed circuit, The nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions involving magnetic fields, The magnetic circuit, Potential energy and forces on magnetic materials, Inductance, Basic expressions for self and mutual inductances, Inductance evaluation for solenoid, toroid, coaxial cables and transmission lines, Energy stored in Magnetic fields.

UNIT V TIME VARYING FIELDS AND MAXWELL'S EQUATIONS 9

Fundamental relations for Electrostatic and Magnetostatic fields, Faraday‟s law for Electromagnetic Induction, Transformers, Motional Electromotive forces, Differential form of Maxwell‟s equations, Integral form of Maxwell‟s equations, Potential functions, Electromagnetic boundary conditions, Wave equations and their solutions, Poynting‟s theorem, Time harmonic fields, Electromagnetic Spectrum.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

Upon completion of the course, the students would be able to

- Analyze field potentials due to static changes and static magnetic fields.
- Explain how materials affect electric and magnetic fields.
- Analyze the relation between the fields under time varying situations.
- Discuss the principles of propagation of uniform plane waves.

TEXT BOOKS

1. William H Hayt and Jr John A Buck, “Engineering Electromagnetics”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008
2. Sadiku MH, “Principles of Electromagnetics”, Oxford University Press Inc, New Delhi, 2009.

REFERENCES

1. David K Cheng, “Field and Wave Electromagnetics”, Pearson Education Inc, Delhi, 2004.
2. John D Kraus and Daniel A Fleisch, “Electromagnetics with Applications”, Mc Graw Hill Book Co, 2005.
3. Karl E Longman and Sava V Savov, “Fundamentals of Electromagnetics”, Prentice Hall of India, New Delhi, 2006.
4. Ashutosh Pramanic, “Electromagnetism”, Prentice Hall of India, New Delhi, 2006.

UNIT I STATIC ELECTRIC FIELD

PART –A

1. Define scalar and vector field? Give its two examples.
2. Define base (unit) vector? What is its function while representing a function?
3. Define rectangle, cylindrical & spherical coordinates.
4. Define line, surface & volume charge density.
5. Define Curl, Divergence & Gradient with mathematical expression.
6. State Stroke"s theorem & Write mathematical expression for Stroke"s theorem.
7. State Divergence theorem & Write mathematical expression for Divergence theorem.
8. Convert the point P(3, 4, 5) from the cartesian to spherical coordinates. Prove that curl grad $\Phi = 0$.
9. Determine the gradient of the scalar filed $F = 5r^2+r\ Sin\theta$. Show that vector $H = 3y^4z^2a_x+4x^3z^2a_y+3x^2y^2a_z$ is solenoidal.
10. State Coulomb"s law (or) State Coulomb"s law in vector form. What are the features of Coulomb"s law?
11. In XY plane, Q_1=100 µC at (2,3)m, experiences a repulsive force of 7.5 N because of Q_2 at (10,6)m. Find Q_2.
12. State the principle of superposition of fields. A uniform surface charge of σ=2µc/m^2 is situated at z=2 plane. What is the value of $\vec{D}$ at P(1,1,1)m.
13. Define electric field intensity. Mention any two sources of electromagnetic field.
14. State Gauss law. What is the use of Gauss"s law?
15. State Divergence theorem. Show that $\nabla.E=0$ in the case of a point charge.
16. Define electric flux and electric flux density? Write relation between E & D.
17. Define potential. Distinguish potential & potential difference.
18. Define electric scalar potential. Write down relation between potential & electric field.
19. What is an electric dipole? Write down the potential due to an electric dipole.
20. State nature of conservative field. A point charge +2 nC is located at origin. What is the value of potential at P(1,0,0)m.

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PART –B

1. (i) Write shot notes on three co-ordinates. **(8)**

   (ii) Given the two points A(x=2,y=3,z=-1) & B(r=4,θ=25^o,Φ=120^o). Find the spherical coordinates of A and cartesian coordinates of B. **(8)**

2. (i) Find the gradient of scalar system $t = x^2y+e^z$ at point P(1,5,-2). **(4)**

   (ii) Determine the divergence and curl of the given filed $F=30a_x+2xya_y+5xz^2a_z$ at (1,1,-0.2) and hence state the nature of the filed. **(6)**

   (iii) Describe the classification of vector filed. **(6)**

3. (i) Explain Coulomb"s law and deduce the vector form of force equation between two point charges. **(6)**

   (ii) Write short notes on principle of superposition of fields as applied to charge distribution. **(6)**

   (iii)A point charge Q=300μC located at (1,-1,-3)m experiences a force $F_1=8\vec{a}_x - 8\vec{a}_y + \vec{a}_z$ (N) due to point charge Q_2 at (3,-3,-2)m. Find the charge Q_2. **(4)**

4. (i) Find the electric field at the origin due to 10^{-8} C charge located P(0,4,4)m and -0.5×10^{-8} C charge at Q (4,0,2)m. **(4)**

   (ii) Explain electric filed due to continuous charge distribution. **(6)**

   (iii) An infinitely long uniform line charge located at y=3, z=5. If ρ_L = 30 nC/m. Find the electric field intensity at (i) Origin (ii) P(0,6,1) (iii) P(5,6,1). **(6)**

5. (i)Determine the electric field intensity of an infinitely long, straight line charge of a uniform density ρ_L C/m. **(8)**

   (ii) Find the force on a point charge q located at (0,0,h)m due to charge of surface charge density ρ_s C/m^2 uniformly distributed over the circular disc r ≤ a, z=0m. Also find electric field intensity at the same point. **(8)**

6. (i)Obtain the expression for electric field intensity on the axis of a uniformly charged circular disc. **(8)**

   (ii) Obtain $\vec{D}$ due to a point charge Q placed at origin. Hence obtain the relation between $\vec{D}$ & $\vec{E}$. **(8)**

7. (i) Derive the electric field due to an infinite uniformly charged sheet. **(8)**

   (ii) Derive electric flux density for various charge distribution. **(8)**

8. (i) Derive an expression for electric field intensity at point P due to an electric dipole. Also find E at the same point. **(8)**

   (ii) Given that $\vec{D} = (5r^2/4)\, a_r$ C/m^2. Evaluate both the sides of divergence theorem for the volume enclosed by r=4m and θ=π/4. **(8)**

9. (i) State and prove Gauss"s law. Write applications of Gauss"s law. Describe any one application of Gauss"s law. **(16)**

10. (i) Given a filed $E = (-6y/x^2)\, a_x + (6/x)\, a_y + 5\, a_z$ v/m.

Find the potential difference V_{AB} given

A(-7,1,2) & B (4,1,2). **(8)**

(ii) Derive an expression for potential energy stored in the system of n point charges. **(8)**

UNIT II CONDUCTORS AND DIELECTRICS

PART –A

1. State continuity equation in integral and differential form? What do you understand from current continuity equation?
2. Write the equation of Ohm"s law in point form.
3. Define current density. Write the relation between current and current density.
4. What is the difference between homogeneous and nonhomogeneous medium.
5. State properties of conductor and dielectric materials.
6. What is polarization? Define polarization and Write mathematical equation for polarization.
7. Define dielectric strength. Write its value for the air with unit.
8. What is the difference between linear and nonlinear medium.
9. Why is the electrostatic potential continuous at boundary?
10. Define the boundary conditions for the conductor- free space boundary in electrostatic and interface between two dielectrics.
11. How is the principle of conservation of charges depicted? Calculate the energy stored in a 10 µF capacitor which has been charged to a voltage of 400v.
12. What is capacitance? Write the capacitance equation of a coaxial cable.
13. Using Gauss"s law, derive the capacitance of a co-axial cable.
14. Determine the capacitance of a parallel plate capacitor having tin foil sheets, 25 cm square plates separated through a glass dielectric 0.5 cm thick with relative permittivity 6.
15. Determine the value of capacitance between two square plates cross sectional area 1 sq.cm separated by 1 cm placed in a liquid whose dielectric constant ids 6 and the relative permittivity of free space is 8.854 pF/m.
16. Obtain Poisson"s equation from Gauss"s law.
17. Express Laplace"s equation in different co-ordinate systems.
18. State the difference between Poisson"s and Laplace"s equation.
19. Write Laplace"s equation and its applications.
20. State Uniqueness theorem.

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PART –B

1. (i) Obtain the equation of continuity in integral and differential form. **(8)**

   (ii) Find the total current in a circular conductor of radius 4 mm if the current density varies according to $J = (10^4/r)\ A/m^2$. **(4)**

   (iii) Explain the electric field distribution inside and outside a conductor. **(4)**

2. (i) Discuss briefly about the nature of dielectric materials. List out the properties of dielectric materials. **(8)**

   (ii) A linear, homogeneous, isotropic dielectric material has $\xi_r = 3.6$ and is covering the space between z = 0 and z = 1. If V= -6000 z volts in the material, Find E, P and ρ_S. **(8)**

3. (i) Explain and derive the boundary conditions for a conductor free space interface. **(12)**

   (ii) What are the salient points to be noted when the boundary conditions are applied? **(4)**

4. (i) Derive the boundary conditions of the normal and tangential components of electric field at the interface of two media with different dielectrics. **(12)**

   (ii) Deduce the expression for joint capacitance of two capacitors C_1 and C_2 when connected in series and parallel. **(4)**

5. (i) Derive the capacitance of a parallel plate capacitor. **(8)**

   (ii) A parallel capacitor has an area of 0.8 m^2, separation of 0.1 mm with a dielectric for which $\xi_r = 1000$ and a field of 10^6 V/m. Calculate C and V. **(8)**

6. (i) 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 ξ_r & length of the capacitor is L. Determine the capacitance. **(8)**

   (ii) Derive an expression for the capacitance of a spherical capacitor consisting of 2 concentric spheres of radius „a" & „b". **(8)**

7. (i) Find the capacitance of a conducting sphere of 2 cm in diameter, covered with a layer of polyethelene with $\xi_r = 2.26$ and 3 cm thick. **(8)**

   (ii) Obtain the expressions for the energy stored and energy density in a capacitor. **(8)**

8. (i) Derive the expression for the capacitance of parallel plate capacitor having two dielectric media. **(8)**

(ii) A capacitor with two dielectrics as follows: Plate area 100 cm^2, dielectric 1 thickness = 3 mm, ξ_{r1} = 3, dielectric 2 thickness = 2 mm, ξ_{r2} = 2. If a potential of 100 V is applied across the plates. Find the energy stored in each dielectric and potential gradient in each dielectric. **(8)**

9. (i) Derive Poisson"s and Laplace"s equation. **(8)**

(ii) Given the potential filed, V = (50 Sin θ/r^2) V, in free space, determine whether V satisfies Laplace"s equation. **(8)**

10. (i) Find the expression for the cylindrical capacitance using Laplace"s equation. **(8)**

(ii) Two parallel conducting plates area separated by distance „d" apart and filled with dielectric medium having ξ_r as relative permittivity. Using Laplace"s equations derive an expression for capacitance per unit length of parallel plate capacitor, if it is connected to a DC source supplying „V" volts. **(8)**

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UNIT – III STATIC MAGNETIC FIELDS

PART – A

1. Define magnetic field intensity and state its unit.
2. Define magnetic flux density and state its unit.
3. What is the relation between magnetic flux density and magnetic field intensity?
4. State Biot-Savart‟s law.
5. State Ampere‟s circuital law.
6. State expression for $\overline{H}$ in all the regions if a cylindrical conductor carriers a direct current I and its radius is R m.
7. State Stoke‟s theorem.
8. What is scalar magnetic potential?
9. Define vector magnetic potential and state its unit.
10. State Laplace‟s equation for scalar magnetic potential.
11. Draw the magnetic field pattern in and around a solenoid.
12. Define the term „relative permeability‟.
13. A long straight wire carries a current I = 1 amp. At what distance is the magnetic field H= 1 A/m.
14. Define magnetic flux and flux density.
15. State the application of Ampere‟s circuital law.
16. Can a static magnetic field exist in a good conductor? Explain.
17. Plot the variation of $\overline{H}$ inside and outside a circular conductor with uniform current density.
18. State the point form of Ampere‟s circuital law.
19. Find the magnetic field intensity at a point P (0:01; 0; 0) m, if the current through a co-axial cable is 6A, which is along the z axis and a = 3 mm,
    b = 9 mm and c = 11 mm.
20. A ferrite material has μ_R = 50. Operate with sufficiently low flux densities and B=0.05 T and find H.

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PART – B

1. i) State and explain Biot-Savart law. **(8)**
ii) List the similarities and differences between Coulomb‟s and Biot-Savart law. **(8)**

2. i) Derive 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. **(8)**
ii) A circular loop located on $x^2+y^2=4, z=0$ carries a direct current of 7 A along $\hat{a}_\phi$. Find the magnetic field intensity at (0,0, -5). **(8)**

3. Conductor in the form of regular polygon of „n‟ sides inscribed in a circle of radius R.
Show that the expression for magnetic flux density is $B = \frac{\mu_0 nI}{2\pi R} \tan\left(\frac{\pi}{n}\right)$ at the centre, where I is the current. Show also when „n‟ is indefinitely increased then the expression reduces to $B = \frac{\mu_0 I}{2R}$. **(16)**

4. i) Find the magnetic field intensity due to a finite wire carrying a current I and hence deduce an expression for magnetic field intensity at the centre of a square loop. **(8)**
ii) Derive the magnetic field intensity in the different regions of co-axial cable by applying Ampere‟s circuital law. **(8)**

5. i) Using Biot-Savart‟s law, derive the magnetic field intensity on the axis of a circular loop carrying a steady current I. **(8)**
ii) State and explain Ampere‟s circuit law. **(8)**

6. i) A very long and thin, straight wire located along the z-axis carries a current I in the Z-axis direction. Find the magnetic field intensity at any point in free space using Ampere‟s law.**(8)** ii) Let $\bar{A} = (3y-z)\,\bar{a}_x + 2xz\,\bar{a}_y$ Wb/m in a certain region of free space.
A) Show that $\nabla \bullet \bar{A} = 0$ B) At P(2,-1,3) find $\bar{A}$, $\bar{B}$, $\bar{H}$ and $\bar{J}$. **(8)**

7. 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. **(16)**

8. i) Obtain the expression for scalar and vector magnetic potential **(8)**

   ii) At a point P(x, y, z) the components of vector magnetic potential $\overline{A}$ are given as $\overline{A}_x$ =4x+3y+2z, $\overline{A}_y$ =5x+6y+3z and $\overline{A}_z$ =2x+3y+5z. Determine $\overline{B}$ at point P and state its Nature **(8)**

9. ii) Derive the expression which relate $\overline{J}, \overline{B}$ and vector magnetic potential $\overline{A}$ **(8)**

   i) 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. **(4)**

   iii) Derive the expression for curl H=J. **(4)**

10. i) A differential current element Idz $\overline{a_z}$ is located at the region in free space. Obtain the expression for vector magnetic potential due to the current element and hence find the magnetic field intensity at the point (ρ , ϕ , z). **(8)**

    ii) Derive an expression for the flux density at the centre of a circular loop carrying current I. **(8)**

UNIT IV MAGNETIC FORCES AND MATERIALS

PART – A

1. What is Lorentz force equation for a moving charge? Write its applications.
2. Give an integral expression for the force on a closed circuit of a current I in the magnetic field H.
3. Define magnetic moment?
4. Define magnetic dipole moment. Sketch the field due to magnetic dipole.
5. Classify the magnetic materials
6. Define hysteresis. Draw hysteresis curve.
7. Define magnetization
8. What is relative permeability of material
9. Define self-inductance.
10. Define mutual inductance.
11. Write expression for energy stored in an inductor.
12. A loop with magnetic dipole moment $8 \times 10^{-3} \bar{a}_z$ Am^2 lies in a uniform magnetic field of $\bar{B} = 0.2\,\bar{a}_x + 0.4\,\bar{a}_z$ Wb/m^2. Calculate torque.
13. Compare self-inductance and mutual inductance.
14. Write down the expression for the torque experienced by current carrying loop situated in a magnetic field.
15. State the importance Lorentz Force equation.
16. A conductor 6m long lies along z-direction with a current of 2A in $\bar{a}_z$ direction. Find the force experienced by conductor if $\bar{B} = 0.08\,\bar{a}_x$ (T)
17. Write an expression for torque in vector form.
18. 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.
19. Find the permeability of the material whose magnetic susceptibility is 49.
20. Define Magnetic Torque and magnetic dipole moment.

PART – B

1. i) Derive an expression for the force between two current carrying wires. Assume that the currents are in the same direction. **(8)**
   ii) An iron ring with a cross sectional area of 3 cm square and mean circumference of 15cm is wound with 250 turns wire carrying a current of 0.3A. A relative permeability of ring is 1500. Calculate the flux established in the ring **(8)**

2. i) Derive an expression for a torque on a closed rectangular loop carrying current. **(8)**
   ii) A solenoid is 50 cm long, 2 cm in diameter and contains 1500 turns. The cylindrical core has a diameter of 2 cm and a relative permeability of 75. This is coil is co-axial with a second solenoid, also 50 cm long, but 3 cm diameter and 1200 turns. Calculate L for the inner solenoid and L for the outer solenoid. **(8)**

3. i) Explain magnetic boundary conditions with neat sketch **(10)**
   ii) 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. **(6)**

4. i) An iron ring with a cross sectional area of 8 cm^2 and circumference of 120 cm is wound with 480 turns wire carrying a current of 2 A. A relative permeability of ring is 1250. Calculate the flux established in the ring **(10)**
   ii) Derive an expression for inductance of a solenoid with N turns and *l* metre length carrying a current of I amperes **(6)**

5. i) Calculate the self-inductance of infinitely long solenoid. **(8)**
   ii) Derive the expression for inductance of a toroidal coil carrying current I, with N turns and the radius of toroid R. **(8)**

6. 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‟. Determine the inductance per unit length of the line.**(12)**
   ii) Find the permeability of the material whose magnetic susceptibility is 49. **(4)**

7. i) An iron ring of relative permeability 100 is wound uniformly with two coils of 100 and 400 turns of wire. The cross section of the ring is 4 cm^2. The mean circumference is 50 cm. Calculate
    1. The self-inductance of each of the two coils.
    2. The mutual inductance.
    3. The total inductance when the two the coils are connected in series with flux in the same sense.
    4. The total inductance when the coils are connected in series with flux in the opposite sense **(10)**

   ii) Derive an expression for energy density in inductor **(6)**

8. i) Derive an expression for the energy stored in the magnetic field of a coil possessing an inductance of L Henry when the current in the coil is 1 amp. **(10)**

   ii) Considering toroidal coil, derive and expression for energy density. **(6)**

9. i) Show that energy produced per unit volume per second is equal to sum of energy stored per unit volume per second and the energy crossed per unit volume per second **(10)**

   ii) A magnetic circuit employs an air core toroid with 500 turns, cross sectional area 6 cm^2, mean radius 15cm and 4 A coil current. Determine reluctance of the circuit, flux density and magnetic field intensity. **(6)**

10. i) Derive the magnetic boundary condition at the interface between two magnetic medium. **(8)**

    ii) Show that inductance of the cable $L = \frac{\mu l}{2\pi}$ ln b/a H. **(8)**

UNIT V TIME VARYING FIELDS AND MAXWELL'S EQUATIONS

PART – A

1. State Faraday"s law of electromagnetic induction.
2. State Lenz"s Law.
3. What is the significance of displacement current?
4. What is the significance of the ratio of magnitudes of the conduction current density to the displacement current density?
5. Discuss the condition under which conduction current is equal to the displacement current.
6. What are characteristics of uniform plane wave?
7. Write Maxwell"s equation in point form or differential form and in integral form.
8. Write point form of Maxwell"s equation in phasor form.
9. Write Maxwell"s equation for free space.
10. Write Maxwell"s equation derived from Faraday"s law.
11. Write down Maxwell"s equation derived from Ampere"s law.
12. Give the situations, when the rate of change of flux results in a non-zero value.
13. Distinguish between conduction current and displacement current.
14. Define poynting vector. What is its unit?
15. Brief about complex poynting vector.
16. State poynting theorem.
17. Explain instantaneous, average and complex pointing vector.
18. What is the electric field and power flow in the co-axial cable?
19. Find the poynting vector on the surface of a long straight conducting wire (of radius „b" and conductivityσ) that carries a direct current I
20. Determine the e.m.f induced about the path r=0.5, z=0, t=0. If B=0.01sin377t T.

PART - B

1. i) Derive the expression for total power flow in co-axial cable. **(8)**
   ii) State and prove poynting theorem. **(8)**

2. i) Explain the following poynting vector, average power and instantaneous power **(8)**
   ii) Derive expression for poynting vector. **(8)**

3. i) Discuss about the propagation of the plane waves in free space and in a homogeneous material. **(8)**

ii) In free space, $\bar{H}$ =0.2cos (ωt - βx) $\bar{a}_z$ A/m. Find the total power passing through a circular disc of radius 5 cm. **(8)**

4. i) Derive the wave equation starting from the Maxwell‟s equation for free space. **(8)**
   ii) In free space, $\underline{E}$ =50cos (ωt - βx) $\underline{a}_z$ V/m. Find the average power crossing a circular

   area of radius 2.5m in the plane z=0. Assume Em = Hm . η_o and η_o =120 Ω. **(8)**

5. i) State Maxwell‟s equation for static fields. Explain how they are modified for time varying
   electric and magnetic fields. **(8)**
   ii) Generalise Ampere‟s law for time varying fields. **(8)**

6. i) Derive Maxwell‟s equation in point form and integral form with necessary explanation**(10)**
   ii) Derive expression for displacement current density. **(6)**

7. i) If electric field intensity in the free space is given by $\bar{E} = \frac{50}{\rho}\cos(10^8 t - 10z)\,\bar{a}_\rho$ V/m. **(10)**
   ii) Electric flux density in a charge free region is given by $\bar{D} = 10x\,\bar{a}_x + 5y\,\bar{a}_y + kz\,\bar{a}_z$ μC/m^2, find the constant K. **(6)**

8. i) Write the consistency of Ampere‟s law. Is it possible to construct a generator of EMF which is constant and does not vary with time by using EM induction principle? Explain.**(12)**
   ii) Give the physical interpretation of Maxwell‟s first and second equation. **(4)**

9. i) Derive the integral and point form of Maxwell‟s equations from Faraday‟s law and
   Ampere‟s law. **(8)**
   ii) Given $\underline{E}$ =E$_0$ z^2 e^{-t} $\underline{a}_x$ in free space. Verify whether, there is a magnetic field so that both
   Faraday‟s law and Ampere‟s law are satisfied simultaneously. **(8)**

10. i) In a material for which σ=5.0 S/m and ξ_r= 1, the electric field intensity is E=250sin10^{10} t V/m. Find the conduction and displacement current densities, and the frequency at which both have equal magnitudes. **(8)**

ii) An electric field in a medium which is source free is given by $\bar{E}$ =1.5cos (10^8t- βz)$\bar{a}_x$ V/m. Find $\overline{B}$,$\overline{H}$ and $\overline{D}$. Assume ξ_r= 1. μ_r =1, σ=0. **(8)**