DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FREQUENTLY ASKED QUESTIONS

YEAR/SEM : II / III

NAME OF THE SUBJECT : EE3301 ELECTROMAGNETIC FIELDS

NAME OF THE FACULTY : Mr. S.VIKRAMAN. A.P/EEE

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

1. What are the sources of electromagnetic fields? (AU-May/June 2017)
2. What are the practical applications of electromagnetic fields? (AU-Nov/Dec 2015)
3. Determine the angle between A = 2 ax + 4 ay and B = 6 ay – 4 az? (AU-Nov/Dec 2016)
4. Two vectorial quantities A = 4i + 3j + 5k and B = i – 2j + 2k are known to be oriented in two unique directions. Determine the angular separation between them. (AU-Nov/Dec 2012)
5. Points P and Q are located at (0,2,4) and (-3,1,5). Calculate the distance vector from P to Q. (AU-Nov/Dec 2014)
6. Given A = 4 ax + 6 ay - 2 az and B = -2 ax + 4 ay + 8 az Find Whether the vectors are Parallel or Perpendicular. (AU-May/June 2015) (A.B=0# Perpendicular, AxB=0# Parallal)
7. Find the unit vector extending from the origin toward the Point P (3,-1,-2) (AU-May/June 2018)
8. Give the differential displacement and volume in spherical co-ordinate system. (AU-Nov/Dec 2015)
9. How are the unit vectors defined in cylindrical coordinate systems? (AU-May/June 2010) (AU-Nov/Dec 2013)
10. Express in matrix form the unit vector transformation from rectangular to cylindrical co-ordinate system. (AU-May/June 2015) (AU-Nov/Dec 2013) (AU-May/June 2010)
11. Obtain in the Cartesian co-ordinate system the Gradient of the function : $f(r,\theta,z) = 5r2z3\sin\theta$. (AU-May/June 2014)

12. Convert the given point (2, Π/2, Π/3) in Spherical coordinates into Cartesian coordinates. (AU-Nov/Dec 2018)

13. Prove that curl grad φ = 0 where φ is scalar field. (AU-May/June 2019)

14. State the conditions for Vector A to be (a) Solenoidal, (b) Irrotational. (AU-Nov/Dec 2012)

15. State Divergence theorem (AU-Nov/Dec 2011) (AU-May/June 2010)

16. State stroke's theorem (AU-May/June 2017) (AU-Nov/Dec 2016) (AU-May/June 2014) (AU-Nov/Dec 2013)

17. State Gauss law and its applications **(NOV/DEC 2023)**

18. Define coulomb's Law

19. What is Electric field intensity? (AU-May/June 2016) Nov/Dec 2021

20. Determine the electric flux density at a distance of 20 cm due to an infinite sheet of uniform charge 20 micro C / m2 lying on the z=0 plane. (AU-Nov/Dec 2014) (AU-Nov/Dec 2018)

21. Determine the electric field intensity in free space if D = 30 ax C / m2 (AU-May/June 2018)

22. Given the points A (x=2, y=3, z=-1) and B (r=4, θ=25°, φ=120°). Find the distance from A to B. (AU-May/June 2019)

23. State the properties of Divergence of a vector field Nov/Dec 2020 **(NOV/DEC 2023)**

24. Acharge is distributed on x axis of Cartesian system having a line charge density of 3x2 mc/m Find total charge over a length of 10m Nov/Dec 2020

25. What is the physical significance of div D? Nov/Dec 2021

26. Given point P(-2,6,3) find P in cylindrical and spherical coordinates. **(NOV/DEC 2022)**

27. Given vectors $A=3a_x+4a_y+a_z$ and $B=2a_y-5a_z$, find the angle between A and B. **(NOV/DEC 2022)**

28. State divergence theorem. **(APR/MAY 2023)**

29. State Coulombs law. **(APR/MAY 2023)**

PART-B

1. Given point P(-2,6,3) and A = y i + (x+z) j, express P and A in cylindrical coordinates. (AU-Nov/Dec 2012)

2. Express the vector B in cartesian and cylindrical systems. Given, B = 10/r ar + r cosθ aθ + aϕ . Find B at (-3, 4 , 0) and (5 , Π/2, -2).(AU-Nov/Dec 2013) (AU-Nov/Dec 2018)

3. If B = y ax + (x+z) ay and a point Q is located at (-2 , 6 , 3), express (AU-Nov/Dec 2011)

(i) The point Q in cylindrical and spherical coordinates.

(ii) B is spherical coordinates.

4. Transform 4ax – 2ay – 4az at (2,3,5) to cylindrical coordinates. (AU-Nov/Dec 2016)

5. Write short on the following : Gradient, Divergence, Curl, Stokes theorem. (AU-Nov/Dec 2013) (AU-Nov/Dec 2018)

6. Obtain the curl in the spherical coordinate system. (AU-May/June 2014)
7. Verify whether the vector field E = yz ax + xz ay + xy az is both solenoidal and irrotational. (AU-Nov/Dec 2011)
8. State and prove Gauss's divergence theorem. (AU-Nov/Dec 2012) (AU-Nov/Dec 2016) (AU-May/June 2017)
9. Explain the divergence of a vector field and divergence theorem. (AU-May/June 2018)
10. Verify the divergence theorem for a vector field D = 3x2 ax + (3y +z) ay + (3z-x) az in the region bounded by the cylinder x2 + y2 = 9 and the planes x = 0, y = 0, z = 2 (AU-Nov/Dec 2015)
11. State and explain Coulomb's law of force.State and prove Gauss Law. (AU-May/June 2015)
12. Three point charges in free space and located as follows : 50 nC at (0,0); 40 nC at (3,0) ; -60 nC at (3,4) (AU-May/June 2016) Nov/Dec 2020
13. Find the force on a charge Q1 of 20 μC at (0,1,2)m due to Q2 of 300 μC at (2,0,0)m.
14. 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. (AU-May/June 2018)
15. Obtain an expression for electric field intensity due to a uniformly charged line of length 'L' using Coulomb's law (AU-May/June 2015) (AU-Nov/Dec 2015) (AU-May/June 2017)
16. A charge is distributed along a finite straight line with constant density ρ C/m along X axis. Develop an expression for E at arbitrary point P. (AU-May/June 2016)
17. Derive the expression for electric field intensity due to uniformly charged circular disc of 'σ' c / m2. (AU-Nov/Dec 2016) (AU-May/June 2010)
18. Determine the electric field intensity E at a point 2a along the axis perpendicular to the plane of a circular wire charged uniformly at C/m which has a radiua of 'a'. (AU-May/June 2019)
19. Given that D = (5r2 / 4) ar in spherical co-ordinates. Verify divergence for the volume enclosed between r=1 and r=2. (AU-May/June 2019)
20. Point charges 5 nC and -2 nC are located at (2,0,4) and (-3,0,5) respectively. (i) Determine the force on a 1 nC point charge located at (1, -3, 7). (ii) Determine the electric field intensity at (1,-3,7). (AU-Nov/Dec 2018)
21. Find the divergence and curl of the following function: $\bar{A} = 2xy\bar{a}_x + x^2\bar{a}_y + z^3\bar{a}_z$ (NOV/DEC-21)(NOV/DEC-20)
22. Determine the divergence of the vector field $\bar{P} = x^2yz\bar{a}_x + \text{xz}\bar{a}_z$ **(NOV/DEC 2023)**
23. Given the two points A(x=5,y=7,z=3) and B(r=6,)
24. Express the field $\bar{E} = \frac{A}{r^2}\overline{a_r}$ in rectangular components and cylindrical components. (NOV/DEC-20)

25. Three point charges each 10nC are placed in free space at the points (1, 0, 0),(–1,0, 0) and (0, –1, 0) m respectively. Determine the force on a point charge of 30nC located at (0, 0, 1) m. (NOV/DEC-20)

26. Verify that vector $\bar{A} = yz\bar{a}_x + zx\bar{a}_y + xy\bar{a}_z$ is irrotational and solenoidal (NOV/DEC-21)

27. Calculate the field intensity at a point on a sphere of radius 3 m, if a positive charge of 2nC is placed at the origin of the sphere. (NOV/DEC-21)

28. Show that the divergence of flux density due to point charge and uniform line charge is zero. (NOV/DEC-21)

29. A positive charge 0f $3x10^{-3}$C located at P_1(3,-2,-4)m. find (i) vector force on negative charge (ii) Magnitude of force on charge at P_1. **(NOV/DEC 2022)**

30. Find the electric field intensity at a point P located at (0,0,h)m due to charge of surface charge density σ C/m^2 uniformly distributed over the circular disc r≤a, z=0 m and correlate your result by applying gauss's law. **(NOV/DEC 2022)**

31. Convert the points P(1,3,5), T(0,-4,3) and S(-4,-3,-10) from Cartesian to cylindrical and spherical coordinate system. Then transform the vector $\overline{Q} = \frac{\sqrt{x^2+y^2}}{x^2+y^2+z^2}\vec{a}_x - \frac{yz}{x^2+y^2+z^2}\vec{a}_y$ and evaluate Q and T in all the coordinates. **(NOV/DEC 2022)**

32. Calculate the electric field due to infinite line charge with charge density ρL. **(APR/MAY 2023)**

33. Derive the potential due to Line charge, Surface charge, Volume charge. **(APR/MAY 2023)**

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

1. Define electric potential and potential difference. (AU-Nov/Dec 2013) (AU-May/June 2010) (AU-Nov/Dec 2012)
2. State the properties of electric flux lines. (AU-Nov/Dec 2014) (AU-May/June 2018)
3. What is the electric field intensity at a distance of 20 cm from a charge of 2 μC in vacuum. (AU-Nov/Dec 2015)
4. Find the electric field intensity in free space if D = 30 az C / m2. (AU-May/June 2015)
5. Find the magnitude of D for a dielectric material in which E = 0.15 MV/m and εr = 5.25 (AU-Nov/Dec 2016)
6. The electric potential near the origin of a system of co-ordinates is V = 5x2 + 8 y2 + 10 z2. Find the electric field at (1,2,3) (AU-May/June 2017)
7. What is a conservative field? (AU-May/June 2017) (AU-Nov/Dec 2011)
8. Define dipole moment.
9. State Poisson's and Laplace's Equation. Nov/Dec 2021 **(NOV/DEC 2023)**
10. Relate electric field intensity and electric flux density**. (NOV/DEC 2023)**
11. Give the significant physical differences between Poisson's and Laplace's equations. (AU-Nov/Dec 2014)
12. Write Poisson's equation in cylindrical coordinates. (AU-May/June 2016)
13. State the electrostatic boundary conditions at the interface between two dielectrics.(AU-May/June 2018)
14. What is a capacitor and capacitance? (AU-May/June 2016)
15. Find the capacitance of an isolated spherical shell of radius σ. (AU-Nov/Dec 2016)
16. Calculate the capacitance per Km between a pair of parallel wires each of diameter 1 cm at a spacing of 50 cms. (AU-Nov/Dec 2015)
17. Calculate the capacitance of a parallel plate capacitor having an electrode area of 100 cm2. The distance between the electrodes is 4 mm and the di-electric used has a permittivity of 3.5. The applied potential is 100 V. (AU-May/June 2014)

18. A parallel plate capacitor has a charge of 10-3 C on each plate while the potential difference between the plates is 1000V. Calculate the value of capacitance. (AU Nov/Dec 2012)

19. Why the direction of electric field is always normal to equipotential surface? (AU-Nov/Dec 2018)

20. Evaluate the capacitance of a single isolated sphere of 1.5 m diameter in free space. (AU-Nov/Dec 2018)

21. A point charge Q=0.4nC is located at the origin. Obtain the absolute potential at A(2,2,5) (Nov/Dec 2020)

22. Find the polarization in dielectric material with $\in r = 2.8$ if $D = 3\times10–7C/m2$. (Nov/Dec 2020)

23. Why water has much greater dielectric constant than mica? (Nov/Dec 2021)

24. Define potential difference with equation. **(APR/MAY 2023)**

25. Formulate the total equation capacitance of two capacitor connected in series. **(APR/MAY 2023)**

26. State Poisson's equation and Laplace equations. **(NOV/DEC 2022)**

27. If the electric field intensity is given by $E= (Xu_x+Yu_y+Zu_z)$ volts/m, find the potential difference between X(2,0,0) and Y(1,2,3). **(NOV/DEC 2022)**

PART-B

1. Explain the potential at a point in an electric field. Derive the electric field intensity at any point in a field due to a point charge. (AU-May/June 2016)

2. Derive the electric potential due to an uniformly charged infinite line with uniform charge distribution. (AU-May/June 2017)

3. Calculate the potential at a point P (0,0)m due to point charges Q1 and Q2. Q1 = 10-12 C is located at (0,5,0)m and Q2 = -10-11 C is located at (-0,5,0) m. (AU-May/June 2016)

4. A positive charge 100 x 10-12 C is located in air at x = 0 & y=0.01m and another such charge at x=0, y= - 0.1 m. What is the magnitude and direction of E? (AU-May/June 2015)

5. Point charges 1 mC and -2 mC are located at (3, 2, -1) and (-1, -1, 4) respectively. Calculate the electric force on a 10 nC charge located at (0,3,1) and the electric field intensity at that point. (AU-Nov/Dec 2012)

6. Determine the electric field intensity at P (-0.2, 0, -2.3) due to a point charge of 5nC at Q (0.2, 0.1, -2.5) in air. All dimensions are in meters. (AU-May/June 2010)

7. 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. (AU-May/June 2018)

8. Obtain the electric potential due to electric dipole. (AU-May/June 2017)

9. Derive an expression for polarization 'P' (AU-Nov/Dec 2015)

10. Explain briefly the polarization in dielectrics. (AU-May/June 2018)

11. Write Laplace's equation in cartesion co-ordinates. And obtain the solution when V is function of x only for the boundary condition V=V1 at x = x1 and V=V2 at x=x2. (AU-May/June 2016)

12. Define Laplace and Poisson's equation. (AU-May/June 2016) (AU-Nov/Dec 2016) (AU-May/June 2018) (AU-Nov/Dec 2018)

13. Derive the electrostatic boundary conditions. (AU-May/June 2017) (AU-Nov/Dec 2015)

14. At an interface separating dielectric 1 ($\varepsilon r1$) and dielectric 2 $\varepsilon r2$). Show that the tangential component of E is continuous across the boundary, whereas the normal component of E is discontinuous at the boundary. (AU-Nov/Dec 2014)

15. Find the capacitance between two parallel conductors. The radius of conductor is 'r' separated by a distance 'd' mts. Both wire are carrying the current in opposite direction.

16. At an interface separating dielectric 1 ($\varepsilon r1$) and dielectric 2 ($\varepsilon r2$). Show that the tangential component of E is continuous across the boundary, whereas the normal component of E is discontinuous at the boundary. (AU-May/June 2014) (AU-Nov/Dec 2018)

17. State and derive electric boundary conditions for a dielectric to dielectric medium and a conductor to dielectric medium. (AU-Nov/Dec 2013) (AU-May/June 2010)

18. Develop an expression for the capacitance of parallel plate capacitor having two different dielectric media. (AU-May/June 2016) (AU-May/June 2017) (AU-Nov/Dec 2013) (AU-May/June 2019.

19. Obtain an expression for the capacitance of a parallel plate capacitor with two dielectrics of relative permittivity $\varepsilon 1$ and $\varepsilon 2$ respectively interposed between the plates. (AU-May/June 2015)

20. Derive an expression for capacitance of concentric spheres. (AU-Nov/Dec 2015)

21. Derive the expressions for energy and energy density in static electric fields. (AU-Nov/Dec 2015) (AU-Nov/Dec 2013) (AU-May/June 2010) (AU-Nov/Dec 2012)

22. Derive the expression for capacitance of co-axial capacitor with necessary diagram. (AU-May/June 2019)

23. Explain law of conservation of charge. (AU-May/June 2019)

24. Define the following : (AU-Nov/Dec 2018)

(a) Electric potential and Potential difference.

(b) Uniform and non-uniform fields with examples.

(c) Dielectric polarization and Dielectric constant.

(d) Capacitance and expression for energy stored in the capacitor.

25. A total charge of 10–8C is distributed uniformly along a ring of radius 5 m. Calculate the potential on the axis of the ring at a point 5 m from the centre of the ring. If the same charge is uniformly distributed on the disc of 5 m radius, what will be the potential on its axis at 5 m from the centre ? (NOV/DEC-20)

26. Derive the Boundary conditions between conductor and free space of electric field intensity and electric flux density. (NOV/DEC-20)

27. A total charge of 10–8 C is distributed uniformly along a ring of radius 5 m. Calculate the potential on the axis of the ring at a point 5 m from the centre of the ring. If the same charge is uniformly distributed on a disc of 5 m radius, what will be the potential on its axis at 5 m from the centre? (NOV/DEC-21)

28. Find the capacitance of (i) Co-Axial Cable (ii) Spherical Capacitor. (NOV/DEC-21)

29. A total charge of 25nC is distributed around a circular ring of radius 2.5m with its center located at the origin and lying in XY plane. Find the potential at (0,0,5)m. **(NOV/DEC 2022)**

30. Four equal point charges 100μC each are located at the corners of a square of 10cm side in XY plane. Determine the value of fifth charge, which when placed at center of the square. Keep all four equal charges at their respective equilibrium position. The medium is free space. **(NOV/DEC 2022)**

31. Deduce the expression for the capacitance of parallel plate capacitor having two dielectric media and the capacitor of type specified about as the following details A=1 t_1=0.008, t_2=0.003, $\varepsilon_1 = 6\ \varepsilon_0, \varepsilon_2 = \varepsilon_0$. Calculate the capacitance at the system. If voltage of 6000 volt is applied across the capacitor determine the potential gradient in two dielectrics. **(NOV/DEC 2022)**

32. Derive the boundary condition for electric fields, between conductor and free space. **(APR/MAY 2023)**

33. Applying stokes theorem, derive the continuity equation of current. **(APR/MAY 2023)**

34. Derive the capacitance of a coaxial cable. **(APR/MAY 2023)**

35. Derive the capacitance of a spherical capacitor. **(APR/MAY 2023)**

36. If $V = \left[2x^2y + 20z - \frac{4}{x^2+y^2}\right]$ volts. Evaluate $\vec{E}$ and $\vec{D}$ at point $(6, -2.5, 3)$ **(APR/MAY 2023)**

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

1. Define Biot-Savart's law. (AU-May/Jun 2017) **(NOV/DEC 2023)**
2. State Ampere Circuital law. (AU-Nov/Dec 2016) **(NOV/DEC 2023)**
3. What is the point form of Ampere's circuital law? (AU-Nov/Dec 2011)
4. Give the force on a current element. (AU-Nov/Dec 2018
5. What is Lorentz law of force? (AU-Nov/Dec 2013)
6. What is the practical significance of Lorentz' force? (AU-Nov/Dec 2015) (AU-May/June 2015)
7. A conductor 4m long lies along the y axis with the current of 10 A in ay direction, if the field is B = 0.05ax Tesla, Calculate the force on the conductor. (AU-Nov/Dec 2016)
8. What is the total force acing on a moving charge, Q in the presence of both electric and magnetic fields. (AU-May/Jun 2018)
9. Find a force of interaction between two charges 4 x 10-3 and 6 x 10-5 spaced 10 cm apart in kerosene ($\varepsilon r = 2.0$)
10. Find the maximum torque on an 100 turns rectangular coil of 0.2m by 0.3m, carrying current of 2 A in the field of flux density 5 Tesla. (Wb/m2)
11. Write the expression for magnetic field 'H' at the centre of circular coil carrying a current of I amperes. The radius of the coil is 'a' m. (AU-Nov/Dec 2012)
12. Determine the value of magnetic field intensity at the centre of a circular loop carrying a current of 10A. The radius of the loop is 2m. (AU-Nov/Dec 2014)
13. What is the maximum torque on a square loop of 100 turns in a field of flux density 'B' tesla. The loop has 10 cm side and carries a current of 3 A. What is the magnetic moment of the loop. (AU-May/Jun 2019)
14. Write down the magnetic boundary conditions. (AU-Nov/Dec 2013) (AU-May/Jun 2016) (Nov/Dec 2021)
15. Compare magnetic scalar potential and magnetic vector potential. (AU-May/Jun 2018)

16. Distinguish scalar and vector magnetic potential. (AU-Nov/Dec 2011) (AU-Nov/Dec 2014) (AU-May/Jun 2017)

17. What is the mutual inductance of the two inductively coupled coils with self-inductance of 25mH and 100 mH.? (AU-Nov/Dec 2015)

18. Write down the steps to calculate different from conduction current. (AU-Nov/Dec 2018)

19. Write the expression for the inductance per unit length of a long solenoid of N turns and having a length 'l' mts carrying a current of I amperes. (AU-May/Jun 2014)

20. State the two conditions in choosing the closed amperian path as in gauss's law. (AU-May/Jun 2019)

21. What is energy density in magnetic field and write its expression. (Nov/Dec 2020)

22. Write the Laplace's equation for scalar magnetic potential. (Nov/Dec 2020)

23. State gauss law for magnetic field. Nov/Dec 2021

24. List the difference between scalar and vector magnetic potential. **(APR/MAY 2023)**

25. State ampere's circuital law. **(APR/MAY 2023)**

26. State the boundary conditions between two magnetic materials. **(NOV/DEC 2022)**

27. Given the magnetic vector potential $A=(\sin 2\varphi)a_{\varphi}$ in cylindrical co-ordinates. Find the flux density at $(2,\pi/4,0)$. **(NOV/DEC 2022)**

PART – B

1. Deduce the point form of Ampere's Circuital law. (AU-May/Jun 2016). (AU-May/Jun 2017)

2. State and explain Biot-Savart's law. (AU-May/Jun 2010) (AU-Nov/Dec 2013)

3. Derive Biot-Savart's law and Ampere's law using the concept of magnetic vector potential. (AU-Nov/Dec 2012

4. Obtain an expression for magnetic flux density and magnetic field intensity at any point due to a finite length conductor. (Using Biot-Savart's Law) (AU-May/Jun 2015) (AU-May/Jun 2017) (AU-Nov/Dec 2018)

5. Develop an expression for the magnetic field intensity at any point on the line through the centre at a diameter 'h' m from the centre and perpendicular to the plane of a circular loop of radius 'a' m and carrying a current I amperes in the anti-clockwise direction. (AU-May/Jun 2016)

6. By means of Biot-Savart's law, derive an expression for the magnetic field intensity at any point on the line through the centre at a distance 'h' from the centre and penpendicular to the plane of a circular loop of radius 'ρ' and carrying current 'I'. (AU-May/Jun 2018)

7. Obtain an expression for magnetic flux density and magnetic field intensity at any point along the axis of a circular coil. (AU-Nov/Dec 2015)
8. Derive the expression Ampere's circuital low and show that the field strength at the end of a long solenoid is one half of that at the centre. (AU-Nov/Dec 2013)
9. Develop an expression for magnetic field intensity both inside and outside a solid cylindrical conductor of radius 'a' carrying a current 'I' with uniform density, and sketch the variation of field intensity as a function of distance from the conductor axis. (AU-Nov/Dec 2014) (AU-Nov/Dec 2016)
10. Derive the expression for the magnetic field intensity inside and outside a co-axial conductor of inner radius'a', outer radius'b', and carrying a current of 'I' amperes in the inner and outer conductors. (AU-May/Jun 2014)
11. Find the magnetic field intensity at point P (1.5, 2, 3) caused by a current filament of 24 ampers in the Az direction on the z axis and extending from z=0 to z=6. (AU-May/Jun 2016)
12. Derive the expression for magnetic field intensity H at the centre of a circular wire carrying current 'I' in the counter clock wise direction. Assume wire is in XY plane and radius is 'a' (AU-May/June 2019)
13. Derive an expression for the force between two long straight parallel current carrying conductor. (AU-May/Jun 2010) (AU-Nov/Dec 2013)
14. Determine the torque on a rectangular loop (axb) m carrying current I placed in a uniform magnetic field. (AU-May/Jun 2016)
15. Derive an expression for torque in a rectangular loop which is carrying a current of 'I' amperes and is situated in a uniform magnetic field 'B' Wb/m2. (AU-Nov/Dec 2011)
16. What is the maximum torque on a square loop of 1000 turns in a field of uniform flux density of 1 Tesla? The loop has 10 cm sides and carries a current of 3 A. What is the magnetic moment of the loop? (AU-May/Jun 2018)
17. State and prove magnetic boundary conditions. (AU-May/Jun 2015)
18. Derive the boundary conditions to explain the behavior of magnetic field at the interface of two magnetic media. (AU-Nov/Dec 2011)
19. Derive an expression for the magnetic vector potential in the cases of an infinitely long, straight, conductor in free space. (AU-May/Jun 2014) (AU-Nov/Dec 2016)
20. Distinguish scalar and vector magnetic potential. (AU-Nov/Dec 2015)

21. Prove that scalar magnetic potential is a multivalued function of φ, the given co-axial line conductor, in the region $a < \rho < b$ (AU-May/June 2019)

22. Derive the expressins for Biot-savart law and Ampere's circuital law from the concept of magnetic vector potential and also derive poisson's equation for magneto static field. (AU-Nov/Dec 2018)

23. Obtain an expression for inductance and torque on a long solenoid coil. (AU-May/Jun 2015)

24. An iron ring 0.2 m in diameter and 10 cm2 sectional area of the core, is uniformly wound with 250 turns of wire. The wire carries a current of 4 A. The relative permeability of iron is 500. Determine the value of self-inductance and the stored energy. (AU-May/Jun 2018)

25. Describe the classification of magnetic materials and draw a typical magnetization curve. (AU-Nov/Dec 2014)

26. Derive the expression for coefficient of coupling in terms of mutual and self-inductance of the coils. (AU-May/Jun 2010).

27. What is Magnetization? Explain the classification of magnetic materials. (AU-May/Jun 2018)

28. An iron ring with a cross sectional area of 8 cm2 and a mean circumference of 120 cm is wound with 480 turns of wire carrying a current of 2A. The relative permeability of the ring is 1250. Calculate the flux established in the ring. (AU-May/Jun 2010)

29. Determine the mutual inductance between an infinity long straight conductor along Y axis and a rectangular single turn coil situated in XY plane with its corner located at point (a,0),)a+d , 0), (a, h), (a, d+h). (AU-May/June 2018)

30. Find the magnetic field intensity H due to straight Conductor of finite length carrying current of 'I' amperes. (NOV/DEC-20)

31. Find out the magnetic vector potential in the vicinity of a very long straight wire carrying 'I' amperes. Hence find the magnetic flux density and magnetic field strength. (NOV/DEC-20)

32. Find Magnetic field intensity H , due to a straight conductor of finite length. (NOV/DEC-21)

33. Write about the following:

i. Laplace's Equation for scalar magnetic potential,

ii. Vector Magnetic Potential,

iii. Poisson's equation for magnetic field. (NOV/DEC-21)

34. Two long straight parallel wires in air 2m apart carry current I_1 and I_2 in the same direction. The magnetic field at midway is 7.5 AT/m.if the force on each wire per unit length is 2.5×10^{-4} N, estimate the currents I_1 and I_2. **(NOV/DEC 2022)**

35. State Biot-Savart Law. Deduce the expression for the magnetic field at a point on the axis of a current carrying loop is 'R' distant 'X' from the centre. **(NOV/DEC 2022)**

36. Find the total power passing through a circular disk of radius 5cm in free space, given $\vec{H} = 0.2e^{-j\beta x}\vec{a}_z$ **(APR/MAY 2023)**

37. Given electric field intensity in fee space, $\vec{E} = \frac{50}{\rho}\cos(10^8 t - 10z)\,\vec{a}_\rho V/m$. Find the magnetic flux density. **(APR/MAY 2023)**

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

1. State Ohm's law for magnetic circuits. (AU-Nov/Dec 2014)

2. Give the two important equations that provide a connection between field and circuit theory. (AU-Nov/Dec 2014)

3. Compare Field theory and Circuit theory. (AU-Nov/Dec 2011) (AU-Nov/Dec 2018)

4. Distinguish between transformer emf and motional emf. (AU-Nov/Dec 2013) (AU-May/June 2017) (AU-May/June 2015) (AU-Nov/Dec 2009)

5. What is displacement current and conduction current. (AU-Nov/Dec 2013) (AU-May/June 2010) (AU-May/June 2016) (AU-May/June 2012)

6. What is the significance of displacement current. (AU-Nov/Dec 2012) Nov/Dec 2021

7. Distinguish between conduction and displacement currents. (AU-May/June 2018) (AU-Nov/Dec 2018)

8. What is displacement current density? (AU-May/June 2010)

9. A parallel plate capacitor has an electrode area of 10cm2. The separation between the plates is 5mm. A voltage of 10 sin 100 Πt is applied across its plates. Calculate its displacement current. Assume air dielectric. (AU-May/June 2016) (AU-Nov/Dec 2015)

10. Define Reluctance and Permeability. (AU-May/June 2018) (AU-Nov/Dec 2016)

11. State faraday's law of electromagnetic induction. (AU-May/June 2016) (AU-May/June 2011)

12. State Lenz law. (AU-May/June 2012)

13. Write modified form of Ampere's circular law. (AU-May/June 2019)

14. A conductor of 1m length is moved with a velocity of 100 m/sec perpendicular to a field of 1 Tesla. What is the value of emf induced.? (AU-Nov/Dec 2014) (AU-May/June 2017).

15. A straight conductor of length 40 cm moves perpendicularly to its axis at a velocity of 50 m/sec in a uniform magnetic field of flux density 1.2 tesla. Evaluate the EMF induced in the conductor if the direction of motion is normal to the field. (AU-May/June 2019)

16. State maxwell's third equation. Nov/Dec 2020

17. State point form of ohms law. Nov/Dec 2020

18. State the principle of super position of fields. Nov/Dec 2021

19. Write the faraday's law equation for a moving charge in a constant magnetic field. **(APR/MAY 2023)**

20. Write down the expression for electromotive force induced in the moving loop in static field B. **(APR/MAY 2023)**

21. Determine the maximum torque on 80 turn rectangular coil of 0.25m x 0.4m, carrying a current of 10A in a field of 0.8 Tesla. **(NOV/DEC 2022)**

22. State faradays law. **(NOV/DEC 2022) (NOV/DEC 2023)**

23. What is mutual inductance of coils? **(NOV/DEC 2023)**

PART – B

1. Derive Maxwell's equation from Faraday's law and Ampere's law in Integral form, Differential form and Vector form. (AU-May/June 2014) (AU-May/June 2010) (AU-Nov/Dec 2012) (AU-May/June 2017) (AU-Nov/Dec 2018)

2. Derive the Maxwell's equations in both point and integral forms from Ampere's law and Faraday's law of electromagnetic induction. (AU-Nov/Dec 2014) (AU-Nov/Dec 2011) (AU-Nov/Dec 2013)

3. Derive the set of Maxwell's equations with solutions in integral form from fundamental laws for a good conductor. (AU-May/June 2015)

4. Derive Maxwell's equation in both point and integral form for conducting medium and free space. (AU-Nov/Dec 2016) (AU-Nov/Dec 2015)

5. Explain in detail about the difference between conduction and displacement current. (AU-Nov/Dec 2015)) (AU-May/June 2015)

6. State Faraday's law of electromagnetic induction. (AU-May/June 2015)

7. Write a technical note on "Transformer EMF and Motional EMF". (AU-May/June 2018)

8. Compare Field theory and Circuit theory and thus obtain an expression for ohm's law (AU-May/June 2014) (AU-Nov/Dec 2012) (AU-May/June 2018) (AU-May/June 2017)) (AU-May/June 2015)

9. A Parallel plate capacitor with plate area of 5 cm2 and plate separation of 3mm has a voltage of 50 sin100Πt V applied to its plates. Calculate the displacement current assuming $\varepsilon=2\varepsilon_0$ (AU-Nov/Dec 2014) (AU-Nov/Dec 2018)

10. The magnetic circuit of an iron ring with mean radius of 10cm has a uniform cross-section of 10-3 m2. The ring is wound with two coils. If the circuit is energized by a current i(t) = 3

sin100 ΠIt amps in the first coil with 200 turns, find the induced emf in the second coil with 100 turns. Assume that μ= 500μ0 (AU-Nov/Dec 2014)

11. Explain how the circuit equation for a series RLC circuit is derived from the field relations. (AU-Nov/Dec 2014) (AU-May/June 2010) (AU-Nov/Dec 2018)

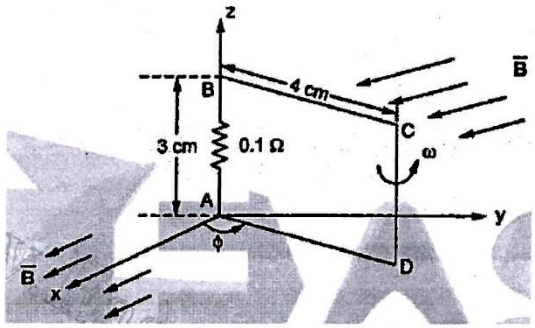
12. Show that the displacement current in the di electric of a parallel plate capacitor is equal to the conduction current in the leads. (AU-May/June 2019) –

13. If the magnetic field H □ [3xcos□ □ 6ysin□]az A/m, find current density J if fields are invariant with time. (NOV/DEC-20)

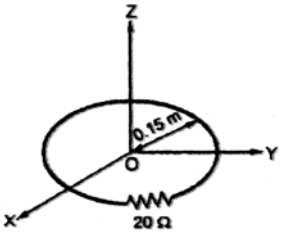
14. An area of 0.65m2 in the plane z=0 encloses a filamentary conductor. Find the induced voltage if,

$\bar{B} = 0.05cos10^3t\left(\frac{\overline{\overline{a_y+a_z}}}{\sqrt{2}}\right)$tesla (NOV/DEC-20)

15. A loop shown in the figure is inside a Uniform magnetic field B = 50 ax mWb/m2. If side DC of the loop cuts flux lines at frequency of 50 Hz and the loop lies in the y-z plane at t = 0, find
i. The induced e.m.f. at t = 1ms
The induced current at t = 3 ms. (NOV/DEC-20)



16. The circular loop conductor having a radius of 0.15 m is placed in X-Y plane. This loop consists of a resistance of 20 □ as shown in the fig. if the magnetic flux density is B □ 0.5□sin 103 □tazT . Find current flowing through this loop. (NOV/DEC-21)



17. Two parallel conducting plates of area 0.05 m^2 are separated by 2 mm of a lossy dielectric for which ε_r = 8.3 and σ= 8x10^{-4} S/m. Given an applied voltage v = 10 sin10^7t V. Find total rms current. (NOV/DEC-21)

18. Derive the Maxwell's equation both in integral and point forms. **(NOV/DEC 2022) (APR/MAY 2023)**

19. Examine whether the following fields satisfy Maxwell's equations or not.

$E = [E_m \sin x \sin t\, a_y]$ and $H = [(\frac{E_m}{\mu 0}) \cos x \cos t\, a_z]$ **(NOV/DEC 2022)**

20. Derive the displacement current from circuital analysis and from Ampere circuital law. **(APR/MAY 2023)**

21. In a material for which $\sigma = 5.0 \frac{s}{m}$ and $\varepsilon_r = 1$ and $\vec{E} = 250\sin 10^{10} t(\frac{V}{m})$. Find the condition and displacement current densities, and the frequency at which both have equal magnitudes. **(APR/MAY 2023)**

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

1. Define Wave.

2. What is the wavelength (λ) and frequency (f or ω) of a wave propagation in free space when β = 2?) (AU-May/June 2015)

3. Compare the equi-potential plots of uniform and non-uniform fields. (AU-May/June 2015)

4. Find the velocity of a plane wave in a lossless medium having a relative permittivity 2 and relative permeability of Unity. (AU-May/June 2017) (AU-May/June 2010)

5. Define propagation constant.

6. What is practical significance of skin depth? (Mention the practical importance of 'Skin depth'). (AU-Nov/Dec 2015) (AU-May/June 2017) (AU-May/June 2016) (AU-May/June 2018) (AU-May/June 2010)

7. Define Skin depth or Depth of Penetration. **(NOV/DEC 2023)**

8. What is group velocity? **(NOV/DEC 2023)**

9. Calculate the characteristics impedance of free space. (AU-Nov/Dec 2012) (AU-Nov/Dec 2018)

10. The capacitance and inductance of an overhead transmission line are 0.0075 μF/km and 0.8 μH/km respectively. Determine the characteristic impedance of the line. (AU-Nov/Dec 2014)

11. State the poynting theorem and Poynting vector. (AU-Nov/Dec 2013) (AU-May/June 2016) (AU-Nov/Dec 2010) (AU-May/June 2011) (AU-Nov/Dec 2018)

12. What are the standing wave ratio. (AU-Nov/Dec 2011) (AU-May/June 2014) (AU-Nov/Dec 2016) (AU-May/June 2018) (AU-Nov/Dec 2012) (AU-May/June 2014)

13. State the properties of uniform plane wave. (AU-Nov/Dec 2016) (AU-Nov/Dec 2013) (AU-Nov/Dec 2010)

14. Define Polarization.

15. If a plane wave is incident normally from medium 1 to medium 2, write the reflection and transmission coefficients. (AU-Nov/Dec 2014)

16. Write one dimensional wave equation. (AU-May/June 2019)

17. What is transverse electromagnetic wave (AU-May/June 2019)

18. Mention the properties of uniform plane wave. Nov/Dec 2020 Nov/Dec 2021

19. Define intrinsic impedance or characteristic impedance of a medium . Nov/Dec 2020 Nov/Dec 2021

20. List the properties of uniform plane wave. **(APR/MAY 2023)**

21. Outline the term 'skin depth'. **(APR/MAY 2023)**

22. State pointing vector and write its significance. **(NOV/DEC 2022)**

23. Define intrinsic impedance and estimate its value for free space. **(NOV/DEC 2022)**

PART – B

1. Derive the relationship between electric field and magnetic field. Derive the wave equation for magnetic field in phasor form. (AU-Nov/Dec 2013)

2. Obtain the electromagnetic wave equation for the free space in terms of electric field and explain the wave propagation with necessary parameters. (AU-Nov/Dec 2015) (AU-Nov/Dec 2012) (AU-May/June 2019)

3. Derive the expression for electromagnetic wave equation for conducting and perfect dielectric medium. (AU-Nov/Dec 2016)

4. Derive wave equations in phasor form. (AU-May/June 2010)

5. Derive the relationship between electric field and magnetic field. Derive the wave equation for magnetic field in phasor form. (AU-Nov/Dec 2013)

6. Describe the concept of electromagnetic wave propagation in linear, isotropic, homogeneous, lossy dielectric medium. (AU-Nov/Dec 2014)

7. Obtain an expression for electromagnetic wave propagation in lossy dielectrics. (AU-May/June 2015)

8. Deduce the equation of the propagation of the plane electromagnetic waves in free space. (AU-May/June 2017)

9. Write short notes on the following : a) Plane waves in loss dielectrics b) Plane waves in free space c) Plane waves in good conductors.

10. Find the velocity of a plane wave in loss-less medium having $\varepsilon r = 5$ and $\mu r = 1$. (AU-Nov/Dec 2014)

11. Analyze the following cases: (a) Plane waves in lossless dielectrics, (b) Plane waves in free space, (c) Plane waves in good conductors. (AU-May/June 2019)

12. State Poynting theorem and thus obtain an expression for instantaneous power density vector associated with electromagnetic field. (AU-May/June 2015) (AU-Nov/Dec 2011) . (AU-Nov/Dec 2015) (AU-May/June 2017)

13. Derive the pointing theorem and state its significance. (AU-May/June 2018) (AU-Nov/Dec 2012)

14. State and prove pointing theorem and derive the expression for average power. (AU-May/June 2010)

15. Show that the total power flow along a co-axial cable will be given by the surface integration of the Poynting vector over any closed surface. (AU-Nov/Dec 2014)

16. Define Brewster angle and derive its expression. (AU-Nov/Dec 2013)

17. Describe briefly about Reflection coefficient and Transmission coefficient. (AU-Nov/Dec 2012)

18. A plane wave travelling in air is normally incident on a block of paraffin with $\varepsilon r = 2.2$. Find the reflection coefficient. (AU-May/June 2015) (AU-Nov/Dec 2015)

19. Derive and summarize the equations which describe propagation of uniform plane waves in free space. (NOV/DEC-20)

20. Derive and summarize the equations which describe propagation of uniform plane waves in lossy dielectric medium. (NOV/DEC-20)

21. Derive a wave equation for non dissipative medium making use of Maxwell equations and field vectors E and H. (NOV/DEC-21)

22. The electric field of a plane electromagnetic wave is given $E(z,t) = E_0 Cos(kz-\omega t)\hat{i}$. Find the following quantities: (i) The direction of wave propagation. (ii) The corresponding magnetic field B . (NOV/DEC-21)

23. Derive the propagation constant for waves in lossless dielectric materials. **(NOV/DEC 2022)**

24. Develop the wave equation from Maxwell's equation for lossy dielectric materials. **(NOV/DEC 2022)**

25. Illustrate and derive pointing vector in integral and differential form. **(APR/MAY 2023)**

26. Illustrate the propagation of uniform plane waves in two different Medias with$(\varepsilon_1, \mu_1, \sigma_1)$ and $(\varepsilon_2, \mu_2, \sigma_2)$. Derive reflection coefficient and transmission coefficient of thw wave, from the field components. **(APR/MAY 2023)**