EC 8451 ELECTROMAGNETIC FIELDS

UNIT-1: INTRODUCTION

Part –A (2- marks)

1. Define Divergence. (May 2010)
2. State Coulomb's law. (Nov 2009/May 2008)
3. Define electric field intensity at a point. (Dec 2011)
4. What is an equipotential surface? (May 2011)
5. State Gauss's Law.(May 2008)
6. State the applications of Gauss's law. (May 2007)
7. State Divergence Theorem.(Dec2010/May 2009)
8. State Stoke Theorem. (April/may 2004, Nov/Dec 2007, 2009, April 2010).Give the meaning of Stoke's theorem. (Nov 2014)
9. Explain the term irrotational and solenoidal as applied to vector F.(Dec 2004)
10. Given two points in Cartesian coordinate system as A (3,-2, 1),B (-3,-3, 5).find distance from B to A. (Dec 2010)
11. Give the principles of superposition (Dec 2002,2004)
12. Mention any two sources of electromagnetic field.(May 2008)
13. A uniform surface charge of ρs=2 µc/m2 is situated at z=2 plane, what is the value of electric field intensity at P(1,1,1)?(June 2011)
14. Why Gauss's law cannot be applied to determine the electric field due to finite line charge?(Dec 2008)
15. Define potential (May 2004, 2010)
16. State the principle of superposition as applied to an electric potential of a point.(May 2004,2005)
17. State the nature of conservative field.(May 2005,Nov 2005)
18. Give the relation between electric field and potential.(May 2007,Dec 2007)
19. Define volume charge density.(May/June 2006)
20. What is the physical significance of the term "divergence of a vector field"?(May/June 2006)
21. Name 3 coordinate systems used in electromagnetic engineering?
22. How to represent a point in a Cartesian system?
23. What is separation of vector?
24. State Distance formula?
25. What are differential elements in Cartesian system?
26. What are the differential elements in cylindrical system?
27. What are the differential elements in spherical coordinate system?
28. Which are the surfaces used to define the cylindrical coordinate system?
29. State the relation between Cartesian and cylindrical coordinate system?
30. Show how a point p represented in a spherical coordinate system.
31. State the relationship between Cartesian and spherical system?
32. What is dot product?
33. State dot product properties.
34. What is called as cross product?
35. State cross product properties.
36. Give the application of dot products.
37. Give the application of cross product.
38. Define scalar triple product.
39. State scalar triple product properties.
40. Define vector triple product.
41. State vector triple product properties.
42. Convert Cartesian to cylindrical system.
43. Transform the Cartesian system into spherical system.
42. Transform the cylindrical system into Cartesian system.
43. Give the distance formula in coordinate system.
44. What are the types of integral related to electromagnetic theory?
45. Give the curl vector of the Cartesian system.
46. Give the curl vector of cylindrical coordinate system.
47. Give the curl vector if spherical coordinate system.
48. Given two points A (5, 4, 3) and (2, 3, 4).Find midpoint of AB.
49 What is a position vector?
50. Give the types of charge distribution.
51. Define point charge.
52. Define one coulomb.
53. Define Vector field?
54. Define constant of proportionality (K).
55. What are the various types of charge distribution? Give an example for each.

56. State the assumptions made while defining a Coulomb's law.
57. Define surface and volume charge density.
58. Define scaling of a vector?
59. What are co-planar vector?
60. What is an identical vector?
61. Define base vectors?
62. Define scalar field?
63. Define curl of a vector.
64. Define scalar product of vectors?
65. What is physical significance of curl of a vector field? (Dec 2013)
66. What is physical significance of divergence?
67. State the conditions for a field to be solenoidal.
68. State the conditions for a field to be irrotational.
69. Define scalar.
70. Define vector quantity.
71 .How to represent a vector?
72. What is a unit vector? What is its function while representing a vector?
73. Define electrostatic energy.
74. Define energy density. Write the expression for energy stored and energy density in a capacitor.
75. In XY plane Q1=100100 at (2,3)m,experiences a repulsive force of 7.5N because ofQ2 at(10.6).Find Q2. (May/June 2014)
76. Define Gradient. (May/June 2014)
77. A 15 nC point charge is at the origin in free space. Calculate v2 if point P1 is located at P1(-2,3,-1) and V=0 at (6,5,4). (Nov 2014)

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Part –B (16- marks)

1. Define divergence, gradient and curl in cylindrical and spherical coordinate system with mathematical expressions. **16 Marks (April/May 2004)**

2. Define divergence, gradient and curl in spherical coordinate system with mathematical expression. **9 Marks (Nov/Dec 2004)**

3. State and explain i) divergence theorem ii) stoke's theorem. **8 Marks (Nov/Dec 2008) (or)** State and Explain the fundamental theoremofdivergence and curl**. (May / June 2014)**

4. Explain the term irrotational and solenoidal as applied to vector. **4 Marks (Nov/Dec 2004)**

5. Write short note on 3 coordinate systems.**4 Marks (April/May 2004)**

6. Use spherical coordinate and integrate to find the area of the region $0 \leq \varphi \leq \alpha$ on the spherical shell of radius α. what is the area of $\alpha=2\pi$? **8Marks (Nov/Dec 2007)**

7. Determine the electric field intensity for an infinite line charge. **(April/May 2008,Nov 2006,Dec03,06,08,09,11)**
8. Determine the electric field intensity due to finite long straight conductor**. 8 Marks**
9. State and prove Gauss law**.** List the limitation of Gauss law **8 Marks (Nov/Dec 2006, May/June 2009, May/June 2013)**

10. Explain any two applications of gauss law. **8 Marks (Nov/Dec 2006)**

11. Explain the potential due to circular charged disc. **8 Marks (May 2008)**

12. Establish the relationship between potential and electric field.**8Marks (Nov/Dec 2007, May/June 2013)**

13. Obtain the electric field intensity of an infinitely long, straight line charge of a uniform charge density ρl in air.**16 Marks (Dec-2003, Nov 2006)**

14. A circular disc of radius 'a' is charged uniformly with a charge density of C/m^2.Find the electric field intensity at a point 'h' from the disc along its central axis. **16 Marks (Dec-04, May/dec-07, May-09, Apr-10)**

15. Derive the expression for potential due to electric dipole at a point on broad side position with neat sketch, also derive dipole moment.**16 Marks (May-03)**

16. Explain coulomb's law. three equal positive charges of 4×10^9 coulomb each are located at three corners of a square, side 20 cm .determine the electric field intensity at the vacant corner point of the square**.(May/June 2013)**

17. Derive the expression for E due to charges distributed uniformly on as infinite line**.(May/June 2013)**

18. Derive the expression for potential due to an electric dipole at any point P.also find electric field intensity at the same point.**(Decm10,May 12)**

19. Derive an expression for the electric field intensity at the point due to a uniformly charged sheet with density p,c/m^2**.(May/June 2013)**

20. Show by using Gauss's law:$D= \epsilon_0 E$ **(Dec 2003,May 2006)**

22. Find the force on .3m C at (1,2,3) m due to a second charge of -.1mC at (2,0,5)m in the free space**.(April 99)**

23. Two small diameter 10gm dielectric balls can slide freely on a vertical channel. each carry a negative charge of 1 µc.find the separation between the balls if the lower ball is restrained from the moving.**(May2004,2008)**

24. Two small identical conducting spheres have charges of 2 nc and -1nc respectively .when they are separated by 4 cm apart, find the magnitude of the force between them. If they are brought into contact and then again separated by 4cm, find the force between them**.(May 2000,2006)**

25.A point charge Q1=300 µc located at (1,-1,-3)m experience a force F1=8ax-8ay+4az(N) due to point charge at (3,-3,-2)m.find the charge Q2.**(May 2012).**

25. find the total electric field at the origin due to 10-8 C charge located P(0,4,4)m and -.5x 10-8 C charge at Q(4,0,2)m**.(May 2011)**

26. Determine the electric field intensity for an infinite line charge**.(May 03,07,09,11,Dec03,04,07,10,April2010)**

27. find the force on a point charge q located at(0,0,h)m due to charge of surface charge density ρsC/m2 uniformly distributed over the circular disc r≤a ,z=0m find electric field intensity at the same point**.(May 03,07,09,Dec 03,04,07,Aprl 10,Dec 10)**

28. What are the major sources of electromagnetic fields? **8 Marks**

29. Drive an expression for the electric field due to a straight and infinite uniformly Charged wire of length 'L' meters and with a charge density of +λ c/m at a Point P which lies along the perpendicular bisector of wire. **12Marks**

30. Define the potential difference and absolute potential. Give the Relation between potential and field intensity. **12 Marks**

31. Derive an expression for potential due to infinite uniformly charged line and also derive potential due to electric dipole. **16 Marks**

32. Find the magnetic field density at a point on the axis of a circular loop of a radius b that carries a current I .

33. 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. **8 Marks**

34. Given that potential V=10sinθcosΦ/r2 find the electric flux density D at (2, π/2,0).**8 Marks**

35. Check validity of the divergence theorem considering the field D=2xy ax +x2ay c/m2 and the rectangular parallelepiped formed by the planes x=0,x=1,y=0,y=2 &z=0,z=3. **12 Marks**

36. State and proof electric scalar potential and also derive relationship between Potential and electric field. **12 Marks**

37. Derive the expression for energy stored and energy density in the capacitor. (OR) Show that the energy stored in the capacitor is $C=1/2CV^2$. **(May2010, 2012)**

38. Three infinite uniform sheets of charge are located in free space as follows:3 nC/m^2at z=-4, 6 nC/m^2at z=1, -8 nC/m^2at z=4, Find E at points Pa(2,5,-5), Pb(4,2,-3), Pc(-1,-5,2) and Pd(-2,4,5).**(Nov 2014)**

39. Point charges of 50 nC each are located A(1,0,0), B(-1,0,0), C(0,1,0) and D(0,-1,0) in free space. Find the total force on the charge at A. **(Nov 2014)**

40. Two uniform line charges , 8 nC/m each are located at x=1, z=2 and at x=-1, y=2 in free space. If the potential at the origin is 100V find V at P(4,1,3) **(Nov 2014)**

UNIT – 2: ELECTROSTATICS
PART-A(2MARKS)

1. Writedownthe expressionforcapacitorofaparallelplatecapacitor.(May2008)
2. Define dielectric strength. (May 2006)
3. What is Polarization? (May 2011)
4. What is the energy stored in a capacitor? (May 2007)
5. State Lenz law. (May/June 2006)
6. State Uniqueness Theorem. ((May/June 2006)

7. State the applications of Poisson's equation and Laplace's equation. (May/June 2007)

8. What is polarization and state the mathematical equation and its unit?(May 04,05)
9. Define dielectric strength of a dielectric ad state its value for air? (May 10, Dec 06)
10. State the properties of dielectric materials.(May 07)
11. Why is the electrostatic potential continuous at a boundary?(Dec 03)

12. Calculate the energy stored in a 10 μF capacitor which has been charged to a voltage of 400V.(May 04)

13. Define boundary conditions for the conductor free space boundary in electrostatic.(May 03,04,Dec 05,may 2014)

14. Write the boundaryconditions atthe interface betweentwo perfect dielectrics.(May 05)

15. Determine the capacitance of a parallel plate capacitor having tin foil shets,25 cm square plates separated through a glass dielectric .5cm thick with relative permittivity 6.(Dec 10)

16. State Laplace's equation in Cartesian system.(May 03,06,12,Dec 09,11)

17. State Laplace equation in cylindrical form.(May 03,06,12,Dec 09,11)

18. State Laplace equation in Spherical form. .(May 03,06,12,Dec 09,11)

19. WritePoisson'sandLaplace'sequations.(Nov02,03,May06)

20.What areequipotentialsurfaces?

21. Whatis theeffectofpermittivityontheforcebetweentwocharges?

22. What are the significant physical differences between Poisson's and Laplace equations.

23. Howis electricenergystoredin a capacitor?

24. What are dielectrics?

25. What is a capacitor?

26. Define dielectricstrength.(or) Definerelativepermittivity.

27. What is Polarization of Dielectrics? (May 2011)

28. What is Boundary conditions means?

29. How is electric energy stored in a capacitor?

30.Name some dielectric materials.

31. What are the factors does the capacitance depends on?

32. What is meant by multiple dielectric capacitors?

33. What are the two situations of the boundary conditions based on nature of the media?

34. What meaning would you give to the capacitance of a single conductor?

PART-B (16 MARKS)

1. (i) Derive an expression for the capacitance of a spherical capacitor with conducting shells of radius'a'and'b'.

(ii) Obtaintheexpressionsfortheenergystoredand energydensityinacapacitor.

(May/June2009, May/June 2013)

2. (i) Derive the boundary relations at the boundary between a conductor and a dielectric.**(Nov/Dec2008)**

(ii) Parallel plate capacitor is of area $1m^2$and has a separation of 1mm. The space between the plates is filled with dielectric of Σn=25. If 1000V is applied, find the forcesqueezingthe plates together. **(April/May2008)**

3. (i) Three point charges 1, 2, 3 coulombs are situated in free space at the corners of an equilateral triangle of side 1m. Find the energystored in the system. **(April/May2008)**

4. (i) Derive an expression for the capacitance of a parallel plate capacitor with two dielectric media.

(ii) A parallel plate capacitor with aseparation of 1cm has 29kV applied, when air was the dielectric used. Assume that the dielectric strength of air as 39kV/cm. A thin piece of glass with εr =6.5 with a dielectric strength of 290kV/cm with thickness 0.2 cm is inserted. Find whetherglassorairwill break.**(Nov/Dec2007)**

5. (i) A parallel plate capacitor has a plate separation t. The capacitance with air only between the plates is C. When a slap of thickness't' and relative permittivity εr is placed on one oftheplates,thecapacitanceis C'. Showthat C'/C= εr t/(t'+εr (t-t')).**(Nov/Dec 2007)**

6. (i) A dielectric slab of flat surface with relative permittivity 4 is disposed with its surface normalto a uniform field with flux density $1.5C/m^2$. The slab occupies a volume of $0.08m^3$and is normallypolarized. Determine

(1) Thepolarizationintheslab and

(2) Thetotaldipolemoment oftheslab.

(ii) Capacitance of coaxial cable with two dielectrics ε_1 and ε_2. **(May/June2007)**

7. (i) Discussbrieflyabout natureof dielectricmaterials.(ii) Giventhepotentialfield, V=5 0 s i n r 2 V θ,in free space, determine whether V satisfies Laplace's equation.**(May/June2007)**

8. (i) Explain and derive the polarization of a dielectric material. **(Nov/Dec2006)**

Evalauate the capacitance of

(i) A spherical satellite 1.5m diameter in free space.

(ii) A co-axial cable1.5m longfilled with polyethylene(ε_r =2.26) withinnerconductorof radius0.6mm andinner radiusof outerconductor3.5mm.

(iii) An infinitely long conductor with 1.5 mm radius and suspended horizontally at a height of 15 mabovea conductingplaneand parallelto it inair. **(April/May2004)**

9. Deduce the expression for capacitance of two capacitors C1 and C2 in series and in parallel. **(Dec 2009)**

10. Derive the boundary condition of the normal and tangential components of electric field at the interface of two media with differential dielectrics.

(Dec 2008,04,May '13,16 mark)

11. Derive the capacitance of a parallel plate capacitor using Laplace's equation. **(May 2012)**

12. Derive the electrostatic boundary conditions at the interface between two dielectrics**. (May/June 2013)**

13. Derive an expression for the capacitance of a spherical capacitor with conducting shells of radius a and b**. (May/June 2013)**

14. In a cylindrical conductor of radius 2 mm, the current density varies with distance from the axis according to $J=10^3 e^{400r}$ A/m^3.fine the total current I**.(May/June 2013)**

15. State the difference between poisons equation and laplaces equation and its applications**.(Dec 10,05)**

16. Discuss briefly about nature of dielectric materials and its properties. **(May 04,05,06,07,10)**

18.A certain homogeneous slab of lossless dielectric material is characterized by electric susceptibility of .12 and carries a uniform electric flux density inside of 1.6 nC/m2.determine the value of polarization and electric field intensity.**(May 04)**

19. A dielectric free space interface has the equation 3x+2y+z=12 m the origin side of the interface has εn=3.0 and E1=2ax+5az V/m.find E2. (**Dec 05)**

20. If C1=100mF and C2=50 mF, calculate the joint capacitance an total energy stored with a steady applied potential difference of 1000v in each case.**(May 04)**

21. Explain about parallel plate capacitor. **(April 95, May 04, 06, 08, 10)**

22. A 4 mF capacitor is charged by connecting its across 100V/dc.the supply is disconnected and another un charged 2 mF capacitor is connected across it. if leakage charge is negligible, determine the potential between the plates. **(April 05)**

23. The capacitance of the condenser formed by the two parallel metal sheets, each 100cm2 in area separated by a dielectric 2mm thick is 2 x 10-4 µF.A potential of 20 Kv is applied to it. Find

a) electric flux

b) Potential gradient in kv/m

c) the relative permittivity of the material and

d) electric flux density. **(April 95, May 06)**

24. Derive poisons and Laplace's equation. **(Oct 02, Dec 02,03,05,07,08)**

25. Procedure for solving Laplace equation. **(June 03, May 06, 07, 11)**

26. Calculating capacitance using Laplace equation. (**May 03, 11, 12, Dec 08,09,10)**

27. Use Laplace equation to find the capacitance per unit length of a co axial cable of inner radius a m and outer radius b m. assume V=V0 at r =a and V=0 at r=b**.(Dec 09,16 mark)**

28. Determine whether or not the following potential fields satisfy the Laplace's equation.

a) V=x2-y2+z2 b)V=rcos c)V=rcos **(May 11)**

29. Solve the Laplace's e quation for the potential field in the homogenous

region between the tw o concentric conducting spheres with radius 'a' and 'b' where b>a V=0 at r = b and V =V0at r=a .find the capacitance between the two concentric spheres.

30. A cylindrical capacitor consists of an inner conductor of radius a and an outer conductor of radius b. The space between the conductors filled with a dielectric whose permittivity e, the length of the capacitor is L. Determine the capacitance

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

32. The capacitance of the conductor formed by the two parallel metals Sheets, each $100cm^2$, in area separated by a dielectric 2mm thick is, $2x10^{-10}$ micro farad .a potential of 20kv is applied to it .find

(i) Electric flux

(ii) Potential gradient in kV/m

(iii) The relative permittivity of materials

(iv) Electric flux density **(May / June 2012)**

33. Two concentric metal spherical shells of radii a and b are separated by weakly conducting material of conductivity σ If ther arwe maintained at a potential difference V What current flows from one to another What is the resistance between the shells?Find the resistance if b>>a.(**May 2014**)

34. Derive the expression for electrostatic energy density.(**Nov 2014**)

UNIT-3 MAGNETOSTATICS

PART-A (2 MARKS)

1. State Biot – Savarts law.(May 2010/ Dec 2010)
2. State Gauss law for magnetic fields.(Dec 2009)
3. Define magnetic flux density.(Dec2009, 2010)
4. Give the relation between magnetic flux density and magnetic field intensity.(May 209/ Dec 2008)

5. Give the Lorentz force equation. (Dec 2008)

6. Sate Ampere's law for a magnetic field. (May 2009)

7. What is the force between two current carrying conductors? (May 2011)

8. What is the torque on a current carrying loop?

9. Define magnetic moment. (Dec 208/May 2010)

10. What is the magnetic field at any point due to an infinitely long conductor carrying current? (Dec 2007)

11. Define magnetic field intensity.(May 2012)

12. Give the value of relative permeability of water up to 6 decimal points. (May/June 2006)

13. how do you find the vector potential, knowing the current distribution? May/June 2006)

14. Write applications of Lorentz force equation. May/June 2006)

15. Distinguish between magnetic scalar potential and magnetic vector potential. (May/June 2006)

16. State Ampere's circuital law. (Nov/Dec 2007)

17. What do you mean by magnetic moment? (Nov/Dec 2007)

18. A very long and thin wire located along the z axis carries a current I in the z direction .determine the magnetic field intensity using Ampere's law.(May/June 2010)

19. write the expression for the torque experienced by a current carrying loop, placed in the magnetic field. (May/June 2010)

20. Give the relation between magnetic flux density and magnetic field intensity. (May/June 2010)

21. Write down the magnetic boundary conditions. (May/June 2010)

22. Whatis scalarmagneticpotential?(Dec03,May05)
23. Define magnetic vector potential.(Dec 03, April 04, 06)
24. Cana staticmagneticfieldexist in a good conductor?Explain.(May03)
25. Plane y=0 carries a uniform current of 30 a_z m A/ m. calculate the magnetic field intensity at (1, 10, -2) m in rectan gular co-ordinate system. (Dec 2006)

26. What should be the direction of currents in two identical co-axial cylindrical coils to have maximum magnitude of B at a point on the axis?(May07)

27. State the application of Ampere's circuital law.(Nov 07)

28. Define magnetic flux. (Dec 2010)

29. A ferrite material has μ_R=50 operate with sufficiently low flux densities and B=.05T find H. (Dec 04)

30. Define magnetic moment.(Dec-04,07,May09)

31. Define torque. (May 04)

32. Classify the magnetic material or name magnetic materials. (Dec=02,09,May 08)

33. Define magnetic dipole.(May 03)

34. Define magnetization.(Dec-03,06,11,May10)

34. Define magnetic susceptibility.

35. What is torque on a solenoid?

36. Define magnetic field strength.

37. What is the fundamental difference between static electric and magnetic field lines?

38. Write down the equation for general, integral and point form of Ampere's law.

39. What is the torque on a planar coil?

40. What is Lorentz force?

41. Define permeability with respect to the field cell.

42. Give the expressions relating B and h with the current density J.

43. Give the expression relating magnetic vector potential with the current density.

44. Give the relation between B and magnetic vector potential.

45. Give the formula to find the force between two parallel current carrying conductors.

46. What is the magnetic field at any point due to a finite length conductor carrying current?

47. What is the magnetic field at the centre of the circular coil carrying current?

48. What is the magnetic field at any point on the axis of a solenoid carrying current?

49. What is the magnetic field at a point midway on the axis of the solenoid carrying current?

50. What is the magnetic field at any end of the axis of the solenoid carrying current?

51. Give the expression for torque experienced by a current carrying loop situated in a magnetic field.

52. Write down the expression for magnetic field at the centre of the circular coil.

53. A long conductor with current 5A is in coincident with positive 'z' direction. If B=4i +4j. Find the force per unit length.

54. A steady current of 'I' flows in a conductor bent in the form of a square loop of side'a' meteres. Find the magnetic field intensity at the centre of the loop

55. Give the force on a current element.

56. Describe what are the sources of electric field and magnetic field.

57. An infinite solenoid (n turns per unit length current I)is filled with a linear material of susceptibility Xm.Find the magnetic field inside the solenoid.(May/June 2014)

58. A current filament carrying 15 A in the ax direction lies along the entire z axis. Find H in rectangular coordinates at Pa(2,-4,4). (Nov 2014)

PART-B (16 MARKS)

(i) State and prove Ampere's law. (ii) Find the magnetic field intensity at the centre 'O' of a square of sides equal to 5 m and carrying10 amperes of current. **(May/June 2009)**

2.(i) Obtain an expression for magnetic vector potential. (ii) At a point P(x, y, z) the components of magnetic vector potential A are given as Ax= (4x +3y +2z); Ay= (5x +6y +3z); Az= (2x +3y +5z); Determine B at point P.(May/June 2009)

3.(i) State Biot - Savart's law in vector form.(ii)Obtain the expression for magnetic field intensity due to a circular loop of wire carrying a current I, placed with its centre at origin. **(Nov/Dec2008,May/June 2013)**

4. (i) Derive an expression for Magnetic Gauss law in point formand integral form.(ii)Explain themagneticfieldintensitydueto a straightwire. **(April/May2008)**

5. Obtain an expression for the magnetic field intensity due to infinitely long current carrying conductor.**(May07)**

6.(i) Find the force exerted between current carrying conductors kept in '1' meter distanceand carries the current in the same directio n. **(April /May 2008)**

(ii) Find the magnetic field intensity at the origin due to a currentelemen dL = 3π(ux+2uy+3uz)μA. m, at thepoint P (3,4, 5) in free space.**(May/June2 007)**

7. (i) Consider a conductor of rectangular loop 'abcd' situated in a uniform magneticfield of 'B'wb/m^2. Derivethe expressionfor torqueand magneticmoment.**(N ov/Dec2006)**

(ii) A single –phase circuit comprises two parallel conductors A and B, 1cm diameter and spaced 1metre apart. The conductors carry currents of +100 and -100 amps respectively. Determine the field intensity at the surface of each conductor and also in the space exactly midwaybetween A and B. **(Nov/Dec 2006)**

8. (i) Obtaintheexpressionformagneticfieldintensityatthecentreof a circularwire.

(ii) If the vector magnetic potential is given by A =10x2+y2+z2u x, obtain the magnetic flux densityin vector form. **(May/June2007,11,Dec 09,10,11)**

9. (i) A rectangular loop (8 x 4) m, carrying 10A in placed on z =0 plane. Find the field intensity at(4, 2, 0)m.

(ii) Find the magnetic flux density around infinitely long straightconductorbymagneticvectorpotential. **(No v/Dec 2005)**

10.(i) Explain the constructional features of solenoid.

(ii) Derive expressions for a magnetic flux density(B) at any point alongthe axis of thesolenoid

.(iii)Draw the variationsof flux density(B)along the axis. **(April/May 2005)**

11.(i) Define a magnetic circuit with a sketch and hence obtain the expression for its reluctance.

(ii) A magneticcircuitemploys an air coretoroidwith 500 turns, cross sectionalarea 6cm^2 mean radius 15cm and coil current 4A. Determine the reluctance of the circuit, flux density and magneticfieldintensity.**(Nov/Dec2004)**

12. Derive modified form of ampere's circuital law in integral and differential form. **(May 2012)**

13. Obtain the expression for vector magnetic potential. **(May2012,May/June 2013)**

14. Obtain the expression for magnetic field intensity at the center of a circular wire. **(May 2010)**

15. Find the magnetic flux density at a point on the axis of a circular loop of radius 'a' that carries current I.**(May 2009)**

16. Find an expression for H at any point due to a long, straight conductor carrying current I amperes. **(Dec 2008,April 10,Dec10)**

17. Derive the B at the center of a square loop with side W carrying current I. **(May2006)**

18. Find the magnetic field intensity and flux density at the center of the square loop of sides 5m and carrying a current of 10 A.**(Dec 2011,03,May 09)**

19. Using Ampere's law derive the magnetic field intensity due to a co-axial cable carrying a steady current I.**(May/June 2013)**

20. Obtain the expression for magnetic field intensity at the centre of square current loop. **(May 07) (or)** Find the magnetic field at the centre ofa square loop which carries a steady curr ent I,Let R be the distance from the centre to

side.Find the field at the center of a n-sided polygon,carrying a steady current I.Again let Rbe the center to anyside .Find the formula in the limit ntends to infinity**. (May 2014)**

21. Obtaintheexpressionof Hfinitelongstraightconductor**.(Dec03,11,May08,09,12)**

22.A circular loop located on $x^2+y^2=9$,z=0 carries a direct current of 10 A along a -4).**(Dec09,16 mark)**

23. Using biot-savarts law, derive the magnetic field intensity on the axis of a circular loop carrying steady current I**.(Dec 10,May11)**

24. Derive expression for magnetic flux density (B)at any point along the axis of the solenoid.(**May 05)**

25. State ampere's circuital law and explain any two applications of amperesCircuital law**.(May 07)**

26. Obtain an expression for magnetic vector potential in the region surrounding an infinitely long straight filamentary current I**.(May 09,Dec 02)**

27. Let A= (3y-z)ax+2xz ay wb/m in a cetain region of free space

a) Show that ▼.A=0

b) T p (2,-1,3) find A,B,H,J **(Dec 10,May 12)**

28. Explain Magnetic materials and scalar and vector magnetic potentials**.(Dec 08,10,May 12)**

29. Derive the expression for the E at a point P due to an electric dipole.

30. Circular disc of radius 'a' is uniformly charged with a charge density of s c/m2. Find the electric field intensity at a point 'h' from the disc along its central axis

31. Derive an expression for magnetic field strength, H, due to a current carrying conductor of finite length placed along the y- axis, at a point P in x-z plane and 'r' distant from the origin.

32. Derive the expressions for magnetic field intensity and magnetic flux density due to circular coil.

UNIT-4 TIME VARYING FIELDS AND MAXWELL'S EQUATIONS

PART-A (2 MARKS)

1. **Write applications of Lorentz force equation. May/June 2006)**
2. **Write the expression for Lorentz force equation.**
3. **Give the formula to find the force between two parallel current carrying conductors.**
4. **Give the expression for torque experienced by a current carrying loop situated in a magnetic field.**
5. **A long conductor with current 5A is in coincident with positive 'z' direction. If B=4i +4j. Find the force per unit length.**
6. **Give the force on a current element.**
7. **Define current density. (May/June 2006)**
8. **Define a current and its unit Ampere. (May/June 2006)**
9. **Writethepointformof continuityequationandexplainitssignificance.(Dec08)**
10. **State point form of ohms law.(Dec 02, May 04,05)**
11. **State the properties of conductor.(Dec 09)**
12. **What do you understand from the current continuity equation.(May 11)**
13. **Defineselfinductance.(Dec02,03,05,07,May04,05,08,09,11,12)**
14. **Define mutualinductance.(Dec02,03,05,07,May04,05,08,09,11,12)**
15. **Define mmf.(May 05)**
16. **What is Gaussian surface? What are the conditions to be satisfied in special Gaussian surface?**
17. **Writedownthe magneticboundaryconditions.**
18. **Writehe expressionforfieldintensitydueto a toroidcarryinga filamentary currentI.**
19. **What areequipotentialsurfaces?**
20. **Distinguish betweensolenoidandtoroid.**
21. **Define inductance.**
22. **Define reluctance.**
23. **Whatis maincauseofeddycurrent?**
24. **Howcanthe eddycurrentlosses be eliminated?**
25. **Distinguishbetweendiamagnetic, paramagneticandferromagneticmaterials.**
26. **A ferrite material has μ_R = 50, operate with sufficiently low flux densities and B =0.05T and H.**
27. **What is drift current and convection current?**
28. **State the principle of conservation of charge.**
29. **What is drift velocity?**

30. What is the expression for energy stored in a magnetic field?

31. What meaning would you give to the capacitance of a single conductor?

32. What is energy density in magnetic field?

33. Classify the magnetic material or name magnetic materials. (Dec=02,09,May 08)

34. Define magnetization.(Dec-03,06,11,May10)

35. Define magnetic susceptibility.

36. What is hysteris? Draw the B-H curve.

37. Find the magnetization in a magnetic material where $\mu = 1.8 \times 10^{-5}$ H/m and H=120 A/m.

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Part – B (8&16 MARKS)

1. (i) Find the force exerted between current carrying conductors kept in '1' meter distanceand carries the current in the same dir ection. **(April /May 2008)**
2. (i) Consider a conductor of rectangular loop 'abcd' situated in a uniformmagneticfieldof 'B'wb/m^2. Derivetheexpressionfortorqueandmagneticmo ment.**(Nov/Dec2006)**
   (ii) A single–phasecircuit comprisestwo parallel conductors A and B, 1cm diameter and spaced 1metre apart. The conductors carry currents of +100 and -100 amps respectively. Determine the field intensity at the surface of each conductor and also in thespaceexactly midwaybetween A and B. **(Nov/Dec 2006)**
3. (i) Consider a solenoid in a uniform magnetic field of flux density 'B' wb/m^2. Obtain the expressionforthetorqueonthe solenoid.
   (ii) A conductorlocated at x =0.4 m; y=0 and 0< z<2.0m carriesa current of 5.0 A in the z direction. Along the length of conductor B = $2.5a_z$T. Find the torque about Z axis. **(May/June 2009)**
4. A rectangular loop in the loop in the xy plane with sides b1 and b2 carrying a current I lies in a uniform magnetic field B = axBx+ ayBy+ azBz . Determine the force and torqueon theloop.**(Nov/Dec2007)**
5. Derive the expression for torque developed in a rectangular closed Circuit carrying current I a uniform field**.(May/June 2013)**
6. Determine the force per unit length between two infinitely long parallel conductors carrying current I in the opposite directions, separated by a distance's'. **(May 2007)**
7. Determine the force per unit length between two infinitely long parallel conductors carrying current I in the same directions, separated by a distance d'
8. Derive an expression for force between two current carrying conductors.
   A solenoid 25cm long, 1cm mean diameter of the coil turns a uniformly Distributed windings of 2000turns .the solenoid is placed in uniform field of 2 teals flux density. A current of 5a is passed through the winding. Determine

   (i) Maximum torque on the solenoid&

   (ii) Maximum force on the solenoid

   (iii) Compute the magnetic moment on the solenoid
9. (i) Derive the boundary conditions between two magnetic media.

   (ii)A solenoid has an inductanceof 20mH. If thelength of the solenoid is increased by two times and the radius is decreased to half of its original value, find the new inductance. **(May/June2009)**

10. (i) An air core toroid has a mean radius of 40mm and is wound with 4000 turns of wire. The circular cross section of the toroid has a radius of 4mm. A current of 10A is passed in the wire. Find the inductance and the energy stored.

    (ii) Calculate the inductance of a 10m long co-axial cable filled with a material for whichμr = 80andradii of inner and outerconductorsare1mm and 4mmrespectively.

11. (i) Showthat the inductance of the cable L=l2πlnbaHμ.**(April/May2008) (Nov/Dec 2008)**
    (ii)Obtain the expression for the inductance of a toroid. **(May/June2007)**

12. (i) Derive an expression for inductance of a solenoid with N turns and l meters length carrying a current of I amperes.
    (ii) Calculatetheinductance of solenoid of 200 turns wound tightly on a cylindricaltube of 6cm diameter. T he length of the tube is 60cm and the solenoid is in air.**(Nov/Dec 2007)**
13. Obtain the equation of continuity in integral and differential form. **(May 2012,Dec 02,05,08,11)**
14. Derive the inductance of a solenoid and toroid. **(May 2009)**

15. Show that the inductance of the cable L=μl/2π (ln(b/a))H.**(Dec 2010, May/June 2013)**
16. In a cylindrical conductor of radius 2 mm, the current density varies with distance from the axis according to $J=10^3 e^{400r}$ A/m^3.fine the total current I.**(May/June 2013)**
17. Explain brieflyabout self inductance and mutual inductance.**(Dec02,03,05,07, May04,05,08,09,11,12)**
18. 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 second solenoid also 50 cm long bt 3 cm diameter and 1200 turns .calculate l for the inner solenoid and L for the outer solenoid.**(Dec 10,May 12)**
19. An air co axial transmission line has a solid inner conductor of radius a and very thin outer conductor of inner radius b.determine the inductance per unit length of the line**.(Dec 03,May11)**
20. (i) Calculate the inductance of a ring shaped coil having a mean diameter of 20 cm. Wound on a wooden core of 2 cm diameter. The windingisuniformlydistributed andcontains 200turns.

    (ii) A coil has a self inductance of 1H and a resistance of 4 ohms if it is connected to a 40 volts DC supply, estimate the energy stored in the magnetic field whrn the current has attained its final steady value
21. A Derive an expression for the capacitance of two wire transmission line.
22. Determine the inductance of a solenoid of 2500 turns wound uniformly over a length of 0.25m on a cylindrical paper tube, 4 cm in diameter .the medium is air.

UNIT-5 PLANE ELECTROMAGNETIC WAVES

PART-A (2 MARKS)

1. Define Poyntingvector.whatis itsunit?(May 2009,11,Dec07,10)
2. State Faraday's law.(Or) Faraday's law of electromagnetic induction.(May 2010/May2009)
3. Give the Maxwell's equation – I in both integral form and point form.(Dec 2008)
4. Give the Maxwell's equation – II in both integral form and point form.(May 2008)
5. Distinguish between the conduction current and displacement current.(May 2011/Dec 2010)
6. What is meant by displacement current?(Dec 2010)
7. What is meant by dielectric breakdown?(May /June 2006)
8. What is a homogeneous material? (May /June 2006)
9. What is the significance of displacement current density?(Nov/Dec2007)
10. List of applications of ampere's circuital law.(Nov/Dec2007)
11. Write down the Maxwell's equations derived from faradays law. (Nov/Dec 2007)
12. Write the Maxwells equations in differential form.(Nov/Dec 2008)
13. Distinguish between transformer emf and motional emf. (Nov/Dec 2009)
14. Write down the general,integral and point form of faradays law. (Nov/Dec 2009)
15. Define permeance(Nov/Dec 2009)
16. Statelen'zlaw.(Dec-03,05,07)
17. State Maxwell's I and II equations.(May/June 2010)
18. Write the integral form of modified ampere's law. (May/June 2010)
19. Give the expression for complex poynting vector.(May/June 2010)
20. Give the situations, when the rate of change of flux results in a non – zero value.(April/May 2011)
21. Write point from of maxwells equation is phasor form.(Dec10)
22. Write the Maxwell's equations from ampere's law both in integral and point form.(Dec 06)
23. Give the situation, when the rate of change of flux results in a non-zero value.(May 11)
24. Brief about complex Poynting vector?(May06,07)
25. State Poynting Theorem?(Dec 08,09)
26. Exlpaininstantaneous, average andcomplexpoyntingvector.(Dec 09,10,May11)

27. Explainflow of power in co axialcable. Or what is theelectricfieldand powerflowin the co axialcable?(Dec 11)
28. State Faraday'slawfora movingchargein a constantmagneticfield.
29. Write down Maxwell's equation in integral form?
30. Mention significanceof displacementcurrentdensity?
31. Discuss the condition under which conduction current is equal to displacement current?
32. Write Helmholtz's equation.
33. What is meant by displacement current?
34. State Maxwell's fourth equation.(or) StatemagneticGausslaw.
35. State Maxwel's Third equation. (or)Modified form of Gausslaw.
36. Stateelectric displacement
37. What isdisplacementfluxdensity?
38. Whatis thesignificanceofdisplacementcurrent?
39. Distinguishbetween conductionanddisplacementcurrents.
40. State Ampere's circuital law.
41. Determineemfdevelopedaboutthepathr = 0.5, z = 0 andt= 0. If B= 0.01 sin 377t.
42. Write down Maxwell's equation derived from Faraday's law?
43. What is displacement current and conduction current?
44. Give the Maxwell's equation – III in both integral form and point form.
45. Give the Maxwell's equation – IV in both integral form and point form.
46. Brief about the ampere's circuital law for a in integral form.
47. What are the boundary conditions between the two different magnetic materials?
48. Give the significance Δ . B=0
49. Give the significance Δ x E=0
50. Give the significance Δ .D=0
51. What is conduction current? Give example.
52. Write the maxwell's equations in complex form.
53. Write the wave equation for electric field.
54. Write the wave equation for magnetic field.
55. Draw the electromagnetic spectrum.
56. Stateonedimensionalwaveequation.(Nov/Dec 2008)
57. Define Poyntingvector.(Nov/Dec 2013)
58. Findthe pointingvector on the surfaceofalong straightconductingwire(ofradius b andconductivity)thatcarriesa dirctcurrentI.(May/June 2014)
59. Statethefluxrulefor a nonrectangularloopmovingthrough a nonuniform magnetic field.(May/June 2014)

PART-B (8 &16 MARKS)

1. With necessary explanation, derive the Maxwell's equation in Differential and integral forms, write the Maxwell's curl equation from ampere's law and faradays law.**(May/June 2013)**

2. How is power flow referred by using poynting vector. explain the poynting theorem and gives its significantance . **(May/June 2013)**

3. A circular loop of N turns of conducting wire lies in the x- y plane with its center at the origin of a magnetic field specified by B = $az B_0 \cos(\pi r/2b) \sin\omega t$, where b is the radius of the loop and ω is the angular frequency. Find the emf induced in the loop**. (Nov/Dec2003)**

4. Define poynting vector and deduce the poynting's theorem neatly. **(April/May 2004, Nov/Dec 2006,May/June 13)**

6. Prove that $\nabla \times E = -\partial B / \partial t$. **(May/June 2007)**

7. Discuss about Poynting vector and power flow**. (May/June 2007)**

8. Obtain the expression for instantaneous power flow /unit area. **(May/June 2007)**

9. From the fundamental law, derive the generalized Maxwell's equations in integral form.(**Nov/dec2004)**

10. Define poynting vector and prove that the electromagnetic power flow is the product of electric and magneticfield intensities. **(Nov/dec2004)**

11. If D = 20 x a_x-15y ay+ kz µC/m2, find the value of k to satisfy the Maxwell's equation forregionσ=0 andρ_v= 0. **(May/June 2006)**

12. A conductor 1 cm in length is parallel to z axis and rotates at radius of 25 cm at 1200 rpm. Findinducedvoltage,iftheradialfieldisgivenbyB= 0.5a_r T**.(May/June2006)**

13. If the magnetic field H = (3x cos β +6y sin α)a_z, find current density J if the fields are invariant with time. **(May/June 2006)**

14. Derivthe expression for total power flow in a coaxial cable. **(May/June 2006, May/June 2013)**

15.A conducting cylinder of radius 5 cms, height 20cm , rotates at 600 rps in a radial field B=0.5 tesla. The sliding contacts at the top and bottom are connected to a voltmeter. Whatis the reading of voltmeter? **(May/June 2006)**

16. The conduction current flowing through a wire with conductivity σ = 3 x 107s/m and relative permittivity ε_r = 1 is given by Ic= 3 sinωt (mA). If ω =108rad/s, Find the displacement current? **(May/June 2006)**

17. A material for which σ = 4.5 mho/m and ε_r =1, electric field intensity is E = 300 sin109t uxV/m. Determine the conduction and displacement current densities and the frequency at which they equal magnitude. **(Nov/Dec 2006)**

18.Explain about displacement current and displacement current density. Also find displacement current density for the field E = 300 sin10^9 t V/m.**(Nov/Dec2006)**

19. Find the frequency at which conduction current density and displacement current density areequalin(1) distilledwater,forwhichε_r =81 and σ= 2.0x 10^{-4}mho/m.(2) seawater,forwhich ε_r =1andσ= 4.0mho/m**.(May/June2007)**

20. Given the conduction current density in a lossy dielectric as Jc=(0.02 sin10^9t)A/m2. Find the displacement current densityif σ= 10^3mho/m and ε_r = 6 . 5 **(Nov/Dec 2006, May 06)**

21. Prove that ▼ x H =- ∂D /∂t. (Dec 2007)

22. State pointing theorem and also prove that P=E X H**.(May 2010/Dec 2011)**

23. Prove that curl H= J. **(Dec 2011)**

24. Show that the energy produced per unit volume per second is equal to sum of energy stored per unit volume per second and the energy caused per unit volume per second**.(Dec 2008)**

25. State and prove the faradays law and lenz's law.**(Dec 03,May 05,06,08,09)**

26. Explain the boundary condition for time varying fields.(**Dec 03)**

27. Calculate the maximum e.m.f induced in a coil of 4000 turns of radius of 12 cm rotating at 30 r.p.s in a magnetic field of 5000 gauss**.(May8)**

28. Explain terms:motional emf and transformer emf**(May 09)**

29. What do you mean by displacement current and displacement current density ? Write down the expression For the total current density **(May 03,06,09,10,12,Dec07,11)**

30. In a material for which _=5 s/m and _r=1 and E=250 sin 10^{10}t (V/m).find the conduction and displacement current densities**.(May 12)**

31. a) show that the ratio of the amplitudes of the conduction current density and displacement current density is $\sigma/\omega\varepsilon$,for the applied E=Em cosωt.assume µ=µ0

b) what is this amplitude ratio if the applied field is E=Em $e^{-t/\iota}$ where ι is real? **(May 03,06)**

32. Do the fields E=Em sinx sint ay and H=Em/µ0 cosxcost az satisfy maxwells equation**.(Dec 07,May 09)**

33. If electric field intensity in free space is given by E=50/p cos(108t -10z)ap V/m Find the magnetic field intensity H.(May 11)

34. Write the short notes on instaneous,average,complex poynting vector.(**Dec10,May 12)**

35. In free space,E=50 cos(ωt-βz)ax V/m.find the average power crossing a circular area of radius 2.5 m in the plane z=0.assume Em=Hm.η0 and η0=120πΩ**.(Dec11)**

36. In free space H=.2cos **(**ωt-βx)az A/m.find the total power passing through a circular disc of radius 5 cm.(**May 10,12,Dec10)**

37. Write short notes on faradays law of electromagnetic induction. **(8)**

38. Find the total current in a circular conductor of radius 4mm if the Current density Varies according to J=104/R A/m2. **(8)**

39. The magnetic field intensity in free space is given as H=H0sin ay t A/m. Where =_t-z and is a constant quantity. Determine the Displacement current density. **(8)**

40. What is the physical significance of the pointing vector? **(6)**

41. Derive the poynting vector from Maxwell's equation and explain**.(Nov 2014)**

42. Derive the Maxwell's curl equation from ampere's law and faraday's law. Explain the equationsinphasorformfortimeharmonicfields.e.

43. Derivethegeneralwaveequation and wave equation for uniform plane wave.(**April/May2008)(May/ June 2013)(Nov/Dec 2014)**