BOOK INSIDE ONE MARKS AND NOTES

UNIT- 1 ELECTROSTATICS STUDY MATERIAL

1. The unit of electric flux is

a) Nm^2C^{-1} b) $Nm^{-2}\ C^{-1}$ c) Nm^2C d) $Nm^{-2}\ C$

2. An electric dipole is placed in a uniform electric field with its axis parallel to the field. It experiences

a) only a net force b) neither a net force nor a torque

c) both a net force and torque d) only a torque

3. The work done in moving 4μC charge from one point to another in an electric field is 0.012J. The potential difference between them is

a) 3000 V b)6000 V c)30 V d) 48×10^3 V

4. The electric field outside the two oppositely charged place sheets each of charge density σ is

a) $\frac{\sigma}{2\varepsilon_0}$ b) $-\frac{\sigma}{\varepsilon_0}$ c) $\frac{\sigma}{\varepsilon_0}$ d)zero

5. Which of the following quantities is a scalar?

a) Electric force b) Electric field c) Dipole moment d) Electric potential

6. Torque on a dipole in a uniform electric field is maximum when angle between P and E is

a)0^0 b) 90^0 c) 45^0 d) 180^0

7. Potential energy of two equal negative point charges of magnitude 2μC placed 1 m apart in air is

a) 2 J b) 0.36 J c)4 J d) 0.036 J

8. A hollow metallic spherical shell carrying an electric charge produces no electric field at points

a) on the surface of the sphere b) inside the sphere

c) at infinite distance from the centre of the sphere d) outside the sphere

9. The unit of electric field intensity is

a) NC^{-2} b) NC c) Vm^{-1} d) Vm

10. Four charges +q, +q, -q and –q respectively are place at the corners A, B,C and D of a square of side a. The electric potential at the centre O of the square is

a)$1/4\ \pi\ \varepsilon_0\ (q/a)$ b)$1/4\ \pi\ \varepsilon_0\ (2q/a)$ c) $1/4\ \pi\ \varepsilon_0\ (4q/a)$ d) zero

11. The value of permittivity of free space is

a)$8.854 \times 10^{12} C^2N^{-1}\ m^{-2}$ b) $9 \times 10^9\ C^2N^{-1}\ m^{-2}$

c) $1/9x10^9\ C^2N^{-1}\ m^{-2}$ d) $1/4\ \pi \times 9x\ 10^9\ C^2N^{-1}\ m^{-2}$

12. The principle use in lightning conductors is

a) corona discharge b)mutual induction c)self-induction d) electromagnetic induction

13. The unit of electric dipole moment is

a) volt / metre (V/m) b) coulomb / metre (C/m)

c) volt. metre (Vm) d) Coulomb. metre (Cm)

14. Electric potential energy of an electric dipole in an electric field is given as

a) pEsin θ b) –pEsin θ c) –pEcos θ d) pEcos θ

15. Electric field intensity is 400 V/m at a distance of 2m from a point charge. It will be 100 V/m at a distance of

a) 50 cm b) 4 cm c) 4m d) 1.5m

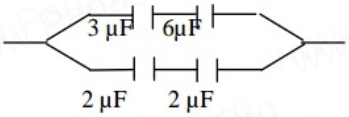
16. Which of the following is not a dielectric?

a) Ebonite b) Mica c) Oil d) Gold

17. The work done in moving 500μC charge between two points on equipotential surface is

a) zero b) finite positive c) finite negative d) infinite

18. In the given circuit, the effective capacitance between A and B will be



a) 3 μF b) 36/13 μF c) 13 μF d) 7 μF

19. The direction of electric field at a point on the equatorial line due to an electric dipole is

a) along the equatorial line towards the dipole

b) along the equatorial line away from the dipole

c) parallel to the axis of the dipole and opposite to the direction of dipole moment

d) parallel to the axis of the dipole and in the direction of dipole moment.

20. The number of electric lines of force originating from a charge of 1 micro coulomb is

a) 1.129×10^{5} b) 1.6×10^{-19} c) 6.25×10^{18} d) 8.85×10^{-12}

21. The equivalent capacitance of two capacitors in series is 1.5μF. The capacitance of one of them is 4μF. The value of capacitance of the other is

a) 2.4 μF b)0.24 μF c) 0.417 μF d) 4.17 μF

22. The law that governs the force between electric charges is

a) Ampere's law b) Faraday;s law c) Coulomb's law d) Ohm's law

23. The unit of permittivity is

a) $C^2N^{-1}m^{-2}$ b) Nm^2C^{-2} c) Hm^{-1} d) $NC^{-2}m^{-2}$

24. An electric dipole place at an angle θ in a non- uniform electric field experiences

a) neither a force nor a torque b) torque only

c) both force and torque d) force only

25. A capacitor of capacitance 6 μF is connected to a 100 V battery. The energy stored in the capacitor is

a) 30 J b) 3J c) 0.03 J d) 0.06 J

26. When an electric dipole of dipole moment P is aligned parallel to the electric field E then the potential energy of the dipole is given as

a) PE b) zero c) –PE d) PE/2

27. The capacitance of a parallel Plate capacitor increases from 5μF to 60 μF when a dielectric is filled between the plates. The dielectric constant of dielectric is

a) 65 b) 55 c) 12 d) 10

28. Quantisation of electric charges is given by

a) q = ne b) q = cv c) q = e/n d) q = c/v

29. An example of conductor is

a) glass b) human body c) dry wood d) ebonite

30. The magnitude of the force acting on a charge of 2×10^{-10} C placed in a uniform electric field of $10Vm^{-1}$ is

a) 2×10^{-9} N b) 4×10^{-9} N c) 2×10^{-10} N d) 4×10^{-10} N

31. Electric potential energy (U) of two point charges is
a) $q_1q_2 / 4\pi \varepsilon_0 r^2$ b) $q_1q_2 / 4\pi \varepsilon_0 r$ c) pE cosθ d) pE sinθ
32. The torque experienced by an electric dipole placed in a uniform electric field (E) at an angle θ with the field is
a) PE cosθ b) –PE cosθ c) PE sinθ d) 2PE sinθ
33. The capacitance of a parallel plate capacitor increases from 5 μF to 50 μF when a dielectric is filled between the plates. The permittivity of the dielectric is
a) 8.854×10^{-12} $C^2N^{-1}m^{-2}$ b) 8.854×10^{-11} $C^2N^{-1}m^{-2}$ c) 12 d) 10
34. The negative gradient of potential is
a) electric force b) torque c) electric current d) electric field intensity
35. When a point charge of 6μC is moved between two points in an electric field, the work done is1.8×10^{-5} J. The potential difference between the two points is
a) 1.08 V b) 1.08 mV c) 3V d) 30 V
36. Three capacitors of capacitances 1μF, 2μF and 3μF are connected in series. The effective capacitance of the capacitors is
a) 6 μF b) 11 / 6 μF c) 6 / 11 μF d) 1 / 6 μF
37. An electric dipole of moment P is placed in a uniform electric field of intensity E at an angle θ with respect to the field. The direction of the torque is
a) along the direction of P b) opposite to the direction of P
c) along the direction of E d) perpendicular to the plane containing P and E
38. The electric field intensity at a distance r due to infinitely long straight charged wire is directly proportional to
a) r b) 1/r c) r^2 d) $1/ r^2$
39. The ratio of electric potential at points 10 cm and 20 cm from the centre of an electric dipole along its axial line is
a) 1 : 2 b) 2 : 1 c) 1 : 4 d) 4 : 1
40. The intensity of electric field at a point is equal to
a) the force experienced by a charge q
b) the work done in bringing unit positive charge from infinity to that point
c) the positive gradient of the potential
d) the negative gradient of the potential
41. The capacitance of a capacitor is
a) directly proportional to the charge q given to it
b) inversely proportional to its potential V
c) directly proportional to the charge q and inversely proportional to the potential V
d) independent of both the charge q and potential V.
42. The intensity of the electric field that produces a force of 10-5 N on a charge of 5μC is
a) 5×10^{-11} NC^{-1} b) 50 NC^{-1} c) 2 NC^{-1} d) 0.5 NC^{-1}
43. The unit of the number of electric lines of force passing through a given area is
a) no unit b) NC^{-1} c) Nm^2C^{-1} d) Nm
44. If a point lies at a distance x from the mid – point of the dipole, the electric potential at this point is proportional to
a)$1/x^2$ b) $1/x^3$ c)$1/x^4$ d) $1/x^{3/2}$

45. A dielectric medium is placed in an electric field E_0. The field induced inside the medium
a) act in the direction of the electric field E_0 b) acts opposite to E_0
c)acts perpendicular to E_0 d) is zero

46. A non- polar dielectric is place in an electric field (E), its induced dipole moment
a) is zero b) acts in the direction of E
c)acts opposite to the direction of E d) acts perpendicular to E

47. n capacitors each of capacitance C are connected in series. The effective capacitance is
a) n/C b) C/n c) nC d) C

48. When the charge given to a capacitor is doubled, its capacitance
a) increases twice b) decreases twice
c)increases four times d)does not change

49. The value of relative permittivity of air is
a) 8.854×10^{-12} C^2 N m^{-2} b) 9×10^9 C^2 N m^{-2} c) 1 d) 8.854×10^{12}

50. The work done in moving 50μC charge between two points on equipotential surface is
a) zero b) finite positive c) finite negative d) infinite

51. The unit of relative permittivity is
a) C^2 N m^{-2} b) Nm^2C^{-2} c) No unit d) NC^{-2} m^{-2}

52. The electric field intensity at a short distance r from uniformly charged infinite plane sheet of charge is
a) proportional to r b) proportional to 1/r
c) proportional to $1/r^2$ d) independent of r

53. Two point charges +q and –q are placed at points A and B respectively separated by a small distance. The electric field intensity at the midpoint O of AB
a) is zero b) acts along AB
c)acts along BA d) acts perpendicular to AB

54. An electric dipole of dipole moment 'p' is kept parallel to an electric field of intensity 'E'. The work done in rotating the dipole through an angle of 90^0 is :
a) zero b) – PE c) PE d) 2PE

55. The total flux over a closed surface enclosing a charge q (in Nm^2 C^{-1})
a) 8πq b) 9×10^9q c) $36\pi \times 10^9$q d) 8.854×10^{-12} q

56. The repulsive force between two like charges of 1 coulomb each separated by a distance of 1 m in vacuum is equal to :
a) $9x\ 10^9$N b) 10^9N c) $9x\ 10^{-9}$ N d) 9 N

57. What must be the distance between two equal and opposite point charges (say +q and –q) for the electrostatic force between them to have a magnitude of 16 N?
a) 4 √kq metre b)q/4 √k metre c) 4 kq metre d)4k / q metre

58. Point charges +q, +q, -q and –q are placed at the corners A,B,C and D respectively of a square is the point of intersection of the diagonals AC and BD. The resultant electric field intensity at the point O
(a) acts in a direction parallel to AB (b) acts in a direction parallel to BC
(c) acts in a direction parallel to CD (d) is zero.

59. The unit of molecular polarisability is
(a) C^2N^{-1} m (b) Nm^2 C^{-1} (c) N^{-1} m^{-2} C^2 (d) C^{-1} m^2V

60. Two point charges $+q_1$ and $+q_2$ are placed in air at a distance of 2m apart, one of the charges is moved towards the other through a distance of 1m. The work done is.

a) $q_1q_2 / 4\pi \varepsilon_0$ b) $q_1q_2 / \pi \varepsilon_0$ c) $q_1q_2 / 8\pi \varepsilon_0$ d) $q_1q_2 / 16\pi \varepsilon_0$

61. Two capacitances 0.5μF and 0.75 μF are connects in parallel, Calculate the effective capacitance of the capacitor.

(a) 0.8μF (b) 0.7 μF (c) 0.25 μF (d) 1.25 μF

62. For which of the following medium, the value of relative permittivity is 1

(a) Mica (b) Air (c) Glass (d) Water

63. Van de Graff generator works on the principle of :

(a) electromagnetic induction and action of points

(b) electrostatic induction and action of points

(c) electrostatic induction only

(d) action of points only

UNIT : 1

ONE MARK ANSWER WITH SOLUTIONS

1. (a) $Nm^2 c^{-1}$
2. (b) neither a net force nor a torque.
3. (a) 3000 V.
4. (d) 0
5. (d) Electric potential.
6. (b) 90°
7. (d) 0.036 J
8. (b) inside the sphere
9. (c) Vm^{-1}
10. (d) Zero
11. (d) $\frac{1}{4\pi \times 9 \times 10^9}$ $c^2 N^{-1} m^{-2}$
12. (a) Corona discharge.
13. (d) Coulomb. metre.
14. (c) $-pE\cos\theta$.
15. (c) 4 m.
16. (d) Gold.
17. (a) Zero.
18. (a) 3 μF
19. (c) Parallel to the axis of the dipole and opposite to the direction of dipole moment.
20. (a) 1.129×10^5
21. (a) 2.4 μF
22. (c) Coulomb's laws
23. (a) $c^2 N^{-1} m^{-2}$
24. (c) both a force and torque
25. (c) 0.03 J

3. $V = W/q = \frac{0.012}{4 \times 10^{-6}} = \frac{12 \times 10^{-3}}{4}$

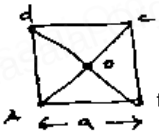
$V = 3000$ V.

7. $U = 9 \times 10^9 \times \frac{q_1 q_2}{r}$

$= \frac{9 \times 10^9 \times 2 \times 10^{-6} \times 2 \times 10^{-6}}{1}$

$U = 0.036$ J

10.



$Ao = Bo = co = do = a/\sqrt{2}$

$V = \frac{9 \times 10^9 \times \sqrt{2} \times \text{Total charge}}{a}$

$V = \frac{9 \times 10^9 \times \sqrt{2}}{a} [+q + q - q - q]$

$V = \frac{9 \times 10^9 \times \sqrt{2}}{a} (0) = 0$

15. $E \propto 1/r^2$

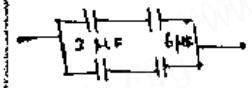
$\frac{E_1}{E_2} = \frac{r_2^2}{r_1^2}$

$\therefore \frac{r_2}{r_1} = \sqrt{E_1/E_2}$

$r_2 = r_1 \sqrt{E_1/E_2} = 2 \times \sqrt{\frac{400}{100}}$

$r_2 = 2 \times 2 = 4$ m.

18.



$C_{s_1} = \frac{3 \times 6}{3+6} = \frac{18}{9} = 2$ μF

$C_{s_2} = \frac{2 \times 2}{2+2} = 1$ μF

$C_p = C_{s_1} + C_{s_2} = 2 + 1 = 3$ μF

20. $N = \frac{q}{e_0} = 1 \times 10^{-6} \times 1.129 \times 10^{11}$

$N = 1.129 \times 10^5$

21. $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2}$ $\therefore \frac{1}{C_2} = \frac{1}{C_s} - \frac{1}{C_1}$

$\frac{1}{C_2} = \frac{1}{1.5} - \frac{1}{4} = \frac{4 - 1.5}{6} = \frac{2.5}{6}$

$\therefore C_2 = \frac{6}{2.5} = \frac{60}{25} = 2.4$ μF

25. $E = \frac{1}{2} CV^2 = \frac{1}{2} \times 6 \times 10^{-6} \times (100)^2$

$E = 0.03$ J

26. (c) $-pE$
27. (c) 12
28. (a) $q = ne$
29. (b) human body.
30. (a) 2×10^{-9} N.
31. (b) $q_1 q_2 / 4\pi\varepsilon_0 r$
32. (c) $pE \sin\theta$
33. (b) $8.854 \times 10^{-11}\ C^2 N^{-1} m^{-2}$
34. (d) electric field intensity
35. (c) 3V.
36. (c) $6/11$ μF
37. (d) $\perp r$ to the plane containing $\vec{P}$ and $\vec{E}$
38. (b) $1/r$
39. (d) 4 : 1
40. (d) the Negative gradient of the potential.
41. (d) independent of both the charge q and potential
42. (c) $2\ Nc^{-1}$
43. (c) $Nm^2 c^{-1}$
44. (a) $1/x^2$
45. (b) acts opposite to E_0
46. (b) acts in the direction of E
47. (b) c/n.
48. (d) does not change.
49. (c) 1.
50. (a) Zero
51. (c) No unit
52. (d) independent of "r"
53. (b) acts along "AB"
54. (c) pE
55. (c) $36\pi \times 10^9\ q$

27. $\varepsilon_r = \frac{C_m}{C} = \frac{60}{5} = 12$

30. $F = Eq = 10 \times 2 \times 10^{-10} = 2 \times 10^{-9}$ N

33. $\epsilon = \varepsilon_0 \varepsilon_r = \varepsilon_0 \frac{C_m}{C}$

$= 8.854 \times 10^{-12} \times \frac{50}{5}$

$\epsilon = 8.854 \times 10^{-11}\ C^2 N^{-1} m^{-2}$

35. $V = \frac{W}{q} = \frac{1.8 \times 10^{-5}}{6 \times 10^{-6}} = 3V$

36. $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3}$

$= \frac{6+3+2}{6} = 11/6$

$\therefore C_s = 6/11$ μF

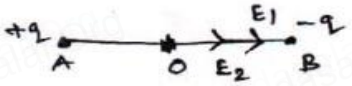
39. $V = P/4\pi\varepsilon_0 r^2 \quad \therefore V \propto \frac{1}{r^2}$

$\frac{V_1}{V_2} = \frac{r_2^2}{r_1^2} = \frac{20^2}{10^2} = 4$

$\therefore V_1 : V_2 = 4 : 1$

42. $E = F/q = \frac{10^{-5}}{5 \times 10^{-6}} = 2\ Nc^{-1}$

53.



E acts $\rightarrow$ B

54. Work done = $pE(1 - \cos\theta)$

$\theta = 90°$ $\therefore W = pE$

55. $\phi = \frac{q}{\varepsilon_0} = q \left/ \left[\frac{1}{4\pi \times 9 \times 10^9}\right]\right.$

$= 36\pi \times 10^9\ q$

56. (a) 9×10^9 N.

57. (b) $q/4\sqrt{k}$. Metre

58. (b) acts in a direction parallel to Bc.

59. (a) $C^2 N^{-1} m$.

60. (c) $q_1 q_2 / 8\pi\varepsilon_0$.

61. (d) 1.25 μF.

62. (b) Air

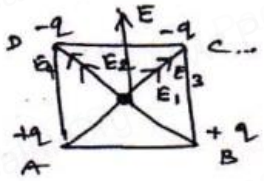
63. (b) electrostatics induction and action of Points.

57. $F = k \cdot \frac{q_1 q_2}{r^2}$

$r^2 = k \cdot \frac{q_1 q_2}{F} = \frac{k \cdot q^2}{16}$

$r = \sqrt{k \cdot q^2/16} = q/4 \cdot \sqrt{k}$

58.



60. $|W| = U_F - U_I = \frac{q_1 q_2}{4\pi\varepsilon_0 r_2} - \frac{q_1 q_2}{4\pi\varepsilon_0 r_1}$

$= \frac{q_1 q_2}{4\pi\varepsilon_0}\left[\frac{1}{r_2} - \frac{1}{r_1}\right]$

$= \frac{q_1 q_2}{4\pi\varepsilon_0}\left[\frac{1}{1} - \frac{1}{2}\right] = \frac{q_1 q_2}{4\pi\varepsilon_0} \times \frac{1}{2}$

$W = \frac{q_1 q_2}{8\pi\varepsilon_0}$

61. $C_p = C_1 + C_2 = 0.5 + 0.75 = 1.25$ μF

Expressions , Unit , Important points , Terms

1. The force between two point charges q_1 and q_2 is given by the equation **F** = $\frac{1}{4\pi\varepsilon_o}\frac{q_1 q_2}{r^2}$5. If
2.. The force exerted by an electric field E on a charge q **F = Eq**.
3 The unit of electric dipole moment is **C m**
4. The electric field at any point on the axial line of an electric dipole is given by **E** = $\frac{1}{4\pi\varepsilon_o}\frac{2p}{r^3}$
5. The electric field at any point on the equatorial line of an electric dipole is **E** = $\frac{1}{4\pi\varepsilon_o}\frac{p}{r^3}$
6. The torque experienced by an electric dipole in an electric field is given by **τ** = pE sin **θ**
7. The direction of the electric dipole moment is from **-q , to +q**
8. The net force on an electric dipole in an electric field is **zero**
9. The relation between the electric field and the electric potential is given by **E = - dV / dr**
10.The total number of electric lines of forces passing through the given area is called **electric flux**
11. The unit of electric potential difference is **volt**
12. The unit of electric field intensity is **V m $^{-1}$**
13. The equation of electric potential at any point due to an electric dipole is **V** = $\frac{1}{4\pi\varepsilon_o}\frac{p\cos\theta}{r^3}$
14. The work done in bringing each charge from infinite distance is called electric **potential energy**

15. The unit of electric flux is **N m ^{2} C^{-1}**
16. The electric field due to an infinite long straight charged wire is E = **$\lambda / 2\pi\varepsilon_0 r$**
17. The electric field due to an infinite long charged plane sheet is E = **$\sigma / 2\ \varepsilon_o$**
18. Electric field at any point in between two parallel sheets of equal and opposite charges is **E = $\sigma / \varepsilon o$**
19. The electric field at any point on the surface of a uniformly charged spherical shell is **E =** $\frac{1}{4\pi\varepsilon_o}\frac{q}{R^2}$
20. Electrostatic shielding is based on the fact that the electric field inside a conductor is **zero**
21. The phenomenon of obtaining charges without any contact with another charge is called **electrostatic induction**
22. The unit of capacitance is **farad**
23 A capacitor is a device to store **charges**
24. The number of electric lines of force originating from 1 coulomb charge is **1.129 X 10 ^{11}**
25. Non polar molecule is **O_2. N_2, H_2**
26. Polar molecule is **N_2 O, H_2 O, HCl, NH_3**
27. The magnitude of the induced dipole moment p is directly proportional to **E**
28. Greater the radius of a conductor, **smaller** is the charge density.
29. The permittivity of a medium is **$\varepsilon_0\varepsilon_r$**
30. Direction of E – **outward for +q and inward for -q**
31. Gaussian Surface – Closed imaginary surface over an enclosed net charge
32. Capacitance of a capacitor **C = Q/V**
33. Electric dipole moment **p = 2qa**
34. Electric potential energy of dipole **U = -pEcosΘ**
35. Electric flux $\emptyset_E = \frac{Q}{\varepsilon_0}$
36. Electric field due to a uniformly charged sphere i) Outside the sphere - **E =** $\frac{1}{4\pi\varepsilon_o}\frac{q}{r^2}$
ii) On the sphere **E =** $\frac{1}{4\pi\varepsilon_o}\frac{q}{R^2}$ iii) Inside sphere – **Zero**
37. Work done by a charge W = qV
38. Charge density **σ = Q/A**
39. Linear charge density $\lambda = \frac{Q}{L}$
40. Polarization **p = $\varkappa$E**
41. Capacitance of a parallel plate capacitor **C =** $\frac{Q}{V} = \frac{Q}{\frac{Qd}{A\varepsilon_0}} = \frac{\varepsilon_0 A}{d}$
42. Capacitance in series $C_S = 1/C_1 + 1/C_2$ In parallel $C_P = C_1 + C_2$
43. 1 micro (μ) farad = 10^{-6} 1 pico farad = 10^{-12}
44. Unit of Charge = **Coulomb (C) .**

Electric field (E) = **NC^{-1} or Vm^{-1}** . Electric potential (V) = **Volt or JC^{-1}** .
Dipole moment (p) = Cm Torque (τ) = **Nm** .
Charge density **σ = Cm^{-2}.** Linear charge density **λ = Cm^{-1}.**
molecular polarisability = **C^2 N^{-1} m.** Dielectric strength = **Vm^1.**

UNIT – 2 CURRENT ELECTRICITY

1. Resistance of a metal wire of length 10cm is 2 Ω. If the wire is stretched uniformly to 50 cm ,resistance is
a) 25 Ω b) 10 Ω c) 5 Ω d) 50 Ω

2. The colour code on a carbon resistor is red – red – black. The resistance of the resistor is
a) 2.2 Ω b) 22 Ω c) 220 Ω d) 2.2 kΩ

3. The brown ring at one end of a carbon resistor indicates a tolerance of
a) 1% b) 2% c) 5% d) 10%

4. The unit of conductivity is
a) mho b) ohm c) ohm – m d)mho – m^{-1}

5. The material through which electric charge can flow easily is
a) quartz b) mica c) germanium d) copper

6. In the case of insulators, as the temperature decreases, the resistivity
a) decreases b) increases c) remains constant d) becomes zero

7. If the length of a copper wire has a certain resistance R, then on doubling the length its specific resistance
a) will be doubled b) will be 1/4th
c) will become four times d) will remain the same

8. When two 2 Ω resistances are in parallel their effective resistance is
a) 2 Ω b) 4 Ω c) 1 Ω d) 0.5 Ω

9. The transition temperature of mercury is
a) 4.2^0C b) 4.2 K c) 2.4^0C d) 2.4 K

10. The toaster operating at 240 V has a resistance of 120 Ω. The power is
a) 400 W b) 2 W c) 480 W d) 240 W

11. The relation between current and drift velocity is
a) $I = Av_d$ b) $I = nev_d$ c)$I = nv_d$ d) $I = neAv_d$

12.When the diameter of a conductor is doubled, its resistance
a) decreases twice b) decreases four times
c) decreases sixteen times d) increases four times

13. A cell of emf 2.2V sends a current of 0.2 A through a resistance of 10 Ω. The internal resistance of the cell is
a) 0.1 Ω b) 1 Ω c) 2 Ω d) 1.33 Ω

14. When n resistors of equal resistance (R) are connected in series the effective resistance is
a) n / R b) R / n c) 1/ nR d) nR

15. The electrical resistivity of a thin copper wire and a thick copper rod are respectively p_1 Ω m and p_2 Ω m. Then :
a) $p_1 > p_2$ b) $p_2 > p_1$ c) $p_1 = p_2$ d) $p_2/p_1 = \infty$

16. The unit of electrochemical equivalent is
a) Kg. coulomb b) kg/ ampere sec c) kg/ sec. d) C/kg

17. When 'n' resistors of equal resistance (R) are connected in series and in parallel respectively, then the ratio of their effective resistance is :
a) $1 : n^2$ b) $n^2 : 1$ c) n : 1 d) 1 : n

18. A graph is drawn taking potential difference across the ends of a conductor along x - axis and current through the conductor along the y-axis the slope of the straight line gives.
(a) resistance (b) conductance (c) resistivity (d) conductivity

1. (d). 50 Ω.
2. (b) 22 Ω.
3. (a) 1 %.
4. (d) mho - m^{-1}
5. (d) copper.
6. (b) increases.
7. (d) will remain the same.
8. (c) 1 Ω.
9. (b) 4.2 K
10. (c) 480 W
11. (b) $I = nAV_d e$
12. (b) decreases four times

UNIT : 2

1. $R_2 = \left(\frac{l_2}{l_1}\right)^2 \cdot R_1 = \left(\frac{50}{10}\right)^2 \times 2$

$= 25 \times 2 = 50\ \Omega.$

2. $22 \times 10^0 = 22\ \Omega$

8. $R_p = R/n = 2/2 = 1\ \Omega$

10. $P = V^2/R = \frac{240 \times 240}{120} =$

$= 480\ W$

12. $R \propto \frac{1}{A} \propto \frac{1}{d^2}$ $\quad d_2 \to 2d_1$

$\frac{R_2}{R_1} = \frac{d_1^2}{d_2^2} = \frac{d_1^2}{(2d_1)^2}$

$R_2/R_1 = \frac{d_1^2}{4d_1^2} = 1/4$

$\therefore R_2 = \frac{R_1}{4}$

13. (b) 1 Ω
14. (d) nR
15. (c) $P_1 = P_2$
16. (b) kg / ampere. sec
17. (b) $n^2 : 1$
18. (b) conductance.

13. $\gamma = \frac{E - V}{I} = \frac{E - IR}{I}$

$= \frac{2.2 - (0.2 \times 10)}{0.2}$

$= \frac{0.2}{0.2} = 1\ \Omega$

17. $R_s = nR$; $R_p = R/n$

$\frac{R_s}{R_p} = \frac{nR}{R/n} = n^2$

$\therefore n^2 : 1$

Based on concepts

1. Nichrome is used as heating element because it has
a) very low resistance b) low melting point
c) high specific resistance d) high conductivity
2. Peltier effect is the converse of
a) Joule effect b) Raman effect
c) Thomson effect **d) Seebeck effect**
3. In which of the following pairs of metals of a thermocouple the e.m.f. is maximum?
a) Fe – Cu b) Cu – Zn c) Pt - Ag **d) Sb – Bi**
4. Joule's law of heating is
a)$H = I^2 t/R$ b) $H = V^2Rt$ c) $H = IR^2t$ **d) H = Vlt**
5.. Fuse wire is an alloy of
a) Lead and Tin b) Tin and Copper
c) Lead and Copper d) Lead and Iron
6. Fuse wire
a) is an alloy of lead and copper b) has low resistance
c) has high resistance d) has high melting point
7. In the case of insulators, as the temperature increases, the resistivity **decreases**
8. The drift velocity acquired per unit electric field is called **mobility**
9. Kirchoff's first law is a consequence of conservation of **charges**
10. Kirchoff's second law is a consequence of conservation of . **energy**
11. 1 kWh is equal to **36 X 10 ^{5}** J.
12. The quantity of charge passing per unit time through unit area is called as **current density**
13. Germanium and silicon are called as **semiconductors**
14. The electric iron works on the principle of **Joule's heating** effect of current.
15. The melting point of tungsten is **3380**^{o}C.
16. Fuse wire has high resistance and **low** melting point.
17. The alloy of nickel and chromium is called **nichrome**
18. Sn, Au, Ag, Zn, Cd, Sb show **Positive Thomson** effect.
19. Bi, Ni, Pt, Co, Fe, Hg show **Negative Thomson** effect.
20. Seebeck effect is a **Reversible** process.
21. Which of the following has negative temperature coefficient of resistance?
(a) copper (b) tungsten **(c) carbon** (d) silver
22. The temperature co-efficient of resistance for alloys is
(a) low **(b) very low** (c) high (d) very high
23. .Joule heating effect is desirable in
(a) AC dynamo (b) DC dynamo **(c) water heater** (d) Transformer
24.The resistivity of a wire depends on
(a) Length (b) material (c) area of cross section **(d) all the above**
25. Ohm's law is applicable for
(a) Complicated circuit **(b)simple circuit** (c) Primary circuit (d) secondary circuit

Notes

1.**Instaneous Current** $I = dq/dt$

2.**Current** $I = Q / t$ **Unit** : A

3.**Drift velocity** $v_d = a\tau$ **Unit:** m/s

4. **Mobility** $\mu = \frac{v_d}{E}$ **Unit :** m^2/Vs

5. **Current density** $J = \frac{I}{A}$ **Unit :** A/m^2 Quantity : Vector

6**. Ohm's law** $V \alpha I$ $V = IR$

V-potential difference I - current R - resistance

7. **Resistance** $R = \frac{V}{I}$ **Unit :** ohm or Ω

8. **Electrical resistivity** $\rho = \frac{RA}{L}$ **Unit :** Ω m or ohm-meter

9.**Resistors in series** $R_s = R_1 + R_2 + R_3$

10.**Resistors in parallel** $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

11. **Temperature coefficient of resistance** $\alpha = \frac{\Delta\rho}{\Delta T\, \rho_0}$ **Unit :** per ^0C

12. **Joule's law of heating.** $H = I^2Rt$

13.**Conductivity** $\sigma = 1 / \rho$ **Unit** : $\Omega^{-1}\, m^{-1}$

14.**Internal resistance of the cell** $r = \left(\frac{\xi - V}{V}\right) R$

15.**Condition for bridge balance** $\frac{P}{Q} = \frac{R}{S}$

16.**In metre bridge ; Unknown resistance** $P = Q\frac{l_1}{l_2}$

17.**Electric power** $P = VI = I^2R$

Unit – 3 MAGNETISM AND MAGNETIC EFFECTS OF ELECTRIC CURRENT

1. The unit of reduction factor of tangent galvanometer is
a) no unit b) tesla **c) ampere** d) ampere / degree

2. A galvanometer is converted into a voltmeter by connecting a
a) low resistance in series b) high resistance in parallel
c) high resistance in series d) low resistance in parallel

3. Of the following devices which has small resistance?
a) Voltmeter b) Ammeter of range 0 – 10 A
c) Moving coil Galvanometer **d) Ammeter of range 0 – 1 A**

4. In a tangent galvanometer a current 1 A, produces a deflection of 30^0. The current required to produce a deflection of 60^0 is
a) 3A b) 2A c) $\sqrt{3}$ A d) 1 / $\sqrt{3}$ A

5. Peltier effect is the converse of
a) Joule effect b) Raman effect c) Thomson effect **d) Seebeck effect**

6. The torque experienced by a rectangular current loop placed perpendicular to a uniform magnetic field is
a) maximum **b) zero** c) finite minimum d) infinity

7. In a tangent galvanometer, for a constant Current, the deflection is 30^0. The place of the coil is rotated through 90^0. Now, for the same current, the deflection will be
a) 30^0 b) 60^0 c) 90^0 **d) 0^0**

8. An ideal voltmeter has
a) zero resistance b) finite resistance between zero and G
c) resistance greater than G but less than infinity **d) infinite resistance**

9. Peltier coefficient at a junction of a thermocouple depends on
a) the current in the thermocouple b) the time for which current flows
c) the temperature of the junction
d) the charge that passes through the thermocouple

10. The torque on a rectangular coil placed in a uniform magnetic field is large, when :
(a) the number of turns is large (b) the number of turns is less
(c) the plane of the coil is perpendicular to the field (d) the area of the coil is small

11. Phosphor – bronze wire is used for suspension in a moving coil galvanometer because it has
a) high conductivity b) high resistivity
c) large couple per unit twist **d) small couple per unit twist**

12. When the number of turns (n) in a galvanometer is doubled, current sensitivity
a) remains constant b) decreases twice
c) increases twice d) increases four times

13. An electron is moving with a velocity of 3×10^6 ms^{-1} perpendicular to a uniform magnetic field of induction 0.5 T. The force experienced by the electron is
a) 2.4×10^{-13} N b) 13.6×10^{-21} N c) 13.6×10^{-11} N d) zero

14. The period of revolution of a charged particle inside a cyclotron does not depend on
a) the magnetic induction b) the charge of the particle
c) the velocity of the particle d) the mass of the particle

15. The direction of force on a current carrying conductor placed in a magnetic field is given by :
a) Fleming's Left Hand Rule b) Fleming's Right Hand Rule
c) End Rule d) Right Hand Palm Rule

16. AB is a rod of lead, The end A is heated. A current I is allowed to flow along AB. Now due to Thomson effect in rod AB
a) heat is absorbed b) heat is liberated
c) heat is neither absorbed nor liberated d) heat is first absorbed and then liberated

17. A proton and α – particle are projects with this same velocity normal to a uniform magnetic field. The ratio of the magnetic Lorentz force experienced by the proton and the α particle is
(a) 1:1 **(b) 1 : 2** (c) 2:1 (d) 1:0

Fill ups

1.Tangent galvanometer works on the principle of **Tangent law**
2.The torque on a current carrying coil is **maximum** when the coil is **parallel** to the magnetic field.
3.The product of current and the loop area is called **magnetic dipole moment**
4.The value of gyro magnetic ratio is **8.8×10^{10}**
5.The magnetic field in a moving coil galvanometer is the **radial magnetic field**
6.The unit of magnetic induction is **tesla**
7.Bohr magneton value **9.27×10^{-24} Am^2**
8. A vertical plane passing through the geographic axis is called **geographic meridian**
9. A great circle perpendicular to Earth's geographic axis is called **geographic equator.**
10. The straight line which connects magnetic poles of Earth is known as **magnetic axis.**
11.A vertical plane passing through magnetic axis is called **magnetic meridian** and a great circle perpendicular to Earth's magnetic axis is called **magnetic equator**
12.At At **higher latitudes**, the **declination is greater** whereas **near the equator**, the **declination is smaller**.
13. For Chennai, **magnetic declination angle is -1º 8' & inclination angle is 14º 16'.**
14. **Horizontal component** of magnetic field is **maximum at equator** and **zero at poles**.
15.Vertical component is zero at equator and maximum at equator.
16.A freely suspended magnet always point along **north – south direction**
17**.** Pole strength depends on the **nature of materials of the magnet, area of cross- section and the state of magnetization.**
18. If a magnet is cut into **two equal halves along the length** then **pole strength is reduced to half.**
19. If a magnet is cut into **two equal halves perpendicular to the length, then pole strength remains same.**
20. Dimensional formula for magnetic flux is **$[ML^{-2}A^{-1}]$**

21. the potential energy of the bar magnet is **minimum** when it is **aligned along (parallel) the external magnetic field** and **maximum** when the bar magnet is **aligned anti-parallel** to external magnetic field.

22. Susceptibility is nearly **temperature independent for diamagnetic material**

23. Bismuth, Copper and Water – **Diamagnetic material**

24. Aluminium, Platinum and chromium – **paramagnetic**

25. Iron, Nickel and Cobalt – **Ferro magnetic material**

26. A solenoid is bent in such a way its ends are joined together to form a closed ring shape, is called a **toroid**

Formula

(1) **Biot Savart law**

In vector form $\vec{dB} = \frac{\mu_o}{4\pi} \frac{\vec{Idl} \times \hat{r}}{r^2}$; In air, $dB = \frac{\mu_o}{4\pi} \frac{I.\, dl \sin\theta}{r^2}$

(2) Magnetic induction due to infinitely long straight conductor carrying current $B = \frac{\mu_o I}{2\pi a}$. In medium, $B = \frac{\mu I}{2\pi a}$ (or) $\vec{B} = \frac{\mu_0 I}{2\pi a}\hat{n}$ (in vector form)

(3) Magnetic induction along the axis of a circular coil carrying current $B = \frac{\mu_0 I R^2}{2(R^2 + z^2)}$ at the centre $B = \frac{\mu_0 I}{2R}$

(4) Tangent galvanometer reduction factor $K = \frac{2aB_h}{\mu_o n}$

(5) Current I through *n* turns of Tangent Galvanometer $I = \frac{2RB_h}{\mu_0 N} = K \tan\theta$

(6) (a) Ampere's circuital law $\oint \vec{B} \cdot \vec{dl} = \mu_0 I_{\text{enclosed}}$

(b) Magnetic field due to infinetely long current carrying wire using ampere's law $\vec{B} = \frac{\mu_0 I}{2\pi r}\hat{n}$

(7) Magnetic induction due to a long solenoid carrying current $B = \mu nI = \mu_0\mu_r nI = \mu_0\mu_r\left(\frac{N}{L}\right)L$

(8) Magnetic Lorentz force.

Force on a moving charge in a magnetic field $\vec{F} = q\left[\vec{v}\times\vec{B}\right]$

(9) In the presence of an electric field $\vec{F} = q\left(\left(\vec{v}\times\vec{B}\right)+\vec{E}\right)$

(10) Radius of the circular path $r = \frac{mv}{Bq}$

Angular velocity $\omega = \frac{Bq}{m}$; Period of rotation $T = \frac{2\pi}{\omega} = \frac{2\pi m}{Bq}$

(11) Force on a current carrying conductor placed in a magnetic field $\vec{F} = \vec{Il}\times\vec{B}$ (or) $F = BIl\sin\theta$.

(12) Force between two parallel long current carrying conductors $\vec{F} = \frac{\mu_0}{2\pi}\frac{I_1I_2dl}{r}\hat{j}$ (or) $\frac{\vec{F}}{l} = \frac{\mu_0 I_1 I_2}{2\pi r}\hat{j}$

(13) Torque experienced by current loop in a uniform magnetic field $\vec{\tau}_{net} = IBA\sin\theta\,\vec{k}$

(14) Moving coil galvanometer, $I = G\theta$; $G = \frac{K}{NBA}$ (Galvanometer constant)

(15) Current sensitivity of galvanometer $\frac{\theta}{I} = \frac{NBA}{K} = I_S$

(16) Voltage sensitivity of galvanometer $\frac{\theta}{V} = \frac{NBA}{KG} = V_S$

(17) Conversion of galvanometer into an ammeter.

Value of shunt resistance $S = \frac{I_gR_g}{I-I_g}$; Effective resistance $R_a = \frac{R_gS}{R_g+S}$

(18) Conversion of galvanometer into a voltmeter $R = \frac{V}{I_g} - R_g$

Effective resistance $R_V = R_g + R_h$

(19) Current loop as a magnetic dipole $\vec{B} = \frac{\mu_0}{2\pi}\frac{\vec{P}_m}{z^3}\hat{k}$; $(\vec{P}_m = IA)$

(20) Magnetic dipole moment of a revolving electron $\mu_L = \frac{neh}{4\pi m}$

(21) Minimum value of magnetic moment $(\mu_l)_{min} = \frac{eh}{4\pi m}$

(22) Bohr magneton = $\frac{eh}{4\pi m}$

UNIT – 4 ELCTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

1. Electromagnetic induction is not used in
a) Transformer b) room heater c) A.C. generator d) choke coil

2.The angle between the area vector A and plane of the area A is
a) π b) 2π c)$\pi/2$ d) Zero

3. If the flux associated with a coil varies at the rate of 1 Wb/minute then the induced e.m.f. is
a)1V b) 1/60 V c) 60 V d) 0.60 V

4. The average power consumed over one cycle in an a.c. circuit is
a) $E_{rms}\ I_{rms}$ b) $E_{rms}\ I_{rms}\cos\phi$ c) $E_{rms}\ I_{rms}\sin\phi$ d) $E_0\ I_0$

5. In LCR series a.c. circuit, the phase difference between current and voltage is 30°. The reactance of the circuit is 17.32 Ω. The value of resistance is
a) 30 Ω b) 10 Ω c) 17.32 Ω d) 1.732 Ω

6.An emf of 12 V is induced when the current in the coil changes from 2 A to 6 A in 0.5 s. The coefficient of self – induction of the coil is
a) 1.5 H b) 6 H c) 0.3 H d) 30 H

7. In an a.c. circuit with an inductor
a) Voltage lags current by $\pi/2$ b) voltage and current are in phase
c) voltage leads current by π d) current lags voltage by $\pi/2$

8. The unit of henry can also be written as
a) $V\ As^{-1}$ b) $Wb^{-1}\ A$ c) Ω s d) all of these

9. The generator rule is
a) Fleming's left hand rule b) Fleming's right hand rule
b) Maxwell's right hand corkscrew rule d) Right hand palm rule

10. The power loss is less in transmission line when
a) voltage is less but current is more b) both voltage and current are more
c) voltage is more but current is less d) both voltage and current are less

11. In an a.c. circuit, the current $I = I_0 \sin(\omega t - \pi/2)$ lags behind the e.m.f. $e = E_0 \sin(\omega t + \pi/2)$ by
a) 0 b) $\pi/4$ c) $\pi/2$ d) π

12. In a step – up transformer the input voltage is 220 V and the output voltage is 11 kV. The ratio of number of turns of primary to secondary is
a) 50 : 1 b) 1 : 50 c) 25 :1 d) 1 : 25

13. In LCR circuit when $X_L = X_C$ the current
a) is zero b) is in phase with the voltage
c) leads the voltage d) lags behind the voltage

14. Transformer works on
a) Both AC and DC b) AC more effectively than DC
c) AC only d) DC only

15. Lenz's law is in accordance with the law of
a) conservation of energy b) conservation of charge
c) conservation of momentum d) conservation of angular moment

16. The self – inductance of a straight conductor is
a) Zero b) infinity c) very large d) very small

17. In an AC Circuit with capacitor only, if the frequency of the signal is zero then the capacitive reactance is
a) Infinity b) zero c) finite maximum d) finite minimum

18. The reactance offered by 300 mH inductor to an AC supply of frequency 50 Hz is
a) 1046 Ω b) 94.2 Ω c) 9420 Ω d) 104.6 Ω

19. The r.m.s value of an a.c voltage with a peak value of 311 V is
a) 110 V b) 220 V c) 50 V d) 70.7 V

20. . The core used in audio frequency chokes is
a) Iron b) carbon c) lead d) steel

21. A power of 11,000 W is transmitted at 220 V. The current through line wire is
a) 50 A b) 5 A c) 500 A d) 0.5A

22. In a transformer, eddy current loss is minimized by using
a) laminated core made of Mumetal b) laminated core made of stelloy
c) shell type core d) thick copper wires

23. Which of the following cannot be stepped up in a transformer?
a) Input current b) Input voltage c) Input power d) All of these

24. For a.d.c. circuit, the value of capacitive reactance (X_c) is
a) zero b) infinity c) $\frac{\pi}{2}$ d) π

25.. The Q-factor (quality factor) of an a.c, circuit containing a resistance L and capacitor C is
a) Q = $\frac{1}{\sqrt{LC}}$ b) Q = $\frac{1}{R}\sqrt{\frac{C}{L}}$ c) Q = $\frac{1}{R}\sqrt{\frac{L}{C}}$ d) Q = $\frac{1}{\sqrt{LCR}}$

26. In a three phase AC generator by three coils are fastened rigidly together and are displaced from each other by an angle
a) 90° b) 180° c) 120° d) 360°

27. A DC of 5A produces the same heating effect as an AC of
a) 50 A rms current b) 5A peak current
c) 5A rms current d) 5/ $\sqrt{2}$A peak current

28. In RLC series circuit, at resonance
a) Current is minimum b) impedance is maximum
c) Circuit is purely inductive d) current is in phase with the voltage

29. In an A.C. Circuit
a) the average value of current is zero b) the average value of square of current is zero
c) the average power dissipation is zero d) the rms current is $\sqrt{2}$ times of peak current

30. A direct current of 5A produces the same heating effect as an A.C. (alternating current) of
a) 50 A rms current b) 5 A peak current c) 15 A rms current d) none of these

31. Which of the following devices does not allow direct current (D.C.) to pass through?
a) Capacitor b) Inductor c) Resistor d) All of these

32. A coil of area of cross – section $0.5m^2$ with 10 turns is in a plane which is perpendicular to a uniform magnetic field of 0.2 Wb/m^2. The magnetic flux through the coil is
a) 100 Wb b) 10 Wb c) 1 Wb d) zero

33. An e.m.f of 12V is induced when the current in the coil changes at the rate of 40 As^{-1}. The Coefficient of self – induction of the coil is
a) 0.3 H b) 0.003 H c) 30 H d) 4.8 H

34. That part of the A.C, generator that passes. The current from the coil to the external circuit is
a) field magnet b) split rings c) slip – rings d) brushes

35. The r.m.s. value of the alternating current flowing through a resistor is 5A.its peak value is
a) 3.536 A b) 70.7 A c) 7.07A d) 7A

36. In an A.c. circuit average power consumed is 200 W and the apparent power is 300 W. the power factor is
a) 1.5 b) 0.66 c) 0.33 d) 1

37. The effective value of alternating current is
a) $\frac{I_O}{2}$ b) $\frac{I_O}{\sqrt{2}}$ c) $I_0\sqrt{2}$ d) $2\ I_0$

38. A rectangular coil is uniformly rotated in a uniform magnetic field such that the axis of rotation is perpendicular to the direction of the magnetic field. When the plans of the coil is perpendicular to the magnetic field
a) (i) Magnetic flux is zero. (ii) induced e.m.f is zero
b) (i) magnetic flux ix maximum (ii) induced e.m.f is maximum
c) (i) magnetic flux is maximum (ii) induced e.m.f is zero
d) (i) magnetic flux is zero, (ii) induced e.m.f is maximum

39. In an a.c. circuit, the voltage leads the current by a phase of $\frac{\pi}{2}$, then the circuit has
a) Only an inductor (L) b) only a capacitor (C)
c) only a resistor (R) d) L, C and R in series

40. The resonant frequency of RLC circuit is γ_0 The inductance is doubled. The capacitance is also doubled. Now the resonant frequency of the circuit is
a) $2\gamma_0$. b) $\frac{\gamma_0}{2}$ c) $\frac{\gamma_0}{4}$ d) $\frac{\gamma_0}{\sqrt{2}}$

41. When the frequency of an a.c. circuit increases, the capacitive reactance offered by capacitor connected in the circuit
a) increases b) decreases c) remains the same d) becomes zero

42. The coefficient of self – induction of a solenoid is independent of
a) the number of turns in coil b) the area of cross – section of the coil
c) the length of the coil d) the current passing through the coil.
a) The instantaneous emf and current equations of an a.c circuit are respectively

43. e = 200 sin (ωt + π/3) and i = 10 sin ωt The average power consumed over one complete cycle is:
a) 2000 W b) 1000 W c) 500 W d) 707 W

44. If an emf of 25V is induced when the current in the coil changes at the rate of 100 As^{-1}, then the coefficient of self induction of the coil is :

a) 0.3 H b) 0.25 H c) 2.5 H d) 0.25 mH

45. In an A.C Circuit, the instantaneous values of emf and current are respectively

$e = 200 \sin((\omega t - \pi/3)$ $i = 10 \sin(\omega t + \pi/6)$

(a) voltage lags behind current by a phase angle of $\pi/3$

(b) current leads voltage by a phase angle of $\pi/6$

(c) Current leads voltage by a phase angle of $\pi/2$

(d) voltage leads current by a phase angle of $\pi/2$

46. In a LCR series a.c circuit, the phase difference between current and voltage is 60^{o}. if the net reactance of the circuit is 17.32 Ω, the value of the resistance is :

(a) 30 Ω (b) 17.32 Ω (c) 10 Ω (d) 17.32 Ω

UNIT : 4

1. (b) room heater

2. (c) $\pi/2$

3. (b) $1/60$ V.

4. (b) $E_{rms}\ I_{rms} \cos\phi$

5. (a) 30 Ω.

6. (a) 1.5 H.

7. (d) Current lags voltage by $\pi/2$

8. (c) Ω s

3. $e = \frac{d\phi}{dt} = 1$ wb/minute

$= \frac{1}{60}\ \frac{wb}{sec} = 1/60$ V

5. $\tan\phi = \frac{X_L - X_C}{R}$

$R = \frac{X_L - X_C}{\tan\phi} = \frac{17.32}{\tan 30^{\circ}} = \frac{10\times\sqrt{3}}{1/\sqrt{3}}$

$= 10 \times 3 = 30$ Ω

6. $L = e/(dI/dt) = \frac{12}{\left(\frac{6-0}{0.5}\right)} = \frac{6}{4} = 1.5$ H

9. (b) Fleming's right hand rule
10. (c) Voltage is more but current is less.
11. (d) π
12. (b) 1 : 50.
13. (b) is in phase with the voltage.
14. (c) AC only
15. (a) Conservation of energy
16. (a) Zero
17. (a) Infinity.
18. (b) 94.2 Ω
19. (b) 220V.
20. (a) Iron.
21. (a) 50 A.
22. (b) laminated Core made of Stelloy
23. (c) Input power.
24. (b) Infinity
25. (c) $Q = \frac{1}{R}\sqrt{L/C}$
26. (c) 120°
27. (b) 5 × rms current.
28. (d) Current is in phase with the voltage.
29. (a) the average value of Current is Zero.
30. (d) None of these.
31. (a) Capacitor.
32. (c) 1 wb.
33. (a) 0.3 H
34. (b) brushes.
35. (c) 7.07 A.
36. (b) 0.66.
37. (b) $I_0/\sqrt{2}$
38. (c) i) Magnetic flux is Maximum, induced emf is Zero
39. (a) only an inductor (L)
40. (b) $\nu_0/2$

11. $\phi = \pi/2 - (-\pi/2)$
$= \pi/2 + \pi/2 = \pi$

12. $\frac{N_p}{N_s} = \frac{E_p}{E_s} = \frac{220}{11\times10^2} = 1/50.$

17. $\nu_0 = 0$; $X_c = \frac{1}{C.\omega} = \frac{1}{C.2\pi\nu}$
$\therefore X_c = \frac{1}{C.2\pi.0} = \frac{1}{0} = \infty$

18. $X_L = L.\omega = L.2\pi\nu =$
$= 300\times10^{-3} \times 2\times3.4\times50$
$= 94.2\ \Omega$

19. $E_{rms} = \frac{E_0}{\sqrt{2}} = 0.7 = 311\times0.707$
$= 220V$

21. $I = P/V = \frac{11000}{220} = 50\ A$

22. $\theta = 0$
$\phi = NAB\cos\theta$
$= 10\times0.5\times0.2\times\cos0$
$= 10\times0.5\times0.2\times1 = 1\ Wb$

33. $L = e/(dI/dt) = \frac{12}{40} = 0.3\ H$

35. $I_{rms} = I_0/\sqrt{2}$
$\therefore I_0 = \sqrt{2}\ I_{rms} = 1.414\times I_{rms}$
$= 1.414\times5 = 7.07\ A$

36. $\cos\phi = \frac{P_{av}}{P_{app}} = \frac{200}{300} = 0.66$

40. $\nu = \frac{1}{2\pi\sqrt{LC}}$
$\nu' = \frac{1}{2\pi\sqrt{L'C'}}$ $\quad L' \to 2L,\ C' \to 2C$
$\nu' = \frac{1}{2\pi\sqrt{2L.2C}}$
$= \frac{1}{2.2\pi\sqrt{LC}} = \frac{\nu_0}{2}$

(1) Magnetic flux $\Phi_B = \vec{B}.\vec{A} = BA\cos\theta$

(2) Rate of change of magnetic flux $\frac{d\Phi_B}{dt}$

(3) Magnitude of induced emf $e = \varepsilon = -\frac{Nd\Phi_B}{dt} = -\frac{d}{dt}(N\Phi_B)$ $N\Phi_B \rightarrow$ flux linkage

(4) Coefficient of self induction and law of electro magnetic induction are related as $\varepsilon = -\frac{d}{dt}(Li)$

(5) Self inductance of a long solenoid : $L = \mu n^2 Al$ $(\therefore n = \frac{N}{l})$

$$L = \frac{\mu_0 N^2 A}{l}; \; L = \mu_0 \mu_r n^2 Al$$

(6) Quantity of energy stored in an inductor $U_B = \frac{1}{2}Li^2$

(7) Coefficient of mutual induction $M_{12} = -\frac{\varepsilon_1}{\frac{di_2}{dt}}$ (or) $M_{21} = -\frac{\varepsilon_2}{\frac{di_1}{dt}}$

(8) Mutual induction of two long solenoids $M = \mu n_1 n_2 Al = \mu_0 \mu_r n_1 n_2 Al$

(9) Induced emf, $\varepsilon = -\frac{d}{dt}(NBA\cos\theta)$; $(\theta = \omega t)$

(10) Induced emf, $\varepsilon = -Blv$ (by changing the area enclosed by the coil) (ε = motional emf)

(11) Induced emf, $\varepsilon = -NA\cos\theta\left(\frac{dB}{dt}\right)$ (by changing the magnetic induction)

(12) Induced emf, $\varepsilon = NBA\,\omega \sin\omega t \Rightarrow \sin\omega t$, Also Induced current, $i = I_m \sin\omega t$

(13) Transformer, $\frac{N_s}{N_p} = \frac{I_p}{I_s} = \frac{V_s}{V_p} = k$

(14) Step up transformer : $k > 1$

(15) Step down transformer : $k < 1$

(16) Efficiency of transformer $\eta = \frac{\text{output power}}{\text{input power}} \times 100\%$

(17) AC voltage

$\varepsilon = I_m \sin\omega t$; $E_m = NBA\,\omega$ (max emf) (Also AC Voltage $v = V_m \sin\omega t$)

(18) AC current

$i = E_m \sin\omega t$

(19) Effective current $I_{eff} = I_{rms} = \frac{I_m}{\sqrt{2}}$; $I_m = \sqrt{2}\, I_{eff}$

(20) Effective voltage $E_{eff} = E_{rms} = \frac{E_m}{\sqrt{2}}$; $E_m = \sqrt{2}\, E_{eff}$

(21) AC through a resistor :

$\varepsilon = E_m \sin \omega t$ (or) $v = V_m \sin \omega t$; $i = I_m \sin \omega t$; $I_m = \frac{V_m}{R}$

E & I are in phase with each other.

(22) AC through an inductor: emf leads the current by 90^o or $\frac{\pi}{2}$

$e = E_0 \sin\left(\omega t + \frac{\pi}{2}\right)$; $i = I_m \sin\left(\omega t - \pi/2\right)$; Where $I_m = \frac{V_m}{X_L}$

Inductive reactance $X_L = 2\pi\nu L = \omega L$

(23) AC through capacitor:

Current leads the voltage by $\frac{\pi}{2}$; $v = V_m \sin \omega t$; $i = I_m \sin(\omega t + \frac{\pi}{2})$; $i_m = \frac{V_m}{X_C}$

Capacitive reactance $X_c = \frac{1}{\omega C} = \frac{1}{2\pi\nu C}$

(24) LCR circuit

(a) Impedance $Z = \sqrt{R^2 + (X_L - X_C)^2}$

(b) Phase angle $\Phi = \tan^{-1} \frac{(X_L - X_C)}{R}$

(c) Resonant frequency $\nu_0 = \frac{1}{2\pi\sqrt{LC}}$

(d) Instantaneous current = $I_m \sin(\omega t \pm \Phi)$

(25) Quality factor (Q - factor) = $\frac{1}{R}\sqrt{\frac{L}{C}}$

(26) Power in an AC circuit $P_{av} = \frac{V_m I_m}{2} \cos\Phi$; $P_{av} = V_{rms} I_{rms} \cos\Phi$

(27) Choke coil : (ideal) $P_{av} = V_{rms} I_{rms} . \cos\frac{\pi}{2} = 0$; $P_{av} = V_{rms} . I_{rms} \frac{r}{\sqrt{r^2 + \omega^2 L^2}}$

(27) Lorentz force, $\vec{F}_B = e(\vec{v} \times \vec{B})$

- $\vec{F}_B = -e\vec{E}$
- $v = \frac{E}{B}$
- $V = El = (Bv)l$
- Motional emf from Lorentz, force , $\varepsilon = B l v$
- $i = \frac{\varepsilon}{R} = \frac{Blv}{R}$

(28) Motional emf from Faraday;s law : $\varepsilon = B\,l\,v$

- Power P = force (f) × velocity (v) Also $P = \frac{B^2 l^2 v^2}{R} = i^2 R$

(29) Energy density, $\mu_B = \frac{U_B}{Al} = \frac{\frac{1}{2}Li^2}{Al}$ Also $\mu_B = \frac{B^2}{2\mu}$ $[B = \mu_0 n_i]$

Values And Units

millihenry (mH)	10^{-3}H	
1 Gauss	10^{-4}T	
Permeability of free space μ_0	$4\pi \times 10^{-7}$ H/m	
1 ms	1 milli second	10^{-3}s
1 μs	1 micro second	10^{-6}s
Exponent *e*	2.718	
1μF	1 micro farad	10^{-6}F
1 pF	1 picro farad	10^{-12}F
1 MW	10^{6}W	

Parameter	**SI Unit**
induced emf	volt (V)
manetic flux	weber (W)
magnetic field	tesla (T) $\left(\frac{\text{weber}}{m^2}\right)$
inductance	henry (H)
capacitance	farad (F)
resistance	ohm (Ω)
impedance	ohm (Ω)
reactance	ohm (Ω)
power dissipated	watt (W)
energy	joule (J)

Unit – 5 ELECTROMAGNETIC WAVES

1. The existence of electromagnetic waves was confirmed experimentally by
a) Hertz b) Maxwell c) Huygens d) Planck

2. Which one of the following is not an electromagnetic wave
a) X – rays b) γ– rays c) U – V rays **d)β – rays**

3. Atomic spectrum should be
a) Pure line spectrum b) emission band spectrum
c) Absorption line spectrum d) absorption band spectrum

4. Electric filament lamp gives rise to
a) Line spectrum **b) continuous spectrum**
c) band spectrum d) line absorption spectrum

5. Which of the following gives rise to continuous emission spectrum?
a) Electric filament lamp b) Sodium vapour lamp
c) Gases in the discharge tube d) Calcium salt in bunsen flame

6. In an electromagnetic wave
a) Power is equally transferred along the electric and magnetic fields
b) Power is transmitted in a direction perpendicular to both the fields
c) Power is transmitted along electric field
d) Power is transmitted along magnetic field

7. Electromagnetic waves are
a) Transverse b) longitudinal
c) may be longitudinal or transverse d) neither longitudinal nor transverse

8. In an EM wave, the angle between the electric and the magnetic field vectors are at **90º**

9. The example of line absorption spectrum is **solar** spectrum

10. The **line** spectrum is used to identify the gas.

11. Incandescent solids, carbon arc lamp etc. give **continuous** spectrum.

12 Electromagnetic waves are discovered by **J.C.Maxwell1**

13.. An accelerated charge is a source of **electromagnetic radiation**

14. spectra of atomic hydrogen, helium is **line emission spectrum**

Rays	Wavelength	Frequency	Uses
Radio waves	1×10^{-1} m to 1×10^{4} m	3×10^{9} Hz to 3×10^{4} Hz.	radio and television
Microwaves	1×10^{-3} m to 3×10^{-1} m	3×10^{11} Hz to 1×10^{9} Hz.	Aircraft , microwave oven
Infrared radiation	8×10^{-7} m to 5×10^{-3} m	4×10^{14} Hz to 6×10^{10} Hz.	Infrared photo , tv remote , night vision
Visible light	4×10^{-7} m to 7×10^{-7} m	7×10^{14} Hz to 4×10^{14} Hz.	Study structure
Ultraviolet radiation	6×10^{-10} m to 4×10^{-7} m	5×10^{17} Hz to 7×10^{14} Hz.	Sterilizing agent
X-rays	10^{-13} m to 10^{-8} m	3×10^{21} Hz to 1×10^{16} Hz.	detecting fractures
Gamma rays	1×10^{-14} m to 1×10^{-10} m	3×10^{22} Hz to 3×10^{18}	atomic nuclei

1. Velocity of EM wave in Vacuum $C=\frac{1}{\sqrt{\mu_0\varepsilon_0}}$

   μ - permeability of free space ; ε_0 - permittivity of free space

2. Frequency of oscillation of charges between plates $\nu=\frac{1}{2\pi\sqrt{LC}}$

   C = capacitance, L - inductance (small wire)

3. The speed of electromagnetic wave $\nu=\frac{E_0}{B_0}$

   E_0 = Amplitude of oscillating electric filed ; B_0 = Amplitude of oscillating magnetic field.

4. Intensity (I) = $\frac{\text{Power (P)}}{\text{Surface Area (A)}}=\frac{\text{Total electromagnetic energy}}{\text{Surface Area (A)} \times \text{time (t)}}$

5. The average energy density of electromagnetic wave is $u=\varepsilon_0E^2=\frac{1}{\mu_0}\times B^2$

   ε_0 = Permittivity of free space ; μ_0 = Permeability of free space

6. Momentum Imparted by electromagnetic wave on the surface is $p=\frac{U}{c}=\frac{\text{Energy}}{\text{Velocity of light}}$

7. Ampere's Maxwell Law : $\oint \vec{B}\cdot\vec{dl}=\mu_0 I_{enclosed}+\mu_0\varepsilon_0\frac{d}{dt}\int\vec{E}\cdot d\vec{A}$

8. Faraday's Law : $\oint \vec{E}\cdot\vec{dl}=\frac{d}{dt}\Phi_B$; Φ_B - Magnetic flus.

9. Gauss's Law : $\oint \vec{E}\cdot d\vec{A}=\frac{Q_{enclosed}}{\varepsilon_0}$

10. Ampere's circuital Law : $\oint \vec{B}\cdot\vec{dl}=\mu_0 I_0$; I_c conduction current

11. Refractive Index of the medium $\mu=\sqrt{\varepsilon_r\mu_r}$