ELECTROMAGNETIC THEORY & TRANSMISSION LINES

UNIT-I

1. State coulombs law.

Coulombs law states that the force between any two point charges is directly proportional to the product of their magnitudes and inversely proportional to the square of the distance between them. It is directed along the line joining the two charges.

$F=Q_1Q_2 / 4\pi\varepsilon r^2$ ar

2. State Gauss law for electric fields

The total electric flux passing through any closed surface is equal to the total charge enclosed by that surface.

3. Define electric flux.

The lines of electric force are electric flux.

4. Define electric flux density.

Electric flux density is defined as electric flux per unit area.

5. Define electric field intensity.

Electric field intensity is defined as the electric force per unit positive charge.

$E = F/Q$

$= Q/4\pi\varepsilon r^2$ V/m

6. Name few applications of Gauss law in electrostatics.

Gauss law is applied to find the electric field intensity from a closed surface.e.g)Electric field can be determined for shell, two concentric shell or cylinders etc.

7. What is a point charge?

Point charge is one whose maximum dimension is very small in comparison with any other length.

8. Define linear charge density.

It is the charge per unit length.

9. Define surface charge density.

It is the charge per surface area.

10. State the principle of superposition of fields.

The total electric field at a point is the algebraic sum of the individual electric field at that point.

11. Explain the conservative property of electric field.

The work done in moving a point charge around a closed path in a electric field is zero.
Such a field is said to be conservative.

$\int E.dl = 0$

12. Define ohms law at a point

Ohms law at appoint states that the field strength within a conductor is proportional to current density.

13. Give the relation between electric field intensity and electric flux density.

$D=\varepsilon E$ C/m^2

14. What is the physical significance of div D?

$\nabla \bullet D = -\rho_v$

The divergence of a vector flux density is electric flux per unit volume leaving a small volume. This is equal to the volume charge density.

15. What is the effect of permittivity on the force between two charges?

Increase in permittivity of the medium tends to decrease the force between two charges and decrease in permittivity of the medium tends to increase the force between two charges.

16. State electric displacement.

The electric flux or electric displacement through a closed surface is equal to the charge enclosed by the surface.

17. What is displacement flux density?

The electric displacement per unit area is known as electric displacement density or electric flux density.

18. State Divergence Theorem.

The integral of the divergence of a vector over a volume v is equal to the surface integral o f the normal component of the vector over the surface bounded by the volume.

19. Give the expression for electric field intensity due to a single shell of charge

$E = Q / 4\pi\varepsilon r^2$

20. What is electrostatic force?

The force between any two particles due to existing charges is known as electrostatic force, repulsive for like and attractive for unlike.

21. Define divergence.

The divergence of a vector F at any point is defined as the limit of its surface integral per unit volume as the volume enclosed by the surface around the point shrinks to zero.

22. Define dielectric strength.

The dielectric strength of a dielectric is defined as the maximum value of electric field that canbe applied to the dielectric without its electric breakdown.

23. Write Poisson's and Laplace's equations.

Poisson's eqn: $\nabla^2 V = -\rho_v / \varepsilon$

Laplace's eqn: $\nabla^2 V = 0$

24. Define potential difference.

Potential difference is defined as the work done in moving a unit positive charge from one point to another point in an electric field.

25. Define potential.

Potential at any point is defined as the work done in moving a unit positive charge from infinity to that point in an electric field. $V=Q / 4\pi\varepsilon r$

26. Give the relationship between potential gradiant and electric field.

$E = -\nabla V$

27. Write the expression for energy density in electrostatic field.

$W=1 / 2\ \varepsilon E^2$

28. Define electric dipole.

Electric dipole is nothing but two equal and opposite point charges separated by a finite distance.

29. Write down the expression for capacitance between two parallel plates.

$C=\varepsilon A / d$

30. What are the significant physical differences between Poisson 's and laplace 's equations.

Poisson's and Laplace's equations are useful for determining the electrostatic potential V in regions whose boundaries are known.

When the region of interest contains charges poissons equation can be used to find the potential. When the region is free from charge laplace equation is used to find the potential.

31. Define Potential gradient?

It is the maximum rate of change of potential w.r.t distance i.e. $\left| dv/dl \right|_{max}$

32. What is a capacitor?

A capacitor is an electrical device composed of two conductors which are separated through a dielectric medium and which can store equal and opposite charges ,independent of whether other conductors in the system are charged or not.

UNIT-II

1. State Biot –Savarts law.

It states that the magnetic flux density at any point due to current element is proportional to the current element and sine of the angle between the elemental length and inversely proportional to the square of the distance between them

$dB=\mu_0 Idl \sin\theta / 4\pi r^2$

2. State stokes theorem.

The line integral of a vector around a closed path is equal to the surface integral of the normal component of its curl over any surface bounded by the path

$H.dl = (\nabla x H)ds$

3. Define current density.

Current density is defined as the current per unit area. $J= I/A$ Amp/m^2

4. Write the point form of continuity equation and explain its significance.

$\nabla \bullet J= - \rho v / t$

5. What is meant by displacement current?

Displacement current is nothing but the current flowing through capacitor. $J= D / t$

6. State point form of ohms law.

Point form of ohms law states that the field strength within a conductor is proportional to the current density. $J=\sigma E$

7. State amperes circuital law.

Magnetic field intensity around a closed path is equal to the current enclosed by the path.

$H \bullet dl=I$

8. **Give the force on a current element.**

$dF = BIdl\sin\theta$

9. **Define magnetic field strength.**

The magnetic field strength (H) is a vector having the same direction as magnetic flux density.

$H=B/\mu$

10. Define magnetic vector potential.

It is defined as that quantity whose curl gives the magnetic flux density.

$B=\nabla \times A$

$=\mu / 4\pi$ J/r dv web/m^2

11. State Gauss law for magnetic field.

The total magnetic flux passing through any closed surface is equal to zero. B.ds =0

12. Give the relation between magnetic flux density and magnetic field intensity.

$B =\mu H$

13. Write down the magnetic boundary conditions.

i) The normal components of flux density B is continuous across the boundary.

ii) The tangential component of field intensity is continuous across the boundary.

14. Write the boundary conditions at the interface between two perfect dielectrics.

i)The tangential component of electric field is continuous i.e Et1=Et2

ii) The normal component of electric flux density is continuous i.e Dn1=Dn2

15. State Lenz law.

Lenz's law states that the induced emf in a circuit produces a current which opposes the change in magnetic flux producing it.

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

$W = ½ LI^2$

18. What is energy density in magnetic field?

$W = ½ \mu H^2$

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

There is a fundamental difference between static electric and magnetic field lines .The tubes of electric flux originate and terminates on charges, whereas magnetic flux tubes are continuous.

20. What is the significance of displacement current?

The concept of displacement current was introduced to justify the production of magnetic field in empty space. It signifies that a changing electric field induces a magnetic field .In empty space the conduction current is zero and the magnetic fields are entirely due to displacement current.

21. Distinguish between conduction and displacement currents.

The current through a resistive element is termed as conduction current whereas the current through a capacitive element is termed as displacement current.

UNIT-III

1. Mention the properties of uniform plane wave.

i) At every point in space, the electric field E and magnetic field H are perpendicular to each other.

ii) The fields vary harmonically with time and at the same frequency everywhere in space.

2. What are uniform plane waves?

Electromagnetic waves which consist of electric and magnetic fields that are perpendicular to each other and to the direction of propagation and are uniform in plane perpendicular to the direction of propagation are known as uniform plane waves.

3. Define intrinsic impedance or characteristic impedance.

It is the ratio of electric field to magnetic field or It is the ratio of square root of permeability to permittivity of medium.

4. Give the characteristic impedance of free space.

377ohms

5. Define propagation constant.

Propagation constant is a complex number

$$\gamma = \alpha + j\beta$$

where α is attenuation constant

β is phase constant

$\gamma = j\omega\mu (\sigma + j\omega\varepsilon)$

6. Define skin depth

It is defined as that depth in which the wave has been attenuated to 1/e or approximately 37% of its original value. $= 1/\alpha = 2 / j\omega\sigma$

7. Define Poynting vector.

The pointing vector is defined as rate of flow of energy of a wave as it propagates.

$P = E \times H$

8. Define pointing vector.

The vector product of electric field intensity and magnetic field intensity at a point is a measure of the rate of energy flow per unit area at that point.

9. State Poyntings Theorem.

The net power flowing out of a given volume is equal to the time rate of decrease of the the energy stored within the volume- conduction losses.

10. Write down the wave equation for E and H in free space.

11. Define loss tangent.

Loss tangent is the ratio of the magnitude of conduction current density to displacement cuurrent density of the medium. Tan $\theta = Jc/J_D = \sigma / \omega\varepsilon$

12. Define reflection coefficients.

Reflection coefficient is defined as the ratio of the magnitude of the reflected field to that of the incident field.

13. Define transmission coefficients.

Transmission coefficient is defined as the ratio of the magnitude of the transmitted field to that of incident field.

14. What will happen when the wave is incident obliquely over dielectric –dielectric boundary?

When a plane wave is incident obliquely on the surface of a perfect dielectric part of the energy is transmitted and part of it is reflected .But in this case the transmitted wave will be refracted, that is the direction of propagation is altered.

15. Write short notes on imperfect dielectrics.

A material is classified as imperfect dielectrics for $\sigma << \omega\varepsilon$ that is conduction current density is small in magnitude compared to the displacement current density.

16. Define Brewster.

It is the angle of incidence for which the angle of reflection is zero. i.e Er/Ei = 0

Tan $\theta = \sqrt{e2}/e1$

17. Define critical angle.

It is the angle of incidence for which total refection occurs or angle of incidence for which angle of reflection is 90^0. $\theta = \sin^{-1}(\sqrt{e2}/e1)$

18. Give snell's law?

Sin θ_i / sin $\theta_t = \sqrt{e2}/e1$

19. Define law of reflection?

It is defined as the angle of incidence is equal to the angle of reflection. $\theta_i = \theta_r$

UNIT-IV

1. What is transmission line? Draw its equivalent circuit.
2. Write the general equations of transmission line at any point from sending end.
3. Define propagation constant, attenuation constant and phase shift constant.
4. Write the relation between phase velocity and group velocity.
5. Define primary constants of transmission line.
6. Define secondary constants of transmission line.
7. Write the expressions for α and β interms of primary constants.
8. What is the condition for distortion-less transmission line?
9. List the important characteristics of a Transmission line or telephone line.
10. State skin effect?

UNIT-V

1. What is reflection coefficient?
2. Define VSWR?
3. Write relationship between K and VSWR?
4. What are the minimum and maximum values of K and S?
5. What are the applications of Smith chart?
6. Write the relation between Zo,Zoc and Zsc?
7. What is stub matching?
8. List the advantages of single stub matching?