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ELECTROMAGNETIC THEORY(EE231)

1.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

$\int H.dl = \iint(\nabla xH)ds$

2.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

3.State Gauss law.

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

4.Define electric flux.

The lines of electric force is electric flux.

5.Define electric flux density.

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

6.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

7.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.

8.What is a point charge?

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

9.Define linear charge density.

It is the charge per unit length.

10.Write poisons and laplaces equations.

Poissons eqn:

$$\nabla^2 V = -\rho_v/\varepsilon$$

Laplaces eqn:

$$\nabla^2 V = 0$$

11.State the condition for the vector F to be solenoidal.

$$\nabla \bullet F = 0$$

12. .State the condition for the vector F to be irrotational.

$$\nabla x F = 0$$

13.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.

14.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.

$V=Q / 4\pi\varepsilon r$

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

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

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

$E= - \nabla V$

17.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.

18. Define current density.

Current density is defined as the current per unit area.

$J= I/A \ Amp/m^2$

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

$\nabla \bullet J= - \partial \rho_v / \partial t$

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

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

21.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

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

$C=\varepsilon A / d$

23.What is meant by displacement current?

Displacement current is nothing but the current flowing through capacitor.

$J=\partial D / \partial t$

24.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.

$J=\sigma E$

25 Define surface charge density.

It is the charge per surface area.

26.State amperes circuital law.

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

$\int H \bullet dl = I$

27.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

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

28.Define magnetic vector potential.

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

$B=\nabla \times A$

$=\mu / 4\pi \iiint J/r \, dv \text{ web/m}^2$

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

$H = I/2a.$

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

$B = \mu H$

31.Write down the magnetic boundary conditions.

i) The normal components of flux density Bis continuous across the boundary.
ii) The tangential component of field intensity is continuous across the boundary.

32.Give the force on a current element.

$dF = BIdl\sin\theta$

33..Define magnetic moment.

Magnetic moment is defined as the maximum torque per magnetic induction of flux density.

$m=IA$

34.State Gauss law for magnetic field.

The total magnetic flux passing through any closed surface is equal to zero.

$\int B.ds = 0$

35.Define a wave.

If a physical phenomenon that occurs at one place at a given time is reproduced at other places at later times , the time delay being proportional to the space separation from the first location then the group of phenomena constitutes a wave.

36. 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.

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

$\nabla^2 H - \mu_0 \varepsilon_0 \partial^2 H / \partial t^2 = 0$
$\nabla^2 E - \mu_0 \varepsilon_0 \partial^2 E / \partial t^2 = 0$

38.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.

39.Give the characteristic impedance of free space.

377ohms

40.Define propagation constant.

Propagation constant is a complex number

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

where α is attenuation constant
β is phase constant
$\gamma = \sqrt{j\omega\mu(\sigma + j\omega\varepsilon)}$

41.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.
$\Delta = 1/\alpha = \sqrt{2/j\omega\sigma}$

42.Define Poynting vector.

The pointing vector is defined as rate of flow of energy of a wave as it propagates.
P =E X H

43State 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.

44.Give significant physical difference between poisons and laplaces equations.

When the region contains charges poisons equation is used and when there is no charges laplaces equation is applied.

45.Give the difficulties in FDM.

FDM is difficult to apply for problems involving irregular boundaries and non homogenious material properties.

46.Explain the steps in finite element method.

i) Discretisation of the solution region into elements.
ii) Generation of equations for fields at each element
iii) Assembly of all elements
iv) Solution of the resulting system

47.State Maxwells fourth equation.

The net magnetic flux emerging through any closed surface is zero.

48. State Maxwells Third equation

The total electric displacement through the surface enclosing a volume is equal to the total charge within the volume.

49.State the principle of superposition of fields.

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

50.Define ohms law at a point

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

51.Define self inductance.

Self inductance is defined as the rate of total magnetic flux linkage to the current through the coil.

52.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.

53.Give the formula to find potential at a point which is surrounded by four orthogonal points inFDM.

V0= ¼(V1+V2+V3+V4)

54.Give the formula to find potential at a point which is surrounded by six orthogonal points inFDM.

V0= ¼(V1+V2+V3+V4 +V5+V6)

55.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.

56.Electromagnetic waves are --------- in nature

Transverse

57.Give the properties of electromagnetic waves in free space.

i) The wave propagates with a speed equal to that of light in free space.
ii) Electromagnetic waves are transverse in nature.
iii) The wave vectors E and H are mutually perpendicular .
iv) The electrostatic energy density is equal to the magnetostatic energy density.

58.The speed of electromagnetic wave in isotropic dielectrics is --------- than the speed of electromagnetic waves in free space.

Less.

59.What are uniform plane waves.?

Electromagnetic waves which consists 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.

60.Define wave polarization.

The wave polarization is defined as its electric field vector orientation as a function of time, at a fixed position in space.

61.When is a wave said to be linearly polarized?

A wave is said to be linearly polarized when E is a forced straight line orientation for all times and position.

62.What are boundary conditions?

The conditions pertaining to potential, normal component of electric intensity are called boundary conditions.

63.Explain the finite difference technique.

Finite difference technique defines the electromagnetic fields in regularly arranged grid points and express the discrete differential operator by algebraic equations linking neighbouring nodes.

64.Finite difference method is most commonly used ---------

Time domain method.

65.What is the major drawback in FDM?

The major drawback of FDM is its inability to handle curved boundaries accurately.

66.What are method of charges?

Under favourable conditions, it is possible to infer from geometry of the situation that a small number of suitably placed charges of appropriate magnitudes ,external to the region of interest can conserve the required boundary conditions .there charges are called method of charges.

67.What is method of images?

The replacement of the actual problem with boundaries by an enlarged region with image charges but no boundaries is called the method of images.

68.When is method of images used?

Method of images is mainly used in solving problems of one or more point charges in the presence of boundary surface.

69.What are the disadvantages of method of images?

The disadvantage of method of images is that if the problem consists of a system of conductors maintained at specified potential and with no isolate free charge cannot be solved by this method.

70.Why finite element method is developed?

FEM is developed to accurately model electromagnetic fields in complicated ,homogeneous structures .These elements can be employed for modeling the behaviour of the field at a material interfaces and at the vicinity of geometrical singularities.

71.Where is finite diference method applied?

Finite difference time domain formulation of Maxwells curl equations has been applied to optical wave guide structures such as a directional coupler with two dimensional TE polarization.

72.The finite difference of a constant is --------

Zero.

73.Give any two properties of electromagnetic waves in conducting medium.

i) The wave gets attenuated with penetration.
ii) The wave is transverse with respect to E and H

74.Define inductance.

The inductance of a conductor system may be defined as the ratio of the linking magnetic flux to the current producing flux.

75.Give some examples for inductor.

Some examples for inductors are coils loops and solenoids.

76.Give the expression for energy in an inductor.

$Wm=1/2\ LI^2$

77.What is the main cause of eddy current?

The main cause of eddy current is that it produces ohmic power loss and causes local heating.

78.How can the eddy current losses be eliminated?

The eddy current losses can be eliminated by providing laminations .The total eddy current power loss decreases as the number of lamination increases.

79.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.

80.Distinguish between field and circuit theory

Field Theory	Circuit Theory

1.Deals with distributed elements	Deals with circuit theory lumped elements
2.E and H are the main system variables	V and I are the main system variables
3.It has large number of governing variables and involves vector quantities	It has fewer number of governing variables and is concerned with the magnitude of the various quantities

81.Define electrostatic force

Electrostatic force is defined as the force between the two particles due to the existing charges.

82.Define divergence.

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

83.How is electric energy stored in a capacitor?

In a capacitor the work done in charging a capacitor is stored in the form of electric energy.

84.What are dielectrics?

Dielectrics are materials that may not conduct electricity through it but on applying electric field , induce charges are produced on its faces .The valance electron in an atom of a dielectric are tightly bound to their nucleus.

85.Define capacitance

Capacitance of a conductor is defined as the ratio of the charge on it to its potential due to that charge.

86.Define dielectric strength.

Dielectric strength of a dielectric is defined as the maximum value of electric field that can be applied to the dielectric without its elect breakdown.

87.What is magnetostatics?

Electric charges in motion i.e)currents produce magnetic fields.

88.What is electrostatics?

Electric charges at rest produced on electric field called electostatics.

89.What is a solenoid?

A solenoid is a lond wire wound in a close packed helix and carrying an electric current.

90.Under what circumstances a current carrying loop does not rotate in the magnetic field?

If the current carrying loop is placed in a magnetic field with its plane perpendicular to the field then it will not rotate.

91.Define magnetic dipole moment.

Magnetic dipole moment is deined as the product of the loop current and the vector area of the loop.

92.Define magnetic moment.

Magnetic moment is defined as the maximum torque on the lop per unit magnetic induction.

93.State the stokes theorem.

Stokes theorem states that the integral of the tangential component of a vector field F around C is equal to the integral of the normal component of curl F over s.

94.Write the expression for force on a test charge q that moves with velocity V in magnetic field of flux density B.

$dF = dQ\ V\ xB$

95.What is the direction of force between two parallel wires carrying current in same direction.

In the same direction the force act inwards and the wires attract each other.

96. What is the direction of force between two parallel wires carrying current in opposite direction.

In th e opposite direction the force act outwards and the wires repel each other.

97.Give the relation between J and H

J = curl H

98.Define mutual inductance.

Mutual inductance is defined as the ratio of voltage generated in one circuit by the rate of change of current in another.

99.What is self inductance?

Self inductance is defined as the voltage generated in one circuit by the rate of change of current in the same circuit.

100.What is the significance of faradays law.

The total voltage or emf induced in the circuit is equal to the line integral of the electric field around around a fixed closed loop .It is also equal to the normal component of the time rate of decrease of the flux density integrated over a surface bounded by the circuit.-