$$L = \frac{N\varphi}{I} \quad H$$

- The mutual inductance between two coils is defined as the ratio of induced magnetic flux linkage in one coil to current through in other coil.

$$M = \frac{N_2}{I_1}\varphi_{12}$$

TWO MARKS

1. What is the force exerted in a differential element

   Force exerted on differential current element is, $\overline{\mathbf{dF}} = I\ \overline{\mathbf{dL}} \times \overline{\mathbf{B}}$

2. Define Torque.

   The moment of a force or torque about a specified point is defined as the vector product of the moment arm $\bar{R}$ and the force $\bar{F}$. It is measured in Newton meter (Nm)

   $$\bar{T} = \bar{R} \times \bar{F}$$

3. Define Magnetic Dipole Moment

   The magnetic dipole moment is given by

   $$\bar{m} = (IS)\overline{a_n}\ A.m^2$$

4. Write down the Classification of magnetic materials.
   - Dia magnetic materials
   - Para magnetic materials
   - Ferro magnetic materials
   - Antiferro magnetic materials
   - Ferri magnetic materials

5. State Kirchhoff's flux law

   Kirchhoff's flux law states that the total magnetic flux arriving at any junction in a magnetic circuits is equal to the total magnetic field leaving that junction. Using this law parallel magnetic circuits can be easily analyzed. Mathematically,

   $$\sum \varphi = 0$$

6. State Kirchhoff's m.m.f law

   Kirchhoff's m.m.f law states that the reluctance m.m.f around a closed magnetic circuit is equal to the algebraic sum of products of flux and reluctance of each part of the closed circuits. For closed magnetic circuits,

   $$\sum M.M.F = \sum \varphi\Re$$

   Kirchhoff's m.m.f law can be alternatively stated as reluctance m.m.f around any closed loop of the magnetic field strength and the length of each part of the circuit. Hence,

   $$\sum M.M.F = \sum H.l$$

7. Define Reluctance

   A new quantity reluctance ($\Re$) as the ratio of the magneto motive force to the total flux

   $$\Re = \frac{e_m}{\varphi}$$

The reluctance is measured in $\frac{\text{Ampere. turn}}{\text{weber}}$

The resistance in electric circuit can be expressed in terms of conductivity σ as

$$R = \frac{l}{\sigma S}$$

Where l = length in meter

S = cross section area in m^2

σ = conductivity of the linear isotropic homogeneous material.

In case of magnetic circuit the reluctance

$$\Re = \frac{l}{\mu S}$$

8. Define Permeance

In magnetic circuit the reciprocal of the reluctance is called Permeance denoted by *P*. The Permeance is measured in Henries (H).

$$P = \frac{\mu S}{l}$$

9. Find the maximum torque on a n 100 turn rectangular coil, 0.2 m by 0.3m, carrying a current of 2A in the field of flux density 5 Wb/m^2?

Solution:

Given

N = 100

A = 0.2 x0.3 = 0.06 m2

I = 2A

B = 5 Wb/m2

T_{max} = NIAB

= 100 x 2 x 0.06 x 5

T_{max} = 60 N-m

10. Define Magnetic dipole

A small bar magnet with pole strength m and length l may be treated as small bar magnet. A small current carrying loop is called a magnetic dipole.

11. What is magnetic dipole moment?

It is the product of current and area of the loop .Its direction is normal to the loop.

m = I xA

where m – magnetic dipole moment, I – current in the loop and A – Area of the loop.

12. Define magnetization.

It is defined as ratio of magnetic dipole moment to unit volume.

$$M = \frac{\text{Magnetic dipole moment}}{\text{Volume}} = \frac{m}{V}$$

13. What is the relation between relative permeability and susceptibility.

$\mu_r = 1 + \chi m$

where

μ_r - relative permeability

χm - susceptibility

14. What are the different types of magnetic materials

According to their behavior ,magnetic materials are classified as diamagnetic ,paramagnetic and ferromagnetic materials.

15. Define m.m.f?

Magneto motive force of a magnetic circuit is equal to the line integral of magnetic field H around the closed circuit.

$$\text{m.m.f} = \int H.\,dl = NI \text{ amp-turns.}$$

16. Define Mutual inductance

The mutual inductance between two coils is defined as the ratio of induced magnetic flux linkage in one coil to current through in other coil.

$$M = \frac{N_2}{I_1}\varphi_{12}$$

N_2 = Number of turns in coil 2.

ϕ_{12} = Magnetic flux linkage in coil 12

I_1= Current through coil 1.

17. Write the relation between self inductance and mutual inductance

Relation between Mutual inductance and Self inductance

$$M = K\sqrt{L_1 L_2}$$

where M - Mutual inductance

L_1 - Self inductance of coil 1,

L_2 - Self inductance of coil 2,

K - Coupling coefficient

18. Define self inductance

The self induction of a coil is defined as ratio of total magnetic flux linkage to the circuit thro' the coil

$$L = \frac{N\phi}{I}(H)$$

where ϕ - Magnetic flux (Wb)

N - Number of turns

I - Current thro' the coil.

19. What is the capacitance of a parallel plate capacitor?

The capacitance of a parallel plate capacitor is

$$C = \frac{A\varepsilon_0\varepsilon_R}{D}\ farads$$

Where

A – area of the capacitor

d – distance between the parallel plates

20. Write down the magnetic boundary conditions

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

Bn1 = Bn2

- The tangential component of field intensity H is continuous across the Ht1 = Ht2

21. Define Boundary conditions.

The conditions existing at the boundary of the two media when field passes from one medium to other are called boundary conditions. The conditions existing at the boundary of the two media when field passes from one medium to other are called boundary conditions.

QUESTION BANK

1. Derive the Force on a moving charge
2. Describe Force on a differential current element
3. Derive an expression for the inductance of solenoid.
4. Obtain the expression for torque on the closed circuit.
5. Obtain the expression for force between two current carrying conductors.
6. Explain about The nature of magnetic materials
7. Derive an expression for the inductance of co-axial cable.
8. Derive an expression for the inductance of toroid.
9. Explain about The magnetic circuit
10. What is the Energy stored in Magnetic fields
11. State and explain magnetization and permeability.
12. Obtain boundary condition between two magnetic materials.
13. 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
14. Obtain an expression for the Potential energy and forces on magnetic materials.
15. Derive an expression for the inductance of a transmission lines.
16. Find the magnetic field intensity at the centre O of a square loop of sides equal to 5M and carrying 10A of current

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