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ELECTRICAL ENGINEERING

Objective Practice Sets

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1 CHAPTER Magnetic Circuit

Q.1 The laws of electromagnetic induction are summarized in the following equation:

(a) $e = L\frac{di}{dt}$ (b) $e = iR$

(c) $e = -\frac{d\psi}{dt}$ (d) None of these

Q.2 A coil of 1000 turns is wound on a core. A current of 1 A flowing through the coil creates a core flux of 1 mWb. What is the energy stored in the magnetic field?

(a) 1 J (b) $\frac{1}{4}$ J

(c) 2 J (d) $\frac{1}{2}$ J

Q.3 **Assertion (A) :** In an electric circuit, the current is due to the presence of electromotive force.

Reason (R) : In a magnetic circuit, the magnetic flux is due to the presence of a magnetomotive force.

(a) Both A and R are true and R is a correct explanation of A.
(b) Both A and R are true but R is not a correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Q.4 Consider the following statements regarding methods to increase the mutual inductance between two mutually coupled circuits.

1. Increase in the number of primary turns.
2. Increase in the number of secondary turns.
3. Decrease in the permeance offered to the mutual flux.
4. Decrease in the leakage flux.

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1, 2 and 4
(c) 2, 3 and 4 (d) 1, 2, 3 and 4

Q.5 For a linear electromagnetic circuit, the following statement is true.

(a) Field energy is equal to the co-energy.
(b) Field energy is greater than the co-energy.
(c) Field energy is lesser than the co-energy.
(d) Co-energy is zero.

Q.6 In which region of B-H curve a permanent magnet operating point lie:

(a) Second quadrant of B-H curve
(b) Second and third quadrant of B-H curve
(c) Fourth quadrant of B-H curve
(d) First quadrant of B-H curve

Q.7 A magnetic circuit with relative permeability of 50 having mean core length of 30 cm and cross sectional area of 10 cm^2, the value of permeance is _____ $\times 10^{-7}$ Wb/AT.

Q.8 The emf induced in a conductor of machine driven at 600 rpm, the peak value of flux density is 1.0 Wb/m^2, diameter of machine 2.0 meter and length of machine 0.30 m is

(a) 41.83 V (b) 29.58 V
(c) 9.42 V (d) 18.84 V

Q.9 An iron-cored choke, with 2 mm air-gap length, takes 2 A when fed from a constant-voltage source of 230 V. If its air-gap length is increased to 10 mm, then the magnetic flux produced by the choke would

(a) remains constant and the current would increase.
(b) decrease and the current would increase.
(c) decrease and the current would also decrease.
(d) remain constant and the current would decrease.

Q.10 **Assertion (A) :** Leakage flux does not follow the intended path in a magnetic circuit.

Reason (R) : In a magnetic circuit, all the flux produced by a coil is confined to desired magnetic path.

(a) Both A and R are true and R is a correct explanation of A.

Answers Magnetic Circuit

1. (c)	2. (d)	3. (b)	4. (b)	5. (a)	6. (a)	7. (2.09)	8. (d)	9. (a)
10. (d)	11. (b)	12. (b)	13. (a)	14. (c)	15. (d)	16. (b)	17. (1.2)	18. (a)
19. (0.8)	20. (188.56)		21. (b)	22. (210)	23. (b)	24. (0.833)		

Explanations Magnetic Circuit

1. (c)

From Faraday's law of electromagnetic induction,

$$e = -\frac{d\psi}{dt}$$

(minus sign is due to Lenz's law).

2. (d)

$$L = \frac{N\phi}{I} = \frac{1000 \times 10^{-3}}{1} = 1\text{ H}$$

$$\therefore \text{ Energy stored } = \frac{1}{2}LI^2 = \frac{1}{2} \times 1 \times 1^2$$

$$= \frac{1}{2}\text{ Joule}$$

3. (b)

- For an electrical circuit,

$$I = \frac{\text{Emf}}{R}$$

- For a magnetic circuit

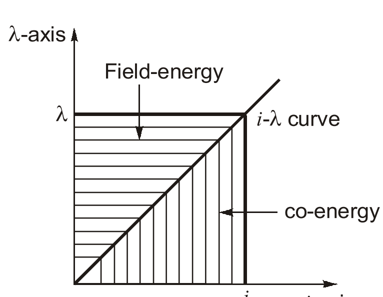
$$\phi = \frac{\text{Mmf}}{\text{Reluctance}}$$

- Current in electric circuit is analogous to flux in magnetic circuit.

4. (b)

Mutual inductance between two circuits can be increased by increasing the permeance or decreasing the reluctance offered to the mutual flux.

5. (a)



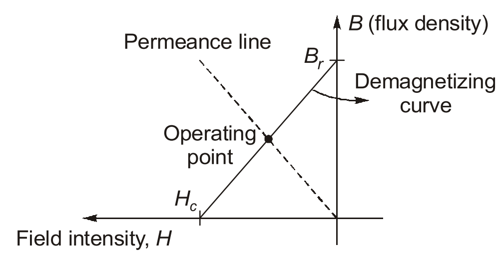
Where, $\lambda = N\phi$ = Flux linkage

Field energy is the energy absorbed by the magnetic system to establish flux ϕ.

For a linear electromagnetic circuit

$$\text{Field energy} = \text{Co-energy} = \frac{1}{2}\lambda i$$

6. (a)



7. Sol.

Given,
$$l = 30\text{ cm} = 0.3\text{ m}$$
$$\mu_r = 50$$
$$\mu_0 = 4\pi \times 10^{-7}\text{ H/m}$$
$$A = 10\text{ cm}^2 = 10 \times 10^{-4}\text{ m}^2$$

$$\because \quad \text{Reluctance} = \frac{l}{\mu_0\mu_r \cdot A}$$

$$\therefore \text{ Permeance } (P) = \frac{1}{\text{Reluctance}} = \frac{\mu_0\mu_r \cdot A}{l}$$

$$= \frac{4\pi \times 10^{-7} \times 50 \times 10 \times 10^{-4}}{0.3}$$

$$= 2.09 \times 10^{-7}\text{ Wb/AT}$$

8. (d)

$$\text{Area} = A = 2\pi rl = 2\pi \times 1 \times 0.3 = 0.6\pi$$
$$\phi = BA = 1 \times 0.6\pi = 0.6\pi$$

$$\text{Induced emf} = \frac{\phi}{T} = \frac{\phi N}{60} = 0.6\pi \times \frac{600}{60}$$
$$= 18.84\text{ V}$$

Hence, option (d) is correct.

9. (a)

Since length of air-gap is increased, therefore, reluctance offered to the magnetic circuit will increase.

2 CHAPTER

Transformers

MCQ and NAT Questions

Q.1 The power transformer is a
(a) constant voltage device
(b) constant main flux device
(c) constant current device
(d) constant power device

Q.2 P_i = core loss, P_c = copper loss. A transformer has maximum efficiency when
(a) $P_i/P_c = 2$ (b) $P_i/P_c = 15$
(c) $P_i/P_c = 1$ (d) $P_i/P_c = 0.5$

Q.3 In an auto-transformer, power is transferred, through
(a) Conduction process only
(b) Induction process only
(c) Both conduction and induction processes
(d) Mutual coupling

Q.4 For a single-phase transformer, r_e = total equivalent resistance, x_e = total equivalent leakage reactance, P_c = core loss. The load current at which maximum efficiency occurs is
(a) $\frac{P_c}{x_e}$ (b) $\sqrt{\frac{P_c}{x_e}}$
(c) $\frac{P_c}{r_e}$ (d) $\sqrt{\frac{P_c}{r_e}}$

Q.5 If the iron core of a transformer is replaced by an air core, then the hysteresis losses in the transformer will
(a) increase (b) decrease
(c) remain unchanged (d) become zero

Q.6 **Statement (I):** In case of parallel connection of transformers the transformer having greater equivalent leakage impedance shares more kVA and that having lower leakage impedance shares less kVA.
Statement (II): Transformers of different kVA rating can be operated in parallel provided their equivalent leakage impedances in ohms are inversely proportional to their respective kVA ratings.
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is **not** the correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Q.7 A 2 kVA transformer has iron loss of 150 Watts and full-load copper loss of 250 Watts. The maximum efficiency of the transformer would occur when the total loss is
(a) 500 W (b) 400 W
(c) 300 W (d) 275 W

Q.8 A 1-phase 250/500 V transformer gave the following result. Open-circuit test 250 V, 1 A, 80 W on l.v. side what is the power factor?
(a) 0.24 (b) 0.32
(c) 0.28 (d) 0.30

Q.9 Which of the following is not true relating to an ideal transformer?
(a) The iron loss in an ideal transformer is zero
(b) The winding resistance has a zero value
(c) The leakage reactance has a non-zero value
(d) The magnetizing current is zero

Q.10 Two transformers with identical voltage ratings are working in parallel to supply a common load. The impedance of one transformer is higher compared to that of the other. The load sharing between the two transformers will
(a) be proportional to their impedances.
(b) be independent of their impedances.
(c) be inversely proportional to their respective impedances.
(d) depend on the resistance to leakage reactance ratio of each transformer.

Explanations Transformers

1. (b)

Transformer is a static device which cannot change frequency, but can change voltage and current level of the system. Practically, transformer is a constant flux machine. However due to losses in transformer, power at both sides may vary. Hence (b) is better option.

2. (c)

In a transformer, condition for maximum efficiency is :

copper loss or variable loss = iron loss

Thus, $P_i = P_c$

or $\frac{P_i}{P_c} = 1$

3. (c)

In transformer there is no direct connection between primary and secondary. So the power only transferred through induction. But in Auto transformer there is a conductive path between primary and secondary. So power transferred through both conduction and induction.

4. (d)

At η_{max},

Copper loss = Iron loss

or, $I_m^2 r_e = P_c$

or, $I_m = \sqrt{\frac{P_c}{r_e}}$

5. (d)

Air-core means non-iron core so there will be no hysteresis losses.

6. (d)

Transformer having greater equivalent leakage impedance shares less kVA and that having lower leakage impedance shares greater kVA.

7. (c)

For maximum efficiency at full load

$$P_{cu} = P_i = 150 \text{ W}$$

$$\text{Total loss} = P_i + P_{cu} = 150 + 150 = 300 \text{ W}$$

8. (b)

Given, $V_{NL} = 250$ V

$I_{NL} = 1$ A

$P_{NL} = 80$ W

For OC test: $P_{NL} = V_{NL} I_{NL} \cdot \cos\phi$

$\cos\phi$ = pf on LV side

$$= \frac{80}{250 \times 1} = 0.32$$

9. (c)

In an ideal transformer there is no-loss (either in winding or core). The leakage reactance is also zero (as no-voltage drop).

Magnetizing current is zero due to infinite permeability of core.

10. (c)

$$\text{kVA shared} \propto \frac{1}{\text{leakage impedance}}$$

11. (a)

The inrush current of the transformer at no load is maximum when the supply voltage is switched on at the instant of zero crossing and going to positive peak.

12. (c)

Given, $\frac{Z_{HV(\Omega)} I_{HV(rated)}}{V_{HV(rated)}} = 0.08$

$$Z_{HV(\Omega)} \cdot I_{HV(rated)} = 0.08\, V_{HV(rated)}$$

$$V_{SC} = 0.08 \times 2000 = 160 \text{ V}$$

13. (b)

In an ideal transformer,

$$Z \propto N^2$$

Given, on port 2:

$$Z_2 = \omega L \text{ i.e. } Z_2 \propto L$$

$$\frac{N_1}{N_2} = n : 1 = n$$

$$\frac{Z_1}{Z_2} = \left(\frac{N_1}{N_2}\right)^2$$

$$Z_1 = (Z_2)[n]^2$$

$$Z_1 = (\omega L)(n^2)$$

X_{L1} = equivalent inductance at port 1:

$$= \frac{Z_1}{\omega} = n^2 L$$