Solution	Marks
Q.2 a. What is meant by hysteresis? Explain the terms retentivity and coercivity Ans 2 a. Refer 1 - 8 (8.9) **b. A mild steel ring having a cross-sectional area of 500 mm^2 and a mean circumference of 400 mm has a coil of 200 turns wound uniformly around it. Calculate:** **(i) The reluctance of the ring and** **(ii) The current required to produce a flux of 800 μwb in the ring. Assumed the relative permeability of mild steel to be 380.** b. (a) The reluctance of the ring is given as $S = \frac{1}{\mu_0 \mu_r} \cdot \frac{l}{A} = \frac{0.4}{380 \times 4\pi \times 10^{-7} \times 500 \times 10^{-6}}$ $= 1.675 \times 10^6$ A/wb (4) Ans (b) We know that $F = \phi S = 800 \times 10^{-6} \times 1.675 \times 10^6 = 1340$A (2) $\therefore$ Magnetising current $= I = \frac{F}{N} = \frac{1340}{200} = 6.7$A (2) Ans	8

Q.3a. Explain how various losses is a transformer can be found from practical tests without actual loading the transformer. **8**

Refer : [9(9.8)]

b. A 10 – kVA, 200V/400V, 50 Hz, single-phase transformer gives the following test result:

Open-circuit test (HT windings open-circuited): 200V, 1.3A, 120W.
Short- circuit test (LT winding short-circuited): 22V, 30A, 200W.
Calculate (i) the magnetising current and the current corresponding to core loss at normal circuit as referred to LT winding.

b. (i) Given : $W_0 = 120W$; $V_0 = 200V$; $I_0 = 1.3A$

$N_{sc} = 200$; $W_{sc} = 200W$; $V_{sc} = 20V$; $I_{sc} = 30A$

$I_w = \frac{W_0}{V_0} = \frac{120}{200} = 0.6A$ Ans.

$I_m = \sqrt{I_0^2 - I_w^2} = \sqrt{1.3^2 - .6^2} = 1.15A$ Ans.

(2)

(ii) $R_0 = \frac{V_0}{I_w} = \frac{200}{0.6} = 332\Omega$ Ans

$X_0 = \frac{V_0}{I_m} = \frac{200}{1.15} = 174\Omega$ Ans.

(2)

If we designate the LT winding as winding 1 and HT winding as winding 2, we get

$$R_{02} = \frac{W_{sc}}{I_{sc}^2} = \frac{200}{30^2} = 0.222\,\Omega \quad \text{Ans}$$

$$Z_{02} = \frac{V_{sc}}{I_{sc}} = \frac{22}{30} = 0.733\,\Omega \quad \text{Ans}$$

$$X_{02} = \sqrt{Z_{02}^2 - R_{02}^2} = \sqrt{0.733^2 - 0.222^2} = 0.699\,\Omega \quad \text{Ans.}$$

(2)

Here, the turn ratio, $k = \frac{V_1}{V_2} = \frac{200}{400} = \frac{1}{2}$

The equivalent resistance and reactance as referred to LT windings are

$$R_{01} = k^2 R_{02} = \frac{.222}{4} = 0.055\,\Omega \quad \text{Ans}$$

$$X_{01} = k^2 X_{02} = \frac{0.699}{4} = 0.175\,\Omega \quad \text{Ans.}$$

(2)

Q.4 a. Draw the power flow diagram for a dc. Motor and explain it. **8**

Refer 1 [11(11.10)]

b. A 6-Pole, lap –connected armature with 864 conductors dc motor takes an armature current of 110A at 480V, the armature circuit has a resistance of 0.2Ω. The flux per pole is 0.05Wb. Calculate: **8**

(i) The speed

(ii) The gross torque developed by the armature

b. (i) Generated emf $E_a = 480 - [110 \times 0.2] = 458\ V$ — (2)

Given $\phi = 0.05\ Wb$; $Z = 864$; $P = 6$, $A = 6$

We know that $E_a = \frac{\phi Z N P}{60A}$

$N = \frac{60 A E_a}{\phi Z P} = \frac{60 \times 6 \times 458}{0.05 \times 864 \times 6} = 636\ rpm$ Ans — (3)

(ii) We know that $E_a I_a = \frac{2\pi N T}{60}$

$T = \frac{E_a I_a 60}{2\pi N} = \frac{458 \times 110 \times 60}{2 \times \pi \times 636} = 75.6\ Nm$ Ans. — (3)

Q.5 a. Explain the effect of change in excitation of a synchronous motor on
(i) its armature current
(ii) its power factor — **8**

5a. Refer 1 [12 (12.2)]

b. State the advantages of having rotating field system rather than a rotating armature system in a synchronous machine. — **8**

b. Refer 1 [12 (12.2)]

Q.6 a. Prove that the frequency of the rotor induced emf in an induction motor is slip times the stator supply frequency. **8**

Refer 1[12(12.3)]

b. A three-phase, 6- pole, 50Hz induction motor develops maximum torque at a speed of 940 rpm. If the rotor resistance per phase is 0.1Ω, determine the stand still rotor reactance.

b. The synchronous speed is given as

$$N_s = \frac{120f}{P} = \frac{120 \times 50}{6} = 1000 \text{ rpm} \quad (2)$$

$$\therefore \text{slip}, s = \frac{N_s - N}{N_s} = \frac{1000 - 940}{1000} = 0.06 \quad (2)$$

We know that maximum torque occurs at a slip so as to satisfy the condition $R_2 = sX_{20}$ (2)

$$X_{20} = \frac{R_2}{s} = \frac{0.1}{0.06} = 1.66\Omega \text{ Ans.} \quad (2)$$

Q.7	**Write short notes on any <u>TWO</u>:** **(i) Shaded pole motor** **(ii) Hysteresis motor** **(iii) Universal motor** Q 7 Refer 1[13 (13.2 + 13.4)]	**8x2**
Q.8	**a. With the help of a neat diagram explain the function of various components of a thermal power plant.** a. Refer 1[15-(15.3)]	**8**
	b. With the help of a neat diagram explain the layout for a storage type hydro power plant. b. Refer 1[15-(15.5)]	**8**
Q.9	**Write short notes on the following:** **(i) HVDC Transmission** **(ii) Energy Storage** Q 9. Refer 1[15-(15.13 + 15.15 + 15.16)] E1 : Refer 1[15-(15.6 + 15.11 + 15.12)] E2 : Refer 1[15-(15.16 + 15.4)] 1[13(13.2)]	**8x2**

TEXT BOOK

1. **Basic Electrical Engineering, D.P. Kothari and I. J. Nagrath, Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 13th Reprint 2006**