Code : 031342

B.Tech 3rd Semester Exam., 2017

ELECTRICAL MACHINES—I

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct option (any *seven*) : 2×7=14

(a) Eddy current loss will depend on

(i) frequency

(ii) flux density

(iii) thickness

(iv) All of the above

(b) Which of the following is variable loss?

(i) Eddy current loss

(ii) Hysteresis loss

(iii) Shunt field copper loss

(iv) Armature copper loss

(c) The frequency of a voltage at the secondary is

(i) greater than the primary

(ii) equal to primary

(iii) less than primary

(iv) Any of the above

(d) R_1 is the resistance of the primary winding of the transformer. The turn ratio in terms of primary to secondary is K. Then the equivalent resistance of the primary referred to secondary is

(i) R_1/K

(ii) K^2R_1

(iii) R_1/K^2

(iv) $K \times R_1$

(e) What is the condition for mechanical power developed by a d.c. series motor to be maximum?

(i) Back e.m.f. is equal to half the applied voltage

(ii) Back e.m.f. is equal to applied voltage

(iii) Back e.m.f. is equal to zero

(iv) None of the above

(f) In a d.c. machine 6-pole wave winding is used. The number of parallel path is

(i) 6

(ii) 4

(iii) 2

(iv) 1

(g) In d.c. motors, under trailing pole tips, flux density will

(i) increase

(ii) decrease

(iii) either increase or decrease

(iv) None of the above

(h) The number of poles required, when the frequency is 50 Hz and speed of the motor is 500 r.p.m., is

(i) 5

(ii) 10

(iii) 12

(iv) 24

(i) At standstill condition the value of slip of induction motor is

(i) 1

(ii) 0

(iii) infinite

(iv) finite

(j) In circle diagram for induction motor, diameter of circle represents which of the following?

(i) Slip

(ii) Rotor current

(iii) Running torque

(iv) Line voltage

2. (a) Explain the short-circuit test and open-circuit test on transformer. Why are these tests to be performed? 6

(b) A 100 kVA, 2200/220 V transformer has leakage reactance drop of 8% and resistance drop of 2%. Find its voltage regulation at full load and 0·8 p.f. lagging. Also find the p.f. at which the regulation will be zero. 8

3. (a) Explain the construction and principle of three-phase induction motors. Also draw the equivalent circuit and phasor diagram. 7

(b) Explain various types of single-phase induction motor and their advantage and disadvantage. 7

4. *(a)* If the induced e.m.f. in the stator of an 8-pole induction motor has a frequency of 50 Hz and that in the rotor is 1·5 Hz, at what speed is the motor running and what is the slip? 7

(b) The e.m.f. per turn for a single-phase 2310/220 V, 50 Hz transformer is approximate 13 V. Calculate—

(i) the number of primary and secondary turns;

(ii) the net cross-section area of the core for a maximum flux density of 1·4 T. 7

5. *(a)* Explain the power stage of induction motor, and prove that torque equation is given as

$$T_g = \frac{60 * 3}{2\pi N_s} \frac{sR_2E_2^2}{R_2^2 + sX_2^2}$$ 8

(b) Explain the armature reaction in d.c. generator with the circuit diagram. 6

6. *(a)* Explain the speed control of various types of d.c. motors with necessary equations and diagram. 8

(Turn Over)

(b) What do you mean by poor commutation? Discuss the reasons for poor commutation. 6

7. *(a)* Discuss various advantages and disadvantages of autotransformer. 7

(b) A sinusoidal flux 0·02 Wb links with 55 turns of a transformer secondary coil. Calculate the r.m.s. value of the induced e.m.f. in the secondary. The supply frequency is 50 Hz. 7

8. *(a)* Explain the methods of speed control employed to d.c. motor. 6

(b) The armature resistance of a 200 V shunt motor is 0·4 Ω and no-load current is 2 A. When loaded and taking an armature current of 50 A, the speed is 1200 r.p.m. Find the no-load speed. 8

9. A 480 V, 60 Hz, 6-pole, three-phase, delta-connected induction motor has the following parameters :

$R_1 = 0{\cdot}461\ \Omega$, $R_2 = 0{\cdot}258\ \Omega$, $X_1 = 0{\cdot}507\ \Omega$, $X_2 = 0{\cdot}309\ \Omega$, $X_m = 30{\cdot}74\ \Omega$

(Continued)

Rotational losses are 2450 W. The motor drives a mechanical load at a speed of 1170 r.p.m.

Calculate the following : 14

(a) Synchronous speed in r.p.m.

(b) Slip

(c) Line current

(d) Air-gap power

(e) Input power

(f) Torque developed

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