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(2063)

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B.Tech 4th Semester Examination

Electrical Machines-II

EE-4002

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/ continuation sheet will be issued.

Note : Attempt five questions in all, selecting one question from each of the section A, B, C, and D. Section E is compulsory.

SECTION - A

1. (a) Explain the principle of working of a three phase induction motor. **(6)**

   (b) A three phase, 50 Hz induction motor has a full load speed of 1440 rpm. For this motor, calculate (i) number of poles (ii) full load slip and rotor frequency (iii) speed of rotor field with respect to (a) stator structure (b) rotor structure and (iv) speed of rotor field with respect to (a) rotor structure (b) stator structure and (c) stator field. **(10)**

   (c) State the merits of squirrel cage induction motor over slip ring induction motor. **(4)**

2. (a) Explain the various losses occurring in induction motor with the help of power flow diagram. **(10)**

(b) A 10 kW three phase, 50 Hz., delta connected 400 V, 4-pole induction motor is running at no load with a line current of 8 A and an input power of 660 Watts. At full load, the line current is 18 A and the input power is 11.20 kW. Stator effective resistance per phase is 1.2 ohm and friction, windage loss is 420 Watts. For negligible rotor ohmic loss at no load, calculate (a) stator core loss (b) total rotor losses at full load, (c) total rotor ohmic losses at full load (d) full load speed (e) internal torque, shaft torque and motor efficiency. **(10)**

SECTION - B

3. (a) Explain star-delta starting for three phase induction motors with the help of a diagram. **(8)**

(b) Design the 5 sections of a 6-stud starter for a 3-phase slip-ring induction motor. The full load slip is 2% and the maximum starting current is limited to twice the full-load current. Rotor resistance per phase is 0.03 Ohm. **(12)**

4. (a) Explain the working principle of a single phase induction motor with the help of cross field theory. **(8)**

(b) Explain the construction and working of a universal motor. State its applications. **(8)**

(c) State why a single phase induction motor should be provided with an auxiliary winding on the stator. **(4)**

SECTION - C

5. (a) Explain the terms normal excitation, under excitation and over excitation in connection with synchronous motor operation. **(10)**

   (b) A 3000 kVA, three phase star connected, 6600 V, 8-pole, 50 Hz alternator has a synchronous reactance of 20% and is running in parallel with infinite bus. Calculate the synchronizing power and the corresponding synchronizing torque per mechanical degree of phase displacement (a) at no load and (b) at full load, 0.8 power-factor lagging. **(10)**

6. (a) Draw and explain the power flow diagram for three phase synchronous motor. **(10)**

   (b) A factory has a total load of 1800 kW at a power factor of 0.6 lagging. If it is desired to improve the factory power factor to 0.95 lagging with the installation of a synchronous condenser, then calculate (a) the kVA rating of the synchronous condenser and (b) total kVA of the factory. **(10)**

SECTION - D

7. (a) Explain the constructional features of synchronous machines with diagram. **(8)**

   (b) A 3-phase, 16 pole synchronous generator has a star connected winding with 144 slots and 10 conductors per slot. The flux per pole is 0.03 Wb, sinusoidally distributed, and the speed is 375 revolutions per minute. Calculate the frequency, and line induced emf. **(8)**

(c) State the causes of harmonics in the synchronous generators and ways to minimize them. **(4)**

8. (a) Define voltage regulation of an alternator. Explain synchronous impedance method of determining regulation of an alternator. **(10)**

(b) A 500 kVA, star connected synchronous generator has a rated line to line terminal voltage of 3300 V. The resistance and synchronous reactance per phase are 0.3 and 4.0 Ohm, respectively. Calculate the voltage regulation at full load, 0.8 power factor lagging. **(10)**

SECTION - E

9. Give brief answers to the followings:

(a) State forced cooling of alternators.

(b) State the importance of equivalent circuits.

(c) State the application of synchronous condenser.

(d) Why damper windings are required in synchronous machines?

(e) Why single phase motors are not self starting?

(f) Why induction motors run on lagging power factor?

(g) State the phenomenon of crawling.

(h) State the application of salient pole alternators.

(i) State how direction of rotation is reversed in 3-phase induction motors.

(j) State the conditions for parallel operation of alternator. **(2×10=20)**