[Total No. of Questions - 9] [Total No. of Printed Pages - 4] (2064)

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B. Tech 4th Semester Examination

Electrical Machines-II (O.S.)

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 and all the subparts of the question in Section E. All questions carry equal marks and assume missing data if any suitably.

SECTION - A

1. (a) Explain the constructional features of an induction motor with help of a diagram. (6)

   (b) Explain the need of starters in three phase induction motors. (4)

   (c) A three phase squirrel cage induction motor has maximum torque equal to twice the full load torque. Determine the ratio of motor starting torque to its full load torque, if it is started by (a) direct-on-line starter (b) star- delta starter (c) auto transformer starter with 70% tapping. The per phase rotor resistance and per phase standstill reactance referred to stator are 0.2 ohm and 2 ohm, respectively. Neglect stator impedance. (10)

2. (a) Draw and explain the exact equivalent circuit of the three phase induction motor and state its importance. (8)

(b) A three phase star connected 400 V, 50 Hz., 4-pole induction motor has the following per phase constants in ohm's referred to stator:

r_1 = 0.15, x_1 = 0.45, r_2 = 0.12, x_2 = 0.45, x_m = 28.5, fixed losses (core, friction and windage losses) =400 watts. Compute the stator current, rotor speed, output torque and efficiency when the motor is operated at rated voltage and frequency at a slip of 4%. (12)

SECTION - B

3. (a) Explain the circle diagram of an induction motor. What information does it convey? (5)

(b) Derive the current locus for the rotor circuit of a poly phase induction motor. (5)

(c) A 7.5 kW, 400 V, three phase 50 Hz., 6-pole squirrel cage induction operates at 4% slip at full load when rated voltage and frequency is applied. Assuming a linear relationship between torque and slip in the operating region, calculate the no load speed of the motor when the supply voltage is reduced to half its rated value. The no load torque is 6 Nm. (10)

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

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

(c) Explain the construction and working of a shaded pole motor. (8)

SECTION - C

5. (a) Derive an expression for power developed in a cylindrical rotor synchronous motor in terms of load angle and synchronous impedance. (10)

(b) A salient pole synchronous motor has X_d=0.85 pu and X_q=0.55 pu. It is connected to bus bars of 1.0 pu voltage, while its excitation is adjusted to 1.2 pu. Calculate the maximum power output that the motor can supply without loss of synchronism. Compute the maximum pu excitation that is necessary for the machine to stay in synchronism while supplying the full load torque. (10)

6. (a) Explain the term synchronous impedance and also explain how it affects the value of the load angle for maximum power delivered when the machine acts as motor. (10)

(b) A 6.6 kV, 3-phase, star-connected synchronous motor works at constant voltage and constant excitation. Its synchronous impedance is (1.5+j12) ohm per phase. When the input power is 1000 kW, the power factor is 0.8 leading. Find the power factor when input is increased to 1500 kW. (10)

SECTION - D

7. (a) Derive an emf equation for an alternator with pitch factor and distribution factor. (8)

(b) A 3-phase, star connected synchronous generator driven at 750 rpm is required to generate a line to line voltage of 440 V, 50 Hz. on open circuit. The stator is wound with 2 slots per pole per phase and each coil has 4 turns. Calculate the useful flux per pole. (8)

(c) State the advantages of having a rotating field system rather than a rotating armature system in an alternator. (4)

8. (a) Explain the various schemes used for excitation of synchronous generators. Which scheme is preferred these days and why? (10)

(b) A 1500 kVA, 6600 V, 3-phase, star connected synchronous generator with a per phase resistance and reactance of 0.4 and 6.0 Ohm respectively, delivers full load current at 0.8 power factor lagging, and a normal rated voltage. Calculate the terminal voltage for the same excitation and load current at 0.8 power factor leading. (10)

SECTION - E

9. Give brief answers to the followings:

(a) State forced cooling of alternators.

(b) State the importance of phasor diagram.

(c) State the need of field current in synchronous generator.

(d) Why parallel operation is required in alternators?

(e) Why three phase induction motors are called singly excited machines?

(f) State the applications of synchronous motors.

(g) State the application of slip ring induction motors.

(h) State the condition for maximum efficiency in AC machines.

(i) State the application of cylindrical rotor type alternators.

(j) State the phenomenon of clogging. (2×10=20)