

B 342

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005

Fourth Semester

Electrical and Electronics Engineering

EE 234 --- ELECTRICAL MACHINES --- II

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A --- (10 × 2 = 20 marks)

1. Under what condition the terminal voltage of an alternator will be greater than induced emf?
2. What are the conditions for parallel operation of alternators?
3. What are the methods of reducing the space harmonics in a machine?
4. Explain what happens when the excitation of synchronous machine connected to an infinite bus is varied, the load torque remains constant.
5. Enlist the advantages and disadvantages of synchronous motor.
6. What is hunting?
7. What is the effect of change in input voltage on starting torque of induction motor?
8. Explain in brief the following term with respect to induction motor :
(a) plugging (b) dynamic breaking (c) regenerative breaking.
9. What is crawling and cogging in induction motor?
10. Draw the vector diagram for (a) capacitor start and (b) split phase induction motor.

PART B — (5 × 16 = 80 marks)

11. (i) Show that a synchronous motor has no net starting torque. (6)
- (ii) Describe a method of starting the synchronous motor against light load torque. (5)
- (iii) Explain the methods of starting synchronous motor against high torque loads. (5)

12. (a) (i) Define the voltage regulation of an alternator. Is it possible to have the full load terminal voltage greater than the no-load terminal voltage? Explain. Why does the armature terminal voltage change as the alternator is loaded? (8)
- (ii) For a Salient pole synchronous machine, prove the d -axis synchronous reactance X_d , can be obtained from its OCC and SCC. Neglect armature resistance. (8)

Or

- (b) (i) Describe the various schemes used for exciting large synchronous machines. Which scheme is being preferred these days for exciting very large turbo generators and why? (8)
- (ii) From the phasor diagram of an over excited Salient-pole synchronous motor, prove the following relations :

$$\tan \delta = \frac{I_a (X_q \cos \theta + r_a \sin \theta)}{V_t + I_a (x_q \sin \theta - r_a \cos \theta)}$$

$$X_q = \frac{V_t \sin \delta - I_a r_a \sin(\delta + \theta)}{I_a \cos(\delta + \theta)}$$

where δ and θ are load and power factor angle respectively. (8)

13. (a) (i) Describe constructional features of both squirrel cage induction motor and slip ring induction motor. Discuss the merits of one over another. (8)
- (ii) A 10 kW, 420 V, 3 phase, 4 pole, 50 Hz, delta connected squirrel cage induction motor gave the following data for blocked rotor test : (8)
- 210 V, 20 A, 5 kW

Stator core loss at rated voltage and frequency is 300 watts. The DC resistance measured between any two stator terminals is 0.6 Ω . Determine the stator current at rated voltage and frequency.

Or

- (b) A 3 phase, 400 V, 50 Hz star connected induction motor gave the following test results :

No load : 400 V, 7.5 A, 0.135 power factor

Blocked rotor : 150 V, 35 A, 0.44 power factor

The ratio of standstill leakage reactance of stator and rotor is estimated as 2. If the motor is running at a speed of 960 rpm. Determine

- (i) Net mechanical power output
- (ii) Net Torque
- (iii) Efficiency of the motor.

Assume stator and rotor copper losses to be equal. (10)

14. (a) (i) Describe the principle of operation of a 3 phase induction motor. Explain why the rotor is forced to rotate in the direction of rotating magnetic field. (8)
- (ii) Develop the equivalent circuit of a polyphase induction motor. What do the various parameters represent? (8)

Or

- (b) (i) Sketch the typical torque-speed characteristic of an induction motor. How is the characteristic modified if
- (1) the rotor circuit resistance is increased
 - (2) the rotor circuit reactance is increased
 - (3) applied stator voltage is reduced to half at rated frequency. (8)
- (ii) Derive the condition of maximum torque developed in a 3 phase induction motor and hence prove that to increase the starting torque extra resistance must be added in the rotor circuit. (8)
15. (a) (i) Show that a single phase sinusoidal field can be replaced by two fields rotating around the air gap in opposite directions; sketch the slip torque curve due to each field. Prove that the motor has no starting torque. (8)
- (ii) Develop equivalent circuit of a single phase induction motor ignoring core losses. (8)

Or

- (b) (i) What is stepper motor? How does it work? What are its applications? (8)
- (ii) Explain the principle and operation of a reluctance motor. State applications. (8)
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