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TEE-501

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2055Roll No. **B. Tech.**

(SEM. V) EXAMINATION, 2007-08

ELECTROMECHANICAL ENERGY CONVERSION - II

Time : 3 Hours]

[Total Marks : 100

Note : (1) Attempt all questions.

(2) All questions carry equal marks.

1 Answer any two of the following : $2 \times 10 = 20$

- (a) Derive emf equation for an alternator. Explain the effect of distribution of winding and use of short-pitch coil on the magnitude of the generated voltage of an alternator.
- (b) What is armature reaction ? Explain the effect of armature reaction on the terminal voltage of an alternator at (i) unity power factor load (ii) 0.8 lagging p.f. load (iii) 0.8 leading pf load. Draw the relevant phasor diagrams.
- (c) Two identical, 3-phase alternator operating in parallel, share equally a load of 1000 kW at 6600 V and 0.8 lagging power factor. The field excitation of the first machine is adjusted so that the armature current is 50A at lagging p.f. Determine :
- the armature current of the second alternator
 - the power factor at which each machine operates.

2 Answer any **two** of the following : **2×10=20**

- (a) Draw and explain the phasor diagram of a salient-pole synchronous generator supplying full-load lagging current. Show that the power output (P) per phase is given by

$$P = \frac{VE_f}{X_d} \sin \delta + \frac{V^2}{2} \left[\frac{1}{X_q} - \frac{1}{X_d} \right] \sin 2\delta$$

where V is terminal voltage, E_f is excitation voltage, X_d and X_q are the direct and quadrature-axis reactances respectively, δ is load angle.

- (b) Discuss the phenomenon of hunting in a synchronous machine. What is the purpose of damper winding in a synchronous machine ?
- (c) A 6.6 kV, 3-phase, star-connected synchronous motor is running in parallel with an infinite bus. Its direct and quadrature-axis synchronous reactances are **10 Ω** and **5 Ω** , respectively. If the field current is reduced to zero, find the maximum load that can be put on the synchronous motor. Also calculate the armature current and the maximum power developed. Neglect armature resistance.

3 Answer any **two** of the following : **2×10=20**

- (a) Discuss the construction of 3-phase cage-type induction motor with neat sketches.
- (b) Derive the relationship for torque developed by a 3-phase induction motor. Draw a typical torque-slip characteristic and deduce the condition for maximum torque.

- (c) A 3-phase induction motor has a 4-pole, star-connected stator winding. The motor runs on a 50 Hz supply with 200 V between lines. The rotor resistance and standstill rotor reactance per phase are 0.1Ω and 0.9Ω respectively. The ratio of rotor to stator turns is 0.67. Calculate :
- (i) total torque at 4% slip
 - (ii) maximum torque developed
 - (iii) speed at maximum torque
 - (iv) maximum mechanical power
- Neglect stator impedance.

4 Answer any **two** of the following : **2×10=20**

- (a) Discuss the construction, working and salient features of a deep-bar cage motor.
- (b) Explain the pole amplitude modulation technique of speed control of 3-phase induction motors. Also compare it with pole changing method of speed control.
- (c) A cage induction motor when started by means of a star-delta starter takes 180% of full-load line current and develops 35% of full-load torque at starting. Calculate the starting torque and current in terms of full-load values, if an auto-transformer with 75% tapping were employed.



5 Answer any **two** of the following : 2×10=20

- (a) Explain the working principle of (i) split phase (ii) capacitor-start single-phase induction motor with the help of neat sketches. How can you reverse the direction of rotation of such motor? What are the industrial and domestic applications of such motors?
- (b) Discuss in detail the modifications necessary to operate a d.c. series motor satisfactorily on single-phase ac supply.
- (c) A 230 V, 500 W, 4000 rpm, 50 Hz, single-phase series motor has total resistance of **3 Ω** and total reactance of **20 Ω**. For a stray-power loss of 40 W, determine the current and pf when working under rated conditions.
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