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BIEE-012

B.Tech. – VIEP – ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

December, 2015

BIEE-012 : ELECTRO-MECHANICAL ENERGY CONVERSION – II

Time : 3 hours *Maximum Marks : 70*

Note :

(i) *Attempt any **seven** questions out of ten.*

(ii) *All questions carry equal marks.*

(iii) *All symbols and abbreviations have their usual meaning.*

(iv) *Any missing data may be assumed with proper justification.*

(v) *Use of scientific calculator is allowed.*

1. (a) A 3-phase, 50 Hz, 415 V, synchronous alternator operates at rated voltage and at a leading p.f of 0·9. Excitation emf is 400 V and power obtained at shaft is 12 kW. If per phase resistance of alternator is 0·4 Ω, find the synchronous reactance.

(Neglect mechanical losses of the system) *7*

(b) What are the advantages of distributed winding in 3-phase alternators ? *3*

2. (a) Describe the procedure for determining the voltage regulation of an alternator by synchronous impedance method. *5*

(b) Explain why cylindrical rotor theory cannot be applied to a salient pole synchronous machine. With the help of two-reaction theory, draw a phasor diagram for a lagging p.f. load for salient pole synchronous alternator. *5*

3. A synchronous generator supplies rated power at 0·8 p.f. lagging. Its resistance and synchronous reactance are 0·01 and 1·0 p.u. respectively. Calculate the terminal voltage, if the open circuit voltage is 2·1 p.u. Also find the minimum allowable excitation voltage. *10*

4. (a) What is 'Hunting' in synchronous machines ? What are its effects ? *5*

(b) What is a synchronous condenser ? What are the advantages of a synchronous condenser in an electrical system ? *5*

5. (a) For a 3-phase induction motor, derive an expression for torque produced. Also draw a torque-slip characteristic. *5*

(b) Show that maximum torque produced is independent of rotor circuit resistance and thus draw a modified torque-slip characteristic, when additional resistance is inserted in rotor circuit via some external means. *5*

6. (a) Explain how the desirable features of high starting torque and low operating slip are obtained in a double cage polyphase induction motor. *5*

(b) Why is it necessary to employ special starting arrangements for 3ϕ induction motors ? Compare the starting torque produced in Auto-transformer starting to that of direct on-line starting. *5*

7. A 400 V, 1450 rpm, 50 Hz wound rotor induction motor has the following circuit parameters : *10*

$R_1 = 0{\cdot}4\ \Omega$ $\quad R_2' = 0{\cdot}3\ \Omega$

$X_1 = X_2' = 0{\cdot}5\ \Omega$ $\quad X_m = 25\ \Omega$

Rotational loss = 1500 Watt.

(a) Calculate the starting torque and current, when the motor is started direct on full voltage.

(b) Calculate the full load current, p.f. and net torque.

8. Find the efficiency of an induction motor operating at full load. Machine details are given as follows : *10*

2000 hp, 2300 V, 3ϕ, star connected, 4 pole, 50 Hz, full load slip = 0·03746.

$R_1 = 0{\cdot}02\ \Omega$ $\quad X_1 = X_2' = 0{\cdot}32\ \Omega$

$R_2' = 0{\cdot}12\ \Omega$ $\quad X_m = 50\ \Omega, R_c = 451{\cdot}2\ \Omega$

9. Explain the working of capacitor-start capacitor-run induction motor with the help of a neat sketch, phasor diagram and torque-speed characteristic. *10*

10. With the help of a neat sketch, describe the working of a stepper motor. Justify the need of Electronic circuitry for stepper motor. *10*
