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Printed Pages : 4 TEE-501

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

PAPER ID : 2055 Roll No.

B. Tech.

(SEM. V) EXAMINATION, 2008-09

ELECTROMECHANICAL ENERGY CONVERSION-II

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** questions.*

*(2) All questions carry **equal** marks.*

1 Attempt any **two** : 2×10

(a) Discuss the difference in construction of rotors of alternators used in hydroelectric plants and steam plants. Also draw the neat sketches of the two types of rotor.

(b) A 6600 V, 1200 kVA, 3-phase alternator is delivering full-load at 0.8 p.f. lagging. Its reactance is 25% and resistance negligible. By changing the excitation, the emf is incresed by 30% at this load. Calculate the new values of current and power factor. The machine is connected to infinite busbars.

(c) Define the term synchronous impedance and voltage regulation of an alternator. Explain the synchronous impedance method of determining regulation of an alternator. Also state the assumptions made.

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2 Answer any **two** : 2×10

(a) Derive an expression for finding power angle characteristics of salient pole alternator using two-reaction theory. Draw its phasor diagram.

(b) A synchronous motor improves the power factor of a load of 500 kW from 0.707 lagging to 0.95 lagging. Simultaneously the motor carries a load of 100 kW. Find :

(i) the leading kVAr supplied by the motor

(ii) kVA rating of the motor

(iii) power factor at which the motor operates.

(c) Explain the operation of a synchronous motor under (i) constant load, varying excitation (ii) constant excitation, varying load. Discuss how a synchronous motor can function as a synchronous capacitor.

3 Answer any **two** : 2×10

(a) Starting from the first principles develop the equivalent circuit of a 3-phase induction motor. Draw and explain the phasor diagram.

(b) Sketch the torque-slip characteristic of a 3-phase induction motor indicating therein the starting torque, maximum torque and the operating region. How do starting and maximum torques vary with the rotor resistance ?

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(c) A 6-pole, 50 Hz, $3-\phi$ induction motor running on full load develops a useful torque of 150 Nm at a rotor frequency of 1.5 Hz. Calculate the shaft power output. If the mechanical torque lost in friction be 10 Nm, determine :

(i) rotor copper loss

(ii) the input to the motor

(iii) the efficiency.

4 Answer any **two** : **2×10**

(a) A 3-phase delta-connected cage-type induction motor when connected directly to 400 V, 50 Hz supply takes a starting current of 100 A in each stator phase. Calculate :

(i) the line current for direct-on-line starting

(ii) line and phase starting currents for star-delta starting

(iii) line and phase starting currents for a 70% tapping on auto-transformer starting.

(b) What is the purpose of using deep-bar cage rotors ? Explain the construction and working of a double cage motor.

(c) Discuss the phenomenon of cogging and crawling in a 3-phase induction motor.

5 Answer any **two** : **2×10**

(a) Discuss why single-phase induction motors do not have a starting torque. Describe with the aid of diagrams of connection and phasor diagrams two methods of producing starting torque in a single-phase induction motor.

(b) Discuss the construction, working and phasor diagram of an ac series motor.

(c) A 230 V, 50 Hz, 4-pole single-phase induction motor has the following equivalent circuit impedances.

$R_{1m} = 2.2\ \Omega,\ R_2' = 4.5\ \Omega$

$X_{1m} = 3.1\ \Omega,\ X_2' = 2.6\ \Omega,\ X_m = 80\ \Omega.$

Friction, windage and core loss = 40 W

For a slip of 0.03 pu, calculate (i) input current (ii) power factor (iii) developed power (iv) output power (v) efficiency.