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B.Tech.
(SEM IV) EVEN SEMESTER EXAMINATION, 2015-16
ELECTROMECHANICAL ENERGY CONVERSION-II

[Time: 3 Hours] **[Max. Marks: 100]**

Note- Attempt All questions. All questions carry equal mark.

1. Attempt any two of the following:- **[10x2=20]**

(a) Derive the equation of emf generated in synchronous generator. Describe about the various winding factors in detail.

(b) Define voltage regulation. Describe the OC and SC tests performed on synchronous machine. Describe the Synchronous Impedance method of finding the voltage regulation.

(c) Discuss about the following.
i) *Effect of excitation on performance of synchronous generator.*
ii) Effect of armature reaction in synchronous machine.
iii) Synchronizing power

2. Attempt any two of the following:- **[10x2=20]**

(a) What is Two Reaction Theory? A 3 phase 100 KVA 6.6 KV star connected salient pole synchronous machine has an armature resistance of 5% and the direct and quadrature axis reactances of 120% and 80% respectively. Determine the no load EMF and the load angle when the machine operates as a generator at the rated voltage on full load and 0.8 p.f lagging. Sketch the two axis phasor diagram and determine the values of direct and quadrature components of armature currents.

(b) Derive power flow equation of salient pole synchronous machine.

(c) Draw labeled V-Curves of Synchronous Motor and Generator. Describe in detail the reasons behind the nature of curves.

3. Attempt any two of the following:- **[10x2=20]**

(a) Derive the exact equivalent circuit of a 3-phase induction motor. What is the difference between the exact and approximate equivalent circuit. From the approximate equivalent circuit, find the (i) rotor output (ii) output power (shaft power) (iii) output torque. A 3-phase induction motor has a rotor for which the resistance per phase is 0.1 Ω and reactance per phase when stationary is 0.4 Ω. The rotor induced emf per phase is 100V when stationary. Calculate the rotor current and rotor power factor (i) when stationary (ii) when running with a slip of 5 percent.

(b) Explain with the help of suitable a diagram, how rotating magnetic field is produced in a 3-phase induction motor and at what speed & in which direction it rotates. Develop expression. A 3-phase, 6-pole, 50Hz, induction motor has a slip of 1% at no-load and 3% at full load. Determine synchronous speed, no-

load speed, full-load speed, frequency of rotor current at standstill and frequency of rotor current at full load.

(c) Derive the expression for developed torque for a 3-phase induction motor and find the condition for maximum torque. Obtain the ratio of full load torque to maximum torque. Draw also Torque-Slip curve describing the three modes of operation of the motor.

4. Attempt any two of the following:- **[10x2=20]**

(a) Discuss briefly the various methods of speed control of 3-phase cage rotor and wound rotor induction motors. Develop expression for available speeds for cascade operation of two motors. Two 3-phase induction motors having 4 and 6 poles respectively operate cascade connected to a supply of 400V, 50Hz, What speeds are obtainable.

(b) Why starter is required to start a 3-phase induction motor. Describe star-delta method of starting a squirrel cage induction motor. Determine the ratio of starting to full load torque. A squirrel cage motor has a starting current of 300A. An auto-transformer with 50% tapping is used to reduce the starting current. Find (i) motor current at starting, (ii) ratio of starting torque with auto-transformer to the starting torque at full voltage.

(c) What is the effect of injecting a voltage ;in the rotor circuit of a 3- phase induction motor? What practical use can be derived from this method? How can the pf be improved? A 100 kw, 440V, 50Hz, 3-ϕ 6-pole wound rotor induction motor has standstill rotor induced emf per phase E is 44 volts. Neglecting losses and winding drops, calculate the approximate no load speed and p.f. of the motor when a per phase emf 22 volts at 180 to E is injected at a time to the secondary (rotor) side.

OR

Explain the phenomenon of cogging and crawling in a 3-phase induction motor. A 3-phase, 4 pole, 1100V, 60Hz cage rotor IM has 24 stator slots and 68 rotor slots. (i) It is crawling at a speed of 78 rpm. Is it induction or synchronous crawling. (ii) In case the crawling speed in 105 rpm, what may be the reason.

5. Attempt any two of the following:- **[10x2=20]**

(a) Describe the principle of operation of a single phase induction motor. Draw the equivalent circuit diagram of a single phase induction motor explaining the theory on which it is based.

(b) Write a note on Single phase A.C. series compensated motor.

(c) Compare and contrast a Universal motor with a Repulsion motor.