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Total Pages : 05

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May 2024

B. Tech. (EL) (Fourth Semester)

Electrical Machines–II (ELPC-402)

Time : 3 Hours] *[Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other. Assume data if missing.

Part A

1. (a) Why is short-pitch winding preferred over full-pitch winding ? **1.5**

(b) Why the rotor slots are made skewed by a small angle to the shaft axis ? **1.5**

(c) A 3-phase induction motor is wound for 4-poles and is supplied from a 50 Hz system. Calculate the speed at which the magnetic field of the stator is rotating. **1.5**

(d) What is meant by plugging ? **1.5**

(e) State the methods by which the starting torque of the induction motor can be increased. **1.5**

(f) How is the direction of rotation of a single-phase induction motor reversed ? **1.5**

(g) Which type of alternator is adopted for hydro turbines and why ? **1.5**

(h) Distinguish between synchronous reactance and Potier reactance of a synchronous generator. **1.5**

(i) What are the methods of starting of 3-phase synchronous motor ? **1.5**

(j) Draw typical torque-angle characteristics of synchronous machine. **1.5**

Part B

2. (a) Define the distribution factor and derive an expression for it. What are the advantages of distributing the winding in slots ? **7.5**

(b) Show that when three identical coils placed at 120° in space are excited from three-phase balanced currents, the resultant mmf will be rotating in nature with amplitude 1.5 times that of each phase. **7.5**

3. (a) Develop the equivalent circuit for a three-phase induction motor and explain, how the mechanical power developed is taken care in the equivalent circuit. **5**

(b) The power input to a 3-phase induction motor is 75 kW. The total stator losses are 1.5 kW. Find the total mechanical power developed and the rotor copper loss per phase if the motor is running with a slip of 2.5%. **5**

(c) Describe with neat sketches the principle of operation of induction generator. **5**

4. (a) A 750 kW, 3-phase, 50 Hz, 16-pole induction motor has a rotor impedance of $(0.02 + j0.15)\ \Omega$ at standstill. Full load torque is obtained at 360 rpm. Calculate : **7.5**

(i) The speed at which maximum torque occurs

(ii) The ratio of maximum to full load torque

(iii) The external resistance per phase is to be inserted in the rotor circuit to get maximum torque at starting.

(b) Why starter is necessary for starting a three-phase induction motor ? State the different methods of starting of 3 3-phase squirrel cage induction motor and discuss in detail any *one* method. **7.5**

5. (a) Using double-revolving field theory, explain why a single-phase induction motor is not self-starting. Draw the torque speed curve of a single-phase induction motor. **7.5**

(b) Describe the construction and working of a capacitor start capacitor run single-phase induction motor with the help of neat sketches. **7.5**

6. (a) A single phase, 500 V, 50 Hz alternator produces a short circuit current of 150 A and open circuit emf of 415 V when a field current of 12 A passes through its field winding. If its armature has an effective resistance of 0.25 Ω, determine its full load regulation at unity power factor and at 0.8 lagging power factor using EMF method. **7.5**

(b) Explain the effect of varying excitation on armature current and power factor in a synchronous motor. Draw V-curves. **7.5**

7. (a) What do you mean by synchronizing of alternators ? State the necessary conditions for parallel operation. Describe any *one* method of synchronizing of alternators. **7.5**

(b) A 1000 kVA, 11000 V, 3-phase star-connected synchronous motor has an armature resistance and reactance per phase of 3.5 Ω and 40 Ω respectively. Determine the induced emf and angular retardation of the rotor when fully loaded at 0.8 p.f lagging and 0.8 p.f leading. **7.5**