B.E. (CST) Part-II 3rd Semester Examination, 2007

Electrical Machines and Applications

(EE-305)

Time : 3 hours **Full Marks : 70**

Use separate answerscript for each half.
Answer SIX questions, taking THREE from each half.
Two marks are reserved for neatness in each half.

FIRST HALF

1. (a) Briefly compare the various methods of speed control of d.c. motors, including electronic method.

   (b) A 220-V d.c. shunt motor has an armature resistance of 0.5Ω and takes a current of 40A on full load. By how much must the main flux be reduced to raise the speed by 50%, if the developed torque is constant? [6+5]

2. (a) What are the various losses in a d.c. machine?

   (b) A 500-V 10 HP shunt motor has a full-load efficiency of 85%. With the same field current and armature current it is desired to reduce the speed by 30%, by insertion of resistance in armature circuit. Assuming that all losses except copper losses vary directly with speed. Calculate the efficiency of the motor, when running at the reduced speed. The resistances of the field and armature are 400Ω and 0.25Ω respectively. [3+8]

3. (a) Derive the condition for maximum efficiency of a d.c. machine.

   (b) 400 volt d.c. shunt motor takes 5A at no load. The armature resistance is 0.5Ω and shunt field resistance is 200Ω. Estimate the kW output and efficiency, when the motor takes 50A on full load. [5+6]

4. (a) Discuss different methods of speed control of an induction motor.

   (b) The rotor of a 4-pole, 50 Hz slip-ring induction motor of negligible leakage reactance has a rotor resistance of 0.25Ω per phase and runs at 1440 rpm at full load. Calculate the external resistance per phase which must be added in the rotor circuit to lower the speed to 1200 rpm, torque being same as before. [6+5]

5. Write short notes on any two of the following :- [5½×2]

   (i) Testing of d.c. machines.

   (ii) Stepper motor.

   (iii) Braking of d.c. motor.

SECOND HALF

6. (a) In the light of double revolving field theory, explain why single-phase induction motor have no starting torque.

   (b) How a split phase induction motor is made self starting? Draw its speed-torque characteristic and explain why this type of motor has a relatively small starting torque. [5+6]

7. (a) What is the difference between capacitor start single-phase induction motor and capacitor start capacitor run single phase induction motor? Sketch the speed torque characteristics of both the motors and explain why the second type of motor has a better power factor.

   (b) Explain the principle of operation of a universal motor? Why the speed of such motor is slightly less in a.c. than in d.c. operation? [5+6]

8. (a) What is a stepper motor? What are its different types depending on the rotor construction? Explain why stepper motor can run only in steps and not continuously.

   (b) Mention some field of applications of a stepper motor and an universal motor. [6+5]

9. (a) Discuss the constructional details of a synchronous machine. Where salient pole rotors are preferred?

   (b) What significant characteristic of a synchronous machine is revealed by its V-curves? [6+5]

10. (a) Explain with a neat phasor diagram and equivalent circuit the principle of operation of a synchronous motor.

(b) A 200 kVA, 3.3 kV, 50 Hz, 3-phase synchronous generator has an effective armature resistance of 5.0Ω /phase and synchronous reactance of 29.2 Ω/ phase. The generator is star-connected. Calculate the voltage regulation (in percentage) at full-load 0.707 power factor (lag) and unity power factor.

[5+6]

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