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Question Paper Code : 11521

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Third Semester

ME 2205/131305/ME 36/10122 ME 306/EE 1205 A/080120013/080210005 — ELECTRICAL DRIVES AND CONTROLS

(Common to Mechanical Engineering, Production Engineering, Chemical Engineering, Petrochemical Engineering and Petrochemical Technology)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define cooling time constant of an electrical machine.

2. Name the four commonly used methods for the determination of power rating of motors.

3. Write down the equation for the back e.m.f. of DC motor in terms of flux per pole and speed.

4. List the types of single phase induction motors.

5. What are the functions of starter of a DC motor?

6. What is the advantage of three phase slip ring induction motor?

7. Enumerate the limitations of field control in DC Motors.

8. What is a DC chopper?

9. What are the advantages of V/f control of three-phase induction motors?

10. Mention the advantages of slip power recovery scheme of controlling the speed of induction motor.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain what is meant by a group drive. What are its advantages and disadvantages? (8)

(ii) The enclosure of a 10 kW motor is equivalent to a cylinder of 70 cm diameter and 100 cm length. The motor weighs 500 kg assuming that the specific heat is 700 J/kg/°C and that the peripheral surface of the enclosure of the motor alone is capable of heat dissipation of 12.5 W/m²/°C. Calculate the heating time constant of the motor and its final temperature rise. Assume the efficiency of the motor as 90 percent. (8)

Or

(b) (i) Show that, for an electric motor, the relationship between temperature rise and time is an exponential function. (8)

(ii) A motor has a thermal heating time constant of 45 minutes. When the motor runs continuously on full load, its final temperature rises to 80 degree Celsius.

(1) What would be the temperature rise after 1 hour, if the motor runs continuously on full load?

(2) If the temperature rise on 1 hour rating is allowed to be 75 degree Celsius, find what would be the new steady state temperature at this rating. (8)

12. (a) (i) Explain, with necessary circuit diagram, the reverse current braking and the braking characteristics of the following :

(1) DC shunt motor. (5)

(2) DC series motor. (5)

(ii) A 250 V, DC shunt motor has an armature resistance of 0.05 Ω and with rated field excitation has a back emf of 245 V at a speed of 1200 rpm. It is coupled to an overhauling load with a torque of 200 N-m. Determine the lowest speed at which the motor can hold the load by regenerative braking. (6)

Or

(b) (i) Sketch the speed-torque characteristics of a three phase induction motor and explain its motoring mode, generating mode and braking mode of operation. (8)

(ii) A 15 kW, 415 V, three-phase, 4 pole, 50 Hz induction motor has a speed of 1455 r.p.m. at full load. At this load, the mechanical losses are 600 watt and the stator losses are 750 watt. Find

(1) Full load slip

(2) Total input power to the motor

(3) Current drawn at full load, if the power factor is 0.8 lagging

(4) Net torque developed at output at full load. (8)

13. (a) (i) Explain the function and working of 'Overload Release' in a three point starter for shunt motors. (6)

(ii) A 250 V, 37 kW, DC shunt motor is allowed to exert a maximum of 150 percent of the full-load torque during the starting period. The resistance of armature is 0.2 ohm and the full-load efficiency is 84 percent. Number of sections of resistances in the starter is 7. Determine :

(1) the upper and lower limits of current during starting

(2) the values of resistances of each section of the starter. (10)

Or

(b) (i) With the help of a neat circuit diagram, explain the working of star-delta starter. (8)

(ii) A three phase induction motor has a ratio of maximum torque to full load torque as 2.5 : 1. The rotor resistance and standstill reactance per phase are 0.4 ohm and 4 ohm respectively. Determine the ratio of starting torque to full load torque, if a star-delta starter is used. (8)

14. (a) (i) Explain the Ward-Leonard method of speed control of DC motor with a neat sketch showing the circuit. State also the advantages of this method. (10)

(ii) A DC series motor having an armature-resistance of 1 ohm, runs at a speed of 800 r.p.m. at 200 V with a current of 15 A. Find the speed at which it will run, when a 5 ohm resistance is connected in series, at the same supply and taking the same current. (6)

Or

(b) (i) Describe the working of step down DC chopper, with the help of a suitable circuit diagram and wave-form diagrams. State the relation between output and input voltages. How is the speed of a DC motor controlled using a step down chopper? (10)

(ii) A 100 V shunt motor has armature resistance and field resistances of 0.4 ohm and 100 ohm respectively. At a particular constant-torque load, it takes a current of 25 A at the speed of 1200 r.p.m. A chopper is used to control the speed of the motor. Find T_{ON} to reduce the speed to 800 r.p.m. at a chopper frequency of 500 Hz. (6)

15. (a) Sketch and explain the circuit, using thyristor controller, to control the speed of a three phase induction motor by varying the stator voltage. Mention the merits and demerits of this method. Also sketch and explain the torque-speed characteristics when stator voltage control is used. (16)

Or

(b) Explain the following solid state methods of controlling speed of three phase induction motors, with suitable schematic diagrams :

(i) Cycloconverter static Scherbius drive (8)

(ii) Static Kramer drive. (8)
