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06EE74

Seventh Semester B.E. Degree Examination, June/July 2017
Industrial Drives and Applications

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. What is an electric drive? List the advantages of electrical drive. **(06 Marks)**

b. Explain the operation of hoist motor driving a hoist load with four-quadrant speed torque diagram. **(08 Marks)**

c. A motor drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with a = 0.1 and efficiency of 90%. The load has a moment of inertia of 10 kg.m^2 and a torque of 10 N-m. Other load has translational motion and consists of 1000 kg weight to be lifted up at an uniform speed of 1.5 m/s. Coupling between this load and the motor has an efficiency of 85% motor has an inertia of 0.2 kg.m^2 and runs at a constant speed of 1420 rpm. Determine equivalent inertia referred to the motor shaft and power developed by the motor. **(06 Marks)**

2 a. What do you understand by steady state stability? State and prove the condition for stability. **(08 Marks)**

b. Derive the equation for short time rating of the machine. **(08 Marks)**

c. A constant speed drive has the following duty cycle:
(i) Load rising from 0 to 400 kW : 5 min
(ii) Uniform load of 500 kW : 5 min
(iii) Regenerative power of 400 kW returned to the supply : 4 min
(iv) Remains idle for : 2 min
Estimate power rating of the motor. Assume losses to be proportional to (Power)^2. **(04 Marks)**

3 a. A 500 V, 45 kW, 600 rpm dc shunt motor has full load efficiency of 90%. The field resistance is 200 Ω and the armature resistance is 0.2 Ω. The field current is maintained constant. Armature reaction and brush drop may be neglected. Calculate the rated armature current and hence, find the speed under each of the following conditions at which the machine develops an electromagnetic torque equal to the rated value:
(i) Regenerative braking : no external resistance
(ii) Plugging : External resistance of 5.5 Ω inserted.
(iii) Dynamic braking : External resistance of 2.6 Ω inserted. **(12 Marks)**

b. Derive an expression for motor speed (W_m) and armature current (i_a) for transient starting of separately excited motor with armature control. Also show the waveforms. **(08 Marks)**

4 a. With a neat circuit diagram and waveforms, explain the rectifier control of dc series motors (Assuming single phase half controlled rectifier). **(10 Marks)**

b. A 230 V, 960 rpm and 200 A separately excited dc motor has an armature resistance of 0.02 Ω. The motor is fed from a chopper which provides both motoring and braking operations. The source has a voltage of 230 V. Assuming continuous conduction

(i) Calculate duty ratio of chopper for motor operation at rated torque and 350 rpm.

(ii) Calculate duty ratio of chopper for braking operation at rated torque and 350 rpm.

(iii) If maximum duty ratio of chopper is limited to 0.95 and maximum permissible motor speed obtainable without field weakening and power fed to the source.

(iv) If motor speed is also controlled in (iii), calculate field current as a fraction of its rated value for a speed of 1200 rpm. **(10 Marks)**

PART – B

5 a. Define single phasing. Explain the operation of induction motor with unbalanced supply voltages. Also show the speed-torque curves. **(10 Marks)**

b. A 400 V, star connected, 3-phase, 6-pole, 50 Hz induction motor has following parameters referred to the stator : $R_s = R_s' = 1\ \Omega$, $X_s = X_s' = 2\ \Omega$. For regenerative operation of this motor determine:

(i) Maximum overhauling torque it can hold and range of speed for safe operation.

(ii) Speed at which it will hold an overhauling load with a torque of 100 N-m.

(iii) Maximum overhauling torque the motor can hold as a ratio of maximum overhauling torque without capacitor if a capacitive reactance of 2 Ω is inserted in each phase of stator. **(10 Marks)**

6 a. Explain the voltage source inverter (VSI) control for induction motor. **(10 Marks)**

b. A 3-phase, 400 V, 6-pole, 50 Hz, delta connected, slip ring induction motor has rotor resistance of 0.2 Ω and leakage reactance of 1 Ω per phase referred to stator. When driving a fan load it runs at full load at 4% slip. What resistance must be inserted in the rotor circuit to obtain a speed of 850 rpm. Neglect stator impedance and magnetizing branch. Stator to rotor turns ratio is 2.2. **(10 Marks)**

7 a. Why the synchronous motor does not have a starting torque? How do you start a synchronous motor? **(10 Marks)**

b. Describe the operation of self controlled synchronous motor drive employing load commutated thyrisor inverter, with neat circuit diagram. **(10 Marks)**

8 a. How do you control the speed of synchronous motor? Explain in brief the two modes of variable frequency control of synchronous motor. **(08 Marks)**

b. Explain the various stages in paper mill and motors used in various stages. **(12 Marks)**

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