Total No. of printed pages = 4

EE 131701 NR

Roll No. of candidate | | | | | | | | | | |

8/2/2021

B.Tech. 7th Semester End-Term Examination

EE

ELECTRICAL DRIVES AND CONTROL

(New Regulation)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

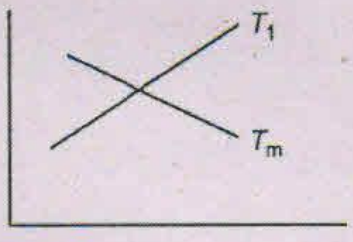
Answer question No. 1 and any *four* from the rest.

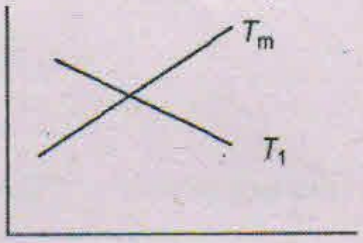
1. Answer the following questions : (10 × 1 = 10)

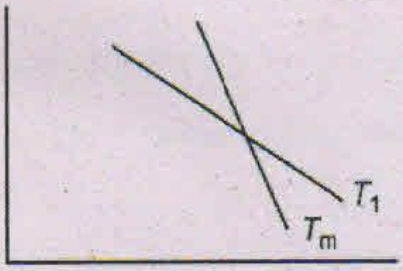
Choose the correct answer :

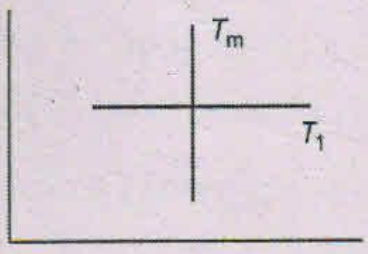
(i) Active loads have the capacity
- (a) To accelerate as well as decelerate the drive motor
- (b) Only to oppose the motion trying to retard the motor
- (c) Provide accelerating torque only
- (d) All the above

(ii) From the characteristics of load and motor torques given below, a typical example of unstable system is

(a) 

(b) 

(c) 

(d) 

[Turn over

(iii) Which braking is not possible in series motors?

(a) regenerative braking (b) dynamic braking

(c) counter-current braking (d) rheostatic braking

(iv) Short time rating of an electric motor

(a) is equal to name plate rating

(b) is less than the name plate rating

(c) is greater than the name plate rating

(d) has no bearing to its name plate rating

(v) Which of the following configurations is used for both motoring and regenerative braking

(a) First quadrant chopper (b) Second quadrant chopper

(c) Two quadrant chopper (d) Four quadrant chopper

(vi) The selection of an electric motor is governed by

(a) Nature of load to be handled

(b) Environmental conditions

(c) Nature of electric supply available

(d) All of the above

(vii) The average value of output voltage of a single phase ac voltage converter with resistive load is

(a) $\frac{V_m}{\pi}(1 + \cos\alpha)$ (b) $\frac{V_m}{2\pi}(1 + \cos\alpha)$

(c) $\frac{V_m}{\pi}\cos\alpha$ (d) $\frac{V_m}{2\pi}\cos\alpha$

(viii) Retardation test is employed

(a) to determine the losses of the motor

(b) to determine the moment of inertia of the rotating parts

(c) to determine speed-torque curve of the motor

(d) to determine the overload capacity of the motor

(ix) Match the items given in List-1 and those in List-2. Select your answer to the question using the codes given

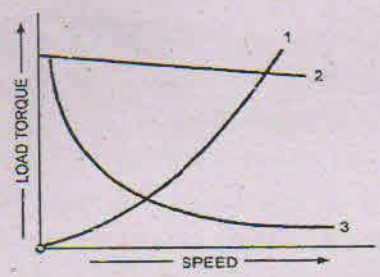
List 1 (Types of Electric Loads)

(A) Hoist winches

(B) Blowers

(C) Boring machines

List 2 (Torque-speed characteristics)



Codes :

	A	B	C
(a)	2	1	3
(b)	1	2	3
(c)	3	1	2
(d)	3	2	1

(x) "A single phase full converter can operate in four quadrants"

(a) True (b) False

2. (a) Draw the block diagram of an electric drive and explain the functions of each component. (8)

(b) A horizontal conveyer belt moving at a uniform speed of 1.2 m/s transports material at the rate of 100 tonnes/hr. The belt is 200 m long and driven by a motor at 1200 rpm

(i) Determine the load inertia referred to the motor shaft

(ii) Calculate the torque that the motor should develop to accelerate the belt from standstill to full speed in 8 seconds. Moment of inertia of the motor is 0.1 kg-m^2. (7)

3. (a) Discuss about the role of a flywheel in an electric drive system. (7)

(b) A 3-phase 100 kW, 6 pole, 960 rpm induction motor has a constant load of 600 N-m at wide intervals and is subjected to additional torque of 2400 N-m for 10 seconds. Calculate the moment of inertia of the flywheel used for load equalization, if motor torque is not to exceed twice the rated torque. The moment of inertia of the motor is 200 kg-m^2. (8)

4. (a) Briefly explain with suitable sketches the heating and cooling curves of electric motors. (7)

(b) A motor has a heating time constant of 60 minutes and cooling time constant of 90 minutes. When running continuously on full load of 20 kW, the final temperature rise is 40°C.

(i) What load the motor can deliver for 10 minutes if this is followed by a shutdown period long enough for it to cool? Assume the losses to be proportional to power^2.

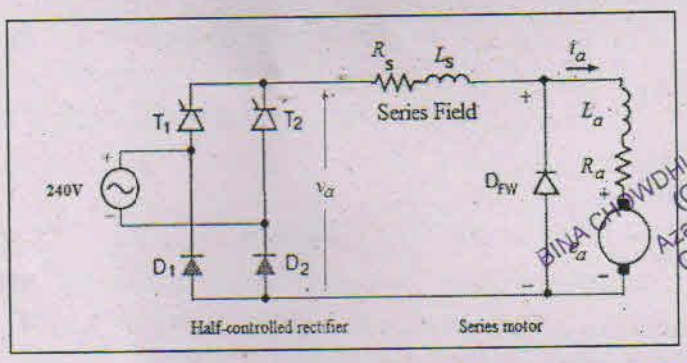
(ii) If it is on an intermittent load of 10 minutes followed by 10 minutes shutdown, what is the maximum value of load it can supply during the on load period? (8)

5. (a) Explain counter-current and regenerative braking methods applied in DC motors. (8)

(b) A 220 V dc shunt motor having an efficiency of 85% , drives a hoist having an efficiency of 80%. Calculate the current drawn from the supply to raise a load of 400 kg at 2.5 m/s. What resistance must be added to the circuit in order to lower the load at 2.5 m/s using rheostatic braking, assuming that efficiencies remain the same? (7)

6. (a) A 100 hp, 1750 rpm, d.c. shunt motor has an armature inductance of 1.15 mH, a resistance of 0.0155 Ω and an armature voltage constant of 1.3V.s/rad. The motor is operated from a three-phase half-wave controlled-rectifier at rated armature current of 35 A. Find the firing angle α, assuming that the supply voltage is 400 V and the motor speed is 1750 rpm. Consider the thyristors to have a forward voltage drop of 1.5 Volt and assume continuous conduction. (5)

(b) A series D.C. motor is to be controlled by a single-phase, half-controlled, full-wave rectifier bridge as shown in the figure. The a.c. input voltage has an rms value of 240V at 50Hz. The combined armature and field resistance is 2.5 Ω and K_{af}= 300 mH. If the load torque is 30 Nm and damping is neglected, calculate the average current and the speed for α = 60° (5)



(c) Briefly explain the constant power mode and constant torque mode of operation of a separately excited dc motor drive system. (5)

7. (a) What is meant by Slip Power in relation to induction motor? With the help of a neat diagram describe how slip power recovery mode is utilized in case of speed control of induction motor. (10)

(b) Draw circuits of a chopper controlled separately excited dc motor in the

(i) First quadrant, forward motoring operation.

(ii) Fourth quadrant, reverse motoring operation. (5)