

Time: 3 hours

Marks: 80

**Instructions:**

- Question No: 1 is compulsory.
- Answer any three from the remaining five questions.
- Figures to the right indicate full marks.
- Answers to questions should be grouped and written together.

- Q1** a) What are the features of vector control **20**  
 b) What are the components of load torque  
 c) Prove that the energy loss during stopping by plugging is  $\frac{3}{2}J\omega_{ms}^2$   
 d) A motor of smaller rating can be selected for a short time duty. Why?
- Q2** a) Draw the block diagram representation of electrical drive and discuss the function of each block. **10**  
 b) A weight of 500 kg is being lifted up at a uniform speed of 1.5 m/s by a winch driven by a motor running at a speed of 1000 rpm. The moment of inertia of motor and winch are 0.5 and 0.3 kg-m<sup>2</sup> respectively. Calculate the motor torque and equivalent moment of inertia referred to the motor shaft. In the absence of weight, motor develops a torque of 100 N-m when running at 1000 rpm. **10**
- Q3** a) Explain the operation of closed loop speed control scheme with inner current control loop. What are the various functions of inner current control loop **10**  
 b) A drive has following parameters:  $J = 10 \text{ kg} - \text{m}^2$ ,  $T = 15 + 0.05N$ , N-m and  $T_l = 5 + 0.06N$ , N-m, where N is the speed in rpm. **10**  
 Initially the drive is working in steady state. Now the drive is braked by electrical braking. Torque of the motor in braking is given by  $T = -10 - 0.04N$ , N-m. Calculate time taken by the drive to stop.
- Q4** a) Derive the thermal model of motor for heating and cooling **10**  
 b) How a chopper fed DC separately excited DC motor operate in motoring and regenerative braking mode. Develop  $\omega$  vs  $T$  relation and draw speed torque characteristics **10**
- Q5** a) Describe the operation regenerative braking of an induction motor **06**  
 b) Why Static Scherbius scheme is called slip energy recovery scheme and what are its advantages. Illustrate with relevant diagrams and derivations. **08**  
 c) What are the reasons for using load equalization in an electrical drive? **06**
- Q6** a) Describe the operation brushless DC motor **10**  
 b) What is the basic principle of Direct torque control method? Explain with block diagram. **06**  
 c) Derive fundamental torque equation and mention the significance of dynamic torque **04**

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