MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FIRST SEMESTER M.TECH (POWER ELECTRONICS & DRIVES)
END SEMESTER ON-LINE PROCTORED EXAMINATIONS

FEBRUARY 2022

POWER SEMICONDUCTOR CONTROLLED DRIVES [ELE 5173]

REVISED CREDIT SYSTEM

Time: 75 Minutes + 10 Minutes **Date: 07 February 2022** **Max. Marks: 20**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Time: 75 minutes for writing + 10 minutes for uploading.

1A. A motor is used to drive a hoist. Motor characteristics are given by

Quadrant I and II: T= 200 – 0.2 N, N-m

Quadrant III and IV: T= -200-0.2N, N-m

where N is the speed in rpm. When the hoist is loaded, the net load torque TL=100 N-m and when it is unloaded, net load torque TL=-80N-m.

Obtain the equilibrium speed for operation in second and fourth quadrants with drawing a neat sketch showing the operation of a hoist in above quadrants. ***(03)***

1B. A motor drives a winch drum which has to lift up a weight of 250kg at a uniform speed of 1.2m/s. The motor is running at a speed of 1200rpm. The moment of inertia of motor and the winch are 0.2kgm^2 and 0.3kgm^2 respectively. In the absence of weight, motor develops a torque of 80.05N-m when running at 1200rpm. Determine the following,

(i) Equivalent torque referred to motor shaft

(ii) Equivalent moment of inertia referred to the motor shaft. ***(02)***

1C. A 220V, 1.98kW, 1500rpm separately excited DC motor is fed from a single phase fully controlled rectifier with an ac source voltage of 230V, 50Hz. Armature resistance Ra is 2.03 Ω and armature inductance La is 50mH. For α=60° and operating efficiency=90%, find no load and critical speed for the drive. Also derive the expression used. ***(05)***

2A. A 2.2 kW, 220V, 11.6A, 1500 rpm dc separately excited motor has an armature resistance and inductance of 2Ω and 32.5mH respectively. This motor is controlled by a Class A chopper with a frequency of 500Hz and the input voltage of 220V. The motor is driving a load whose torque is proportional to the speed. At duty cycle D=0.9 the motor runs at 1260rpm. Calculate the value of duty cycle at 800rpm. ***(02)***

2B. A 440V, 50Hz, 6 pole delta connected 3-phase induction motor operating with 5.501% slip, has the rotor resistance referred to the stator is 2Ω. The motor speed is controlled by stator voltage control and the motor drives a load whose torque is given as TL=k(1-s). Estimate the motor speed and torque when the terminal voltage is 280V. Neglect the stator impedance and rotor leakage reactance. ***(04)***

2C. Draw the circuit schematics of the 3 phase AC voltage controller for 3 phase induction motor to control the speed of a water pump application for star and delta connected stator. Draw the block diagram of the closed loop speed control of the 3 phase AC voltage controller. Also explain the functioning of each block. ***(04)***