Reg. No.									

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

VII SEMESTER B. TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
MAKE UP EXAMINATIONS, DECEMBER 2019

SOLID STATE DRIVES [ELE 4011]
REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 02 January 2020** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Derive expressions for equivalent moment of inertia and torque referred to the motor shaft when a motor is driving two loads; one linear in nature and second rotational in nature ***(04)***

1B. A motor is required to drive the take-up roll on a plastic strip line. The mandrel on which the strip is wound is 15cm in diameter and the strip builds up to a roll 25 cm in diameter. Strip tension is maintained constant at 1000 N. The strip moves at a uniform speed of 25 m/s. The motor is coupled to a mandrel by a reduction gear with a = 0.5. The gears have an approximate efficiency of 87% at all speeds. Determine the speed and power rating of the motor required for this application ***(03)***

1C. Mention the various components of load torque. Hence comment on the modelling of these components of load torque. ***(03)***

2A. Write a short note on the various braking techniques employed for a DC motor. ***(03)***

2B. A 2.4 kW, 220 V, 480 rpm, 12.8 A DC motor has the armature resistance and inductance of 2.2 Ω and 40 mH. It is fed by a single phase fully controlled rectifier with an ac source voltage of 240 V, 60 Hz. Identify the mode and calculate the speed for $\alpha = 120°$, $T_a = 60$ Nm. ***(04)***

2C. Derive an expression for the speed-torque relation of a three phase controlled rectifier fed separately excited dc motor, when operating in motoring mode with continuous current operation. ***(03)***

3A. A dc chopper is used for regenerative braking of a separately excited dc motor. DC supply voltage is 400 V. Motor has armature resistance of 0.2 Ω and motor constant is 1.2 volts/rad/sec. The average armature current during regenerative braking is kept constant at 300 A with negligible ripple for a duty cycle of 60%. Determine the maximum and minimum permissible braking speed. ***(02)***

3B. With a neat circuit schematic, plot the waveforms for armature voltage and armature current for a Class B chopper along with the triggering sequence. ***(04)***

3C. State the advantages of Squirrel cage induction motor over Dc motors. Also, show the stages involved in DC drives and Induction motor drives with help of block diagrams. ***(04)***

4A. With the help of a suitable torque slip characteristics explain why stator voltage control method of speed is best suited for fan and pump drives. Also, with a suitable schematic explain how direction of rotation can be reversed while employing stator voltage control technique to an induction motor. ***(04)***

4B. With the help of torque slip characteristics, explain the speed control of induction motor when operated with adjustable frequency at constant voltage. Mention the advantages and disadvantages of the same. ***(03)***

4C. A 3 phase delta connected 6 pole, 50Hz, 400V, 925rpm, squirrel cage induction motor has the following parameters: Rs = 0.2 Ω, Rr^1 =0.3 Ω, Xs= 0.5 Ω, Xr^1=1 Ω.
The motor is fed from a voltage source inverter at constant V/f ratio. Calculate:

(i) Speed for the frequency of 35Hz at full load torque.

(ii) Frequency for a speed of 600rpm at full load torque. ***(03)***

5A. A three phase slip ring induction motor uses static rotor resistance control. Draw a neat circuit diagram and explain the working stating the advantages and disadvantages of the control scheme. ***(03)***

5B. Explain the working of a static Kramer drive with the help of a suitable circuit diagram. ***(03)***

5C. Mention the advantages of direct torque control technique over field oriented control technique. Draw the block schematic of direct torque control technique for an induction motor control application. ***(04)***