

III B. Tech II Semester Regular/Supplementary Examinations, October/November - 2020
POWER ELECTRONIC CONTROLLERS AND DRIVES

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)

2. Answer **ALL** the question in **Part-A**

3. Answer any **FOUR** Questions from **Part-B**

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**PART -A**

**(14 Marks)**

1. a) Draw the speed-torque characteristics of dc series motor in forward motoring and reverse motoring. [3M]
- b) Draw the voltage waveform of single phase half controlled converter fed dc motor for firing angle  $60^\circ$ . [2M]
- c) What are the advantages of operating choppers at high frequency? [2M]
- d) Briefly describe, is the V/f method of speed control of induction motor is similar to the armature voltage control. [3M]
- e) What are the advantages of Kramer's drive system? [2M]
- f) How the variable frequency control is used for synchronous motor speed control? [2M]

**PART -B**

**(56 Marks)**

2. a) Describe the plugging and regenerative braking of separately excited dc motor. [7M]
- b) Find the resistance to be connected across a dc series motor in a crane when its supply voltage is cut off and dynamic braking is applied to limit the speed to 500 rpm if descending load exerts a constant load torque of 200 N.m. The magnetizing curve of the motor running at 750 rpm is a straight line given by  $E = (5.7 I_a + 228.6)V$  between  $I_a = 30$  A to 50 A. The total motor resistance including series field resistance is  $1.1 \Omega$ . [7M]
3. a) Explain the four-quadrant operation of dc drive using a dual converter. [7M]
- b) A 1 HP, dc shunt motor is loaded by a constant load of 20 Nm. The armature resistance is  $0.5 \Omega$  and the field constant is 2.5 V-sec. The motor is driven by a single-phase full converter supplied by 220 V, 50 Hz source. The triggering angle of the converter is  $60^\circ$ . Calculate the developed torque and speed of the motor. [7M]
4. a) Explain the operation of a two-quadrant class-C separately excited dc motor drive. [7M]
- b) A 220 V, 1500 rpm, 2 kW dc separately excited motor has the armature resistance and inductance of  $1 \Omega$  and 50 mH respectively. It is controlled by a chopper. The chopper operating frequency is 400 Hz at a load whose torque is proportional to the speed. At  $\delta=0.9$ , the motor runs at 1320 rpm. What will be the value of  $\delta$  and the current ripple at 1000 rpm? [7M]
5. a) Explain open-loop V/f control of induction motor with PWM voltage source inverter. [7M]
- b) A 400 V, three-phase, 50 Hz, 6-pole Y-connected induction motor has the following equivalent circuit parameters: [7M]

$$r_1 = 0.2 \Omega, \quad r_2' = 0.1 \Omega, \quad x_m = 5 \Omega$$

The motor is fed from a voltage source inverter with a constant V/f ratio. At 975 rpm, the load torque 80 N.m. When the frequency of supply voltage is reduced to 40 Hz, Calculate: (i) motor speed (ii) maximum torque at 50 Hz and 40 Hz (iii) motor current at 40 Hz.

6. a) Explain the slip-power recovery scheme of induction motor using commutator-less Kramer drive. [7M]
- b) A three-phase, 440 V, 50 Hz, 6-pole Y-connected induction motor is driving 300 N.m constant torque load. The motor has rotational losses of 1 kW. The motor is driven by a slip-energy recovery system. The triggering angle of the dc to ac converter is adjusted to  $100^\circ$ , Calculate: (i) motor speed (ii) rotor RMS current (iii) stator RMS current, and (iv) power returned back to the source. [7M]
7. a) What are the advantages of the self-control scheme of synchronous motor? Explain. [7M]
- b) Explain closed-loop speed control of self-controlled synchronous motor drive fed from voltage source inverter. [7M]

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