III B. Tech II Semester Supplementary Examinations, November - 2019

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 shunt motor in forward motoring and reverse motoring. [2M]
   b) Draw the voltage waveform of single phase half controlled converter fed dc motor for firing angle 90^0. [2M]
   c) Draw the speed-torque characteristics of series dc motor fed using a one quadrant chopper. [2M]
   d) Why stator voltage control is an inefficient method of induction motor speed control? [3M]
   e) Compare the Scherbius and Kramer's drive systems. [3M]
   f) How the PWM control is used for synchronous motor speed control? [2M]

PART –B (56 Marks)

2. a) Describe the plugging and dynamic braking of dc shunt motor. [7M]
   b) A 500 V dc shunt motor taking an armature current of 200 A while running at 800 rpm, it is braked by disconnecting the armature from the supply and closing it on a resistance of 2 Ω, assuming field excitation is constant. The armature has a resistance of 0.2 Ω. Calculate (i) initial braking current (ii) torque at 600 rpm as percentage of the torque at 800 rpm. [7M]

3. a) Draw speed-torque characteristics of single phase full converter fed dc motor drive. Explain its operation for discontinuous and continuous conduction. [7M]
   b) A 220 V, 1500 rpm, 11.6 A dc shunt motor has armature resistance of 2 Ω and inductance 28.36 mH. The motor is driven by single phase full converter supplied by 230 V, 50 Hz source. Identify the mode of operation and torque developed when triggering angle of the converter is 30^0 and speed of the motor is 1480 rpm. [7M]

4. a) Explain closed loop operation of a dc-dc converter fed dc motor drive. [7M]
   b) Derive expressions for the armature current ripple and the average torque for the dynamic braking of a chopper controlled separately excited motor. [7M]

5. a) Explain the variable voltage control of induction motor using three-phase ac voltage controller. [7M]
   b) A three phase 440 V, 50 Hz 6-pole, 945 rpm Y-connected induction motor has the following parameters: [7M]

$$r_1 = 0.2\,\Omega, \qquad r_2' = 0.3\,\Omega, \qquad x_1 = 0.5\,\Omega \qquad x_2' = 1.0\,\Omega$$

The motor is fed from a voltage source inverter with constant V/f ratio. (i) Calculate the maximum torque and corresponding speed for 50 Hz and 20 Hz frequency assuming r_1 is neglected (ii) What is the value of V/f ratio at 20 Hz such that

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6. a) Explain the speed control of induction motor by injection of voltage in rotor in the super-synchronous motoring and super-synchronous braking region. [7M]
   b) A three phase, 50 Hz, Y-connected, 440 V, induction motor rotates at 2800 rpm at full load. The motor is driven by slip-energy recovery system. Calculate the triggering angle for a motor speed of 2100 rpm, assume turns ratio is equal to one. [7M]

7. a) Explain variable frequency control of synchronous motor with pulse width modulation. [7M]
   b) What are the various converters or inverters are used in the self control scheme of synchronous motor? Explain. [7M]