

Code No: **R1632021**

**R16**

SET - 1

**III B. Tech II Semester Regular/Supplementary Examinations, August - 2021**

**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**

**PART -A**

**(14 Marks)**

1. a) Draw the speed torque characteristics of counter current braking for a dc series motor. [2M]
- b) Draw the voltage waveform of single phase fully converter controlled fed dc motor for firing angle  $120^\circ$ . [2M]
- c) Draw the schematic diagram of two quadrant chopper. [2M]
- d) What are the converters used for the speed control of induction motor below the rated frequency? [3M]
- e) What are the disadvantages of rotor resistance control? [3M]
- f) How the variable frequency control is used for synchronous motor speed control? [2M]

**PART -B**

**(56 Marks)**

2. a) Explain the different types of load torques and enlist different motors to suit these torques. [7M]
  - b) A 250 V, 30 kW, 800 rpm dc shunt motor is having full load efficiency of 90%, its field resistance is  $250 \Omega$  and armature resistance is  $0.1 \Omega$ . Assume that field current is constant; armature reaction and brush drop is neglected. Calculate rated current and then find the speed at rated torque when it is operated under:
    - (i) regenerative braking with no external resistance
    - (ii) plugging with external resistance of  $5 \Omega$
    - (iii) dynamic braking with external resistance of  $2 \Omega$ .
3. a) Explain the operation of a dc series motor supplied from single phase full converter with free-wheeling diode. [7M]
  - b) The speed of a 220 V, 3.73 kW, and 1000 rpm dc shunt motor is controlled by a single phase full converter. The ac supply voltage is 230 V, 50 Hz. The motor emf constant is  $1.9 \text{ V sec/rad}$ . For a speed of 600 and 800 rpm at rated torque, calculate the required firing angles of the converter. Draw the waveforms of load voltage and supply current. Assume that a very large inductance connected in series with armature. [7M]



4. a) Describe type-D chopper fed two-quadrant drive operation with necessary equivalent circuits and waveforms. [7M]
- b) A 230 V, 500 rpm, 90 A separately excited dc motor has the armature resistance and inductance of  $0.1 \Omega$  and 10 mH respectively. It is controlled by a class-C two-quadrant chopper operating with a source voltage of 230 V at a frequency of 400 Hz. [7M]
- (i) Calculate the motor speed for a motoring operation at duty ratio of 0.5 with one fourth rated torque.
- (ii) What will be the motor speed when it regenerating at a duty ratio of 0.6 and rated torque?
5. a) Explain why stator voltage control is suitable for speed control of induction motors in fan and pump drives? [7M]
- b) A three phase, 480 V, 4-pole 60 Hz Y-connected induction motor has inductive reactance of  $4 \Omega$  and stator resistance of  $0.6 \Omega$ , the rotor resistance referred to stator is  $0.8 \Omega$ . The motor is driving constant load torque of 60 Nm at a speed of 3500 rpm. Calculate motor speed and starting current if the frequency is reduced to 50 Hz. [7M]
6. a) Explain the speed control of induction motor by injection of voltage in rotor in the sub-synchronous motoring and sub-synchronous braking region. [7M]
- b) A three phase, 440 V, 4-pole 50 Hz induction motor is driving a constant torque load of 80 Nm. The parameters of the motor are: [7M]
- $$r_1 = 0.4 \Omega, \quad r_2 = 0.1 \Omega, \quad x_{eq} = 4 \Omega \quad \text{and} \quad N_1/N_2 = 2.$$
- Calculate the magnitude of the injected voltage that would reduce the motor speed to 1000 rpm. Also calculate the power received by the source of the injected voltage.
7. a) Explain self control principle through the torque angle in synchronous motor. [7M]
- b) Describe the closed loop self control of synchronous motor with VSI. [7M]

\*\*\*\*\*

