

Code: EE6T4

**III B.Tech - II Semester – Regular/Supplementary Examinations  
AUGUST - 2021**

**POWER SEMICONDUCTOR DRIVES  
(ELECTRICAL & ELECTRONICS ENGINEERING)**

Duration: 3 hours

Max. Marks: 70

**PART – A**

Answer *all* the questions. All questions carry equal marks

11x 2 = 22 M

1.

- a) What are the main factors which decide the choice of electrical drive for a particular application?
- b) Write the fundamental torque equation of motor-load system. Also calculate the time and energy loss in transient operations.
- c) Why plugging type braking operation is not preferred for DC drives?
- d) What are the drawbacks of ripple content in the armature current in converter fed DC Motor?
- e) How would you describe chopper fed DC drives are superior over rectifier fed DC drives?
- f) A DC series motor is fed from a 600 V source through a chopper. The DC motor has the following parameters armature resistance is equal to  $0.04 \Omega$ , field resistance is equal to  $0.06 \Omega$ , constant  $k = 4 \times 10^{-3} \text{ Nm / Amp}^2$ . The average armature current of 300 Amps is ripple free. For a chopper duty cycle of 60% determine input power drawn from the source.

- g) For variable frequency control of induction motor explain the following points:
- (i) For speeds below base speed (V/f) ratio is maintained constant, why?
  - (ii) For speeds above base speed, the terminal voltage maintained constant, why?
- h) Why the static scherbius drive has a poor power factor?
- i) Write the advantages of H-bridge 5 level inverter fed induction motor.
- j) What do you understand by the term “linear transformation” as used in electrical machines?
- k) On what basis are the transformations carried out in electrical machines? Explain.

### PART – B

Answer any *THREE* questions. All questions carry equal marks.

3 x 16 = 48 M

2. a) State the essential parts of electrical drives. What are the functions of power modulator? 8 M
- b) A motor is required to drive the take-up roll on a plastic strip line. The mandrel on which the strip is wound is 15 cm in diameter and 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 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. 8 M

3. a) How would you explain the operation of DC separately excited motor fed from three phase full controlled rectifier? And also draw and explain its speed torque characteristics for continuous mode of operation. 8 M

b) A 230 V, 960 rpm, 20 A separately excited DC motor has armature resistance and inductance of 1.2  $\Omega$  and 50 mH respectively. Motor is controlled by a single-phase half-controlled rectifier with source voltage of 230 V, 50 Hz. Calculate no load speed, speeds and developed torques on the boundary between continuous and discontinuous conduction for  $\alpha=45^\circ$  and  $135^\circ$ . 8 M

4. a) Explain the operation of chopper fed DC series motor in motoring and regenerative braking operation. 8 M

b) A 230 V, 960 rpm and 200 A separately excited DC motor has an armature resistance of 0.02 $\Omega$ . The motor is fed from a chopper which provides both motoring and braking operations. The source has a voltage of 230 V DC. Assuming continuous conduction.

i) Calculate duty ratio of chopper for motoring operation at rated torque and 350 rpm.

ii) Calculate duty ratio of chopper for braking operation at rated torque and 350 rpm. 8 M

5. a) How would you explain the operation of induction motor drive using static rotor resistance control? 8 M

b) A 3- $\phi$ , 440 V, 6-pole, 970 rpm, 50 Hz, Y-connected induction motor has the following parameters referred to the stator  $R_s=0.1 \Omega$ ,  $R_r'=0.08 \Omega$ ,  $X_s=0.3\Omega$ ,  $X_r'=0.4 \Omega$ . The stator to rotor turns ratio is 2.

The motor speed is controlled by Static Scherbius Drive. The drive is designed for a speed range of 25% below synchronous speed. The maximum value of firing angle is  $165^\circ$ . Calculate.

i) Turns ratio of the transformer

ii) Torque for a speed of 780 rpm and  $\alpha =140^\circ$ .

DC link inductor has a resistance of  $0.01\Omega$ . 8 M

6. a) Obtain identical transformations for currents and voltages from a rotating balanced 3-phase (a, b, c) winding to a rotating balanced 2-phase ( $\alpha$ ,  $\beta$ ) winding. Show that power invariance is maintained under this transformation. 8 M

b) How would you describe the principle of vector controlled induction motor drive? 8 M