



10EE74

**Seventh Semester B.E. Degree Examination, Jan./Feb. 2023**  
**Industrial Drives and Applications**

Time: 3 hrs.

Max. Marks: 100

**Note: Answer any FIVE full questions, selecting at least TWO questions from each part.**

**PART – A**

1.
  - a. Obtain the fundamental torque equations of a motor load system. (04 Marks)
  - b. Explain the speed-torque conventions and multi-quadrant operations of a motor, driving a height load. (10 Marks)
  - c. A motor equipped with a flywheel is to supply a load torque of 1000N-m for 10sec followed by a light load period of 200N-m long enough for the flywheel to regain its steady state speed. It is desired to limit the motor torque to 700N-m. What should be the moment of inertia of flywheel? Motor has an inertia of  $10\text{kg-m}^2$ . Its no load speed is 500rpm and the slip at a torque of 500N-m is 5%. Assume speed-torque characteristics of motor to be a straight line in the region of interest. (06 Marks)
2.
  - a. Explain the method determination of motor rating for short time duty loads. Draw temperature rise Vs Time curve. (08 Marks)
  - b. Mention the classes of motor duty for different applications. Explain any one of them. (05 Marks)
  - c. Select a motor to be run at 970 rpm for the following intermittent duty :
    - i)  $P_1 = 4\text{ KW}$  for  $t_1 = 2\text{ sec}$
    - ii)  $P_2 = 8\text{ KW}$  for  $t_2 = 3\text{ sec}$
    - iii)  $P_3 = 4\text{ KW}$  for  $t_3 = 2\text{ sec}$
    - iv)  $P_4 = 8\text{ KW}$  for  $t_4 = 3\text{ sec}$
    - v)  $P_5 = 0$  for  $t_5 = 5\text{ sec}$ . (07 Marks)
3.
  - a. Explain with diagram single phase fully controlled rectifier control of DC separately excited motor. (07 Marks)
  - b. Explain the chopper control of separately excited DC motor for regenerative braking. (07 Marks)
  - c. The following parameters are given for a separately excited DC motor :  
240V, 75KW, 1750 rpm,  $R_a = 0.015\Omega$ ,  $L_a = 0.001\text{H}$ ,  $C = 1.27\text{V-S/rad}$ ,  $J = 3.7\text{ kg-m}^2$ ,  $F = 0$ . Assume that the load inertia is equal to the motor inertia. Find the transfer function indicating the natural frequency and damping ratio. (06 Marks)
4.
  - a. With a neat circuit and graph, explain the regenerative, dynamic and plugging type of braking system for separately excited DC motor. (10 Marks)
  - b. A 230V, 960rpm and 200A 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 230V. Assuming continuous conduction.
    - i) Calculate duty ratio of chopper for motoring operation at rated torque and 350rpm
    - ii) Calculate the duty ratio of chopper for braking operation at rated torque and 350 rpm
    - iii) If maximum duty ratio of chopper is limited to 0.95 and maximum permissible motor current is twice the rated, calculate maximum permissible motor speed obtainable without field weakening and power fed to the source. (10 Marks)

## PART - B

- 5 a. Describe the operation of a three phase induction motor operating with unbalanced source voltages and single phasing. (10 Marks)
- b. A 400V, star connected, 3 – phase, 6–pole, 50 Hz induction motor has following parameters referred to the stator :  $R_s = R_r' = 1\Omega$ ,  $X_s = X_r' = 2\Omega$ .  
For regenerative braking operation of this motor determine :
- Maximum over hauling torque it can hold and range of speed for safe operation
  - Speed at which it will hold an overhauling load with a torque of 100 N-m
  - Maximum overhauling torque the motor can hold as a ratio of maximum overhauling torque without capacitor if a capacitive reactance of  $2\Omega$  is inserted in each phase of stator. (10 Marks)
- 6 a. Explain the dynamic braking and multiquadrant operation of voltage source inverter (VSI) induction motor derives. (10 Marks)
- b. Describe the speed control of 3-phase induction motor by static rotor resistance control. (10 Marks)
- 7 a. Explain the operation of a synchronous motor when fed from a fixed frequency supply. (10 Marks)
- b. Explain the self controlled synchronous motor drive employing load commutated thyristor inverter. (10 Marks)
- 8 a. Classify the drives used in cement industry and explain briefly, any one of them. (05 Marks)
- b. With a neat sketch, explain textile mill drive system. (10 Marks)
- c. Write a short note on reversing hot rolling mill driver. (05 Marks)

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