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Eighth Semester B.E. Degree Examination, June/July 2023
Industrial Drives and Applications

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Write the block diagram of an electrical drive and mention the functions of power modulator. (04 Marks)
- b. A motor drives two loads, one has rotational motion and the other translational motion. Moment of inertia of motor is 1.2 kg.m^2 . Motor runs at a speed of 1000 rpm. The load with rotational motion has an inertia of 7 kg.m^2 and a torque of 10 N.m at a speed of 200 rpm. The load with translational motion moves at a speed of 10 m/sec with the weight of 10 kg and a force of 20 N . Calculate the equivalent inertia and torque of the system, referred to the motor shaft and power rating of the motor assuming negligible loss in the transmission system. (05 Marks)
- c. With a neat diagram, explain the four quadrant operation of a motor driving a hoist load. (07 Marks)

OR

- 2 a. Derive expressions for equivalent values of moment of inertia and torque as referred to motor shaft for loads with rotational motion. (07 Marks)
- b. A motor equipped with a flywheel is to supply a load torque of 1000 N.m for 10 sec followed by a light load period of 200 N.m long enough for the flywheel to regain its steady state speed. It is desired to limit the motor torque to 700 N.m . What should be the moment of inertia of flywheel? Motor has an inertia of 10 kg.m^2 . Its no load speed is 500 rpm and slip at a torque of 500 N.m is 5%. Assume speed-torque characteristic of motor to be straight line in the region of interest. (05 Marks)
- c. Explain how a current limit control functions in closed loop control of drives. (04 Marks)

Module-2

- 3 a. Derive an expression for temperature rise of a motor during normal operation. (10 Marks)
- b. A 50 KW , 3 phase, 440 V , 50 Hz , 1440 rpm squirrel – cage induction motor has constant loss to variable loss at full load in the proportion $1 : 3$. Its rated temperature rise is 55°C and its heating and cooling time constants are 40 and 60 minutes respectively. Find the intermittent rating if periodic load of half hour duration are applied at an interval of half hour. (06 Marks)

OR

- 4 a. Explain with drive current and relevant waveforms (discontinuous current) a single phase fully controlled rectifier control of a separately excited DC motor. (08 Marks)
- b. A 230 V , 74 A , 1750 rpm separately excited motor with armatures resistance of 0.18 ohm is supplied through a 3 phase fully controlled rectifier from an AC source of 208 V line 50 Hz . The motor is operating in continuous conduction mode. The field is excited to a voltage which gives rated operation. If the motor is delivering full load torque determine the speed for : i) $\alpha = 45^\circ$ ii) $\alpha = 135^\circ$. (08 Marks)

Module-3

- 5 a. Explain the behaviour of 3 phase induction motor when fed from a non-sinusoidal voltage supply. (06 Marks)
- b. A 2200V, 260kW, 735 rpm, 50Hz, 8 pole, 3 phase, squirrel cage induction motor has the following parameters referred to the stator:
 $R_s = 0.075 \Omega$, $R_r^1 = 0.1 \Omega$, $X_s = 0.45 \Omega$, $x_r^1 = 0.55 \Omega$. Stator winding is delta connected and consists of two sections connected in parallel.
- i) Calculate starting torque and maximum torque as a ratio of rated torque, if the motor is started by star-delta switching. What is the max value of line current during starting?
- ii) If the motor is started by connecting series reactors in line, what should be the value of reactors so as to limit the line current to twice the rated value? (10 Marks)

OR

- 6 a. Explain ac dynamic braking of 3 phase induction motor with i) Two lead connections. ii) Three lead connections. (10 Marks)
- b. Derive expressions for time required stop the induction motor by plugging when running at synchronous speed. (06 Marks)

Module-4

- 7 a. Explain with relevant diagrams the Voltage source Inverter (VSI) control of 3 phase induction motor. What are the disadvantages of this method, how they can be minimized? (08 Marks)
- b. Explain the closed loop control for VSI controlled 3 phase induction motor. (08 Marks)

OR

- 8 a. Explain the 3 phase induction motor fed from a variable frequency CSI. What are its advantages and disadvantages and remedial measures? (06 Marks)
- b. A single phase, 220V, 50Hz, 1425 rpm induction motor has the following parameters:
 $R_s = 2 \Omega$, $R_r^1 = 5 \Omega$, $X_s = X_r^1 = 6 \Omega$ and $X_m = 60 \Omega$. It drives a fan load at rated speed when full voltage is applied. Motor speed is controlled by the stator voltage control. Calculate the motor terminal voltage for a speed of 1200 rpm. (10 Marks)

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Module-5

- 9 a. Explain with neat sketch self-controlled synchronous motor drive employing load commutated inverter. (07 Marks)
- b. Explain with diagram and waveforms trapezoidal PMAC (Brushless dc) motor. (09 Marks)

OR

- 10 a. Explain important features of stepper motors. (06 Marks)
- b. Write a technical note on :
 (i) Textile Mill Drives
 (ii) Steel Rolling Mill Drives. (10 Marks)
