



CBCS SCHEME

USN

--	--	--	--	--	--	--	--	--	--

17EE82

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

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. What are the advantages of an electric drive? Mention the factor on which choice of an electric drive depends. (06 Marks)
- b. With basic block diagram, explain essential parts of electric drive. (07 Marks)
- c. With neat sketch, explain speed torque conventions and multi-quadrant operation of motor driving hoist load. (07 Marks)

OR

- 2 a. Derive the expression for the equivalent load torque and equivalent moment of inertia for loads with rotational motion and translational motion. (08 Marks)
- b. A motor drives two loads. The rotational load coupled to the motor through reduction gear with a = 0.1 and efficiency of 90%. The load has a moment of inertia of 10 kg-m² and a torque of 10 N-m. Other load has a translational motion and consists of 1000 kg weight to be lifted up at an uniform speed of 1.5 m/s. The coupling between this load and motor has an efficiency of 85%. Motor has an inertia 0.2 kg-m² and runs at a constant speed of 1420 rpm. Determine equivalent inertia and torque referred to the motor shaft and power developed by the motor. (08 Marks)
- c. Explain the three modes of an electrical drive operation. (04 Marks)

Module-2

- 3 a. Obtain the thermal model of motor for heating and cooling. Also draw the heating and cooling curve. (07 Marks)
- b. Name the classes of motor duty. With neat graph, explain briefly. (06 Marks)
- c. A motor operates on periodic duty cycle in which it is clutched to its load for 10 min and declutched to run on no-load for 20 min. Minimum temperature rise is 40°C. Heating and cooling time constants are equal and have a value of 60 min. When load is declutched continuously the temperature rise is 15°C. Determine:
 - (i) Maximum temperature during the duty cycle and
 - (ii) Temperature when the load is clutched continuously(07 Marks)

OR

- 4 a. Explain with drive current and relevant waveforms (discontinuous current) a single phase fully controlled rectifier control of separately excited DC motor. (06 Marks)
- b. A 200 V, 875 rpm, 150 A separately excited DC shunt motor has an armature resistance of 0.06Ω. It is fed from a single phase fully controlled rectifier with an AC source voltage of 220V, 50 Hz, assuming continuous conduction. Calculate:
 - (i) Firing angle for rated motor torque and 750 rpm
 - (ii) Firing angle for rated motor torque and -500 rpm
 - (iii) Motor speed for $\alpha = 160^\circ$ and rated torque. (08 Marks)
- c. With neat circuit diagram and waveforms, explain Chopper control of separately excited DC motor. (06 Marks)

Module-3

- 5 a. Explain the behaviour of 3 phase induction motor when fed from a no-sinusoidal voltage supply. (06 Marks)
- b. Explain with speed-torques of three phase induction motor operation with unbalanced rotor impedances. (06 Marks)
- c. A 2200 V, 2600 KW, 735 rpm, 50 Hz, 8 pole, 3-phase squirrel cage induction motor has following parameters referred to the stator:
 $R_s = 0.075 \Omega$, $R'_r = 0.1 \Omega$, $X_s = 0.45 \Omega$, $X'_r = 0.55 \Omega$
 Stator winding is delta connected consists of two sections connected in parallel.
- (i) Calculate starting torque and maximum torque as ratio of rated torque, if the motor is started by star-delta switching. What is the maximum value of line current during starting?
- (ii) If motor is started by connecting series reactors in line, what should be the value of reactors so as to limit line current to twice the rated value? (08 Marks)

OR

- 6 a. Explain AC dynamic braking of 3 phase induction motor with (i) Two lead (ii) Three lead connection. (06 Marks)
- b. A 2.8 KW, 400 V, 50 Hz, 4 pole, 1370 rpm, delta connected squirrel-cage induction motor has following parameters referred to the stator $R_s = 2 \Omega$, $R'_r = 5 \Omega$, $X_s = X'_r = 5 \Omega$, $X_m = 80 \Omega$. Motor speed is controlled by stator voltage control. When driving a fan load if runs at rated speed at rated voltage. Calculate motor terminal voltage at 1200 rpm. (08 Marks)
- c. With voltage-frequency relation and speed-torque characteristics, explain variable frequency control of three phase induction motor and also list out its features. (06 Marks)

Module-4

- 7 a. With a neat circuit diagram and relevant waveform, explain the operation of VSI driven induction motor. (08 Marks)
- b. Draw the block diagram and explain the closed loop speed control of voltage source induction motor drive. (08 Marks)
- c. Discuss the relative advantages and disadvantages of Current Source Inverter (CSI) and Voltage Source Inverter (VSI) drives. (04 Marks)

OR

- 8 a. Explain the starting and pull in process in synchronous motor operation from fixed frequency supply. (07 Marks)
- b. Explain the two modes variable frequency control of a synchronous motor. (06 Marks)
- c. Explain with neat sketch, variable frequency control of multiple synchronous motors. (07 Marks)

Module-5

- 9 a. With a neat circuit diagram, explain the self controlled synchronous motor drive employing load commutated inverter. (10 Marks)
- b. Explain brushless dc motor drive for Servo applications. (05 Marks)
- c. List out important features of stepper motors. (05 Marks)

OR

- 10 a. With a neat sketch, explain single-stack variable reluctance motor. (08 Marks)
- b. What are the different types of steel rolling mills? Explain any one type and requirements of motor for that drive. (06 Marks)
- c. Explain the drive requirement for cranes and hoists. (06 Marks)
