

CBCS SCHEME

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17EE82

Eighth Semester B.E. Degree Examination, Feb./Mar. 2022 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. With relevant block diagram, discuss the operation of electrical drive system. (06 Marks)
- b. With relevant speed – torque characteristics and polarities explain the four quadrant operation of a motor driving. (08 Marks)
- c. A weight of 500kg being lifted up at a uniform speed of 1.5m/sec by a winch driven by a motor running at a speed of 1000rpm. The moment of inertia of the motor and winch are 0.5 and 0.3 kg-m² respectively. Calculate the motor torque and equivalent M.I referred to the motor shaft. In the absence of weight the motor develops a torque of 100N-m, when running at 1000rpm. (06 Marks)

OR

- 2 a. Mention and discuss the factors considered for the choice of electric drives. (04 Marks)
- b. Derive the expression for the load torque and moment of inertia referred to the motor shaft for loads with rotational motion and translational motion. (08 Marks)
- c. With relevant block diagram, discuss the operation of closed loop of drive system incorporating speed and current loop. (08 Marks)

Module-2

- 3 a. With usual notations discuss and derive the expression for heating and cooling curves of an electrical motor. (06 Marks)
- b. With relevant circuit and waveforms, explain the operation of single phase fully controlled rectifier fed separately excited DC motor drive under continuous conduction mode of operation. Derive an expression for speed. (08 Marks)
- c. A DC separately excited DC motor is fed by chopper from 600V source, $R_a = 0.05\Omega$ and back emf constant is $K_v = 1.527V/A\text{-rad/sec}$. The average armature current $I_a = 250A$ and the field current is $I_f = 2.5A$. Assume armature current is continuous and ripple free. For a duty cycle of 60% determine :
i) Input power from the source ii) Motor speed iii) Developed torque. (06 Marks)

OR

- 4 a. Mention and discuss any four classes of duties to be performed by motors with load torque and temperature curves. (08 Marks)
- b. With relevant circuit and waveforms, discuss the operation chopper fed DC drive for motoring and regenerative braking with necessary equations. (08 Marks)
- c. A DC separately excited motor is fed from a single phase semiconverter with 230V, 50Hz supply, for both field and armature. $R_f = 200\Omega$ and $R_a = 0.3\Omega$, the load torque is 50Nm at 900rpm. The voltage constant $K_v = 0.8V/A\text{-rad/sec}$. Assume continuous current. Determine:
i) Field current for $\alpha_f = 0$
ii) Firing angle in armature converter circuit. (04 Marks)

Module-3

- 5 a. With relevant equations, discuss the operation of an IM from unbalanced source voltage. Draw the speed torque characteristics. (06 Marks)
- b. A 440V, 50Hz, 6 pole, 950rpm, star connected IM has the following parameters referred to the stator : $R_s = 0.5\Omega$, $R_r^1 = 0.4\Omega$, $X_s = X_r^1 = 1.2\Omega$, $X_m = 50\Omega$. Motor driving a fan load where $T_L = 0.0123 W_m^2$. Now one phase of the motor fails. Calculate the motor speed and current. Will it be safe to run motor for a long period? (08 Marks)
- c. Mention the two important features of starting of I.M explain with necessary diagram start delta starter using circuit breakers. (06 Marks)

OR

- 6 a. With per phase equivalent circuit discuss and derive the performance characteristics equation of the IM drive. Draw the speed – torque curve. (06 Marks)
- b. With relevant circuit and equations, discuss the operation of AC dynamic braking of an IM with two possible connections. (06 Marks)
- c. A 2200V, 2600KW, 735rpm, 50Hz, 8pole, 3 phase IM 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 in parallel. Determine the following :
- i) Starting torque to maximum torque as a ratio of rated torque, if the motor is started by start – delta starter. What is the maximum value of line current during starting?
- ii) Transformation ratio of an auto transformer so as to limit the maximum starting current to twice the rated value. What is the value starting current? (08 Marks)

Module-4

- 7 a. With relevant circuit and waveforms, discuss the operation of VSI fed induction motor drive. (08 Marks)
- b. With relevant per phase equivalent circuit, analyses the operation of variable frequency control from a current source. Draw S – T and I_s vs rotor frequency curves. (06 Marks)
- c. A star connected squirrel cage IM has the following ratings and parameters : 400V, 50Hz, 4 pole, 1370rpm, $R_s = 2\Omega$, $R_r^1 = 3\Omega$, $X_s = X_r^1 = 3.5\Omega$, $X_m = 55\Omega$. It is controlled by a current source inverter at a constant flux. Determine motor torque, speed and stator current when operating at 30Hz and rated slip speed. (06 Marks)

OR

- 8 a. With relevant circuit and waveforms, discuss the operation of CSI fed induction motor drive. (08 Marks)
- b. With schematic diagram, explain the variable frequency control of multiple synchronous motors. (06 Marks)
- c. With the necessary circuit and equations, explain the operation of current regulated voltage source inverter control of IM. (06 Marks)

Module-5

- 9 a. With relevant circuit diagram, discuss the operation of self controlled synchronous motor employing load commutated inverter. (08 Marks)
- b. What is a stepper motor? Discuss the important features and disadvantages of stepper motor. (04 Marks)
- c. Draw the schematic diagram and explain the various stages of textile mill in brief. (08 Marks)

OR

- 10 a. With necessary circuit, analyse the operation of inverter fed brushless DC motor drive. (08 Marks)
- b. Discuss the construction and working of variable reluctance stepper motor. (04 Marks)
- c. With schematic diagram, explain the various stages of operation in steel rolling mills in brief. (08 Marks)

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