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Total Number of Pages : 02

Course: B.Tech
Sub_Code: PEE6I101/PEL6J003

6th Semester Back Examination: 2022-23

SUBJECT: Electric Drives

BRANCH(S): Electrical, EEE

Time : 3 Hour

Max Marks : 100

Q.Code : M059

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions: (2 x 10)

- Why is load equalization required in electric drives?
- Draw the speed torque characteristics for constant power load and for high speed hoist.
- What type of torque speed characteristic is suitable for centrifugal pump?
- What is the advantage of static rotor resistance control over traditional rotor resistance control as applied to 3-phase slip ring induction motor?
- Half hour rating of a motor is 20 kW. Heating time constant is 80 minute and the maximum efficiency occurs at 72 % of full load. What is the continuous rating of the motor?
- In a single phase semi converter if the firing angle is 60° for R-L-E load having constant load current of 12 A, what is the input power factor?
- At what value of slip the stator current drawn in case of stator voltage control method of three phase induction motor driving fan type load becomes maximum?
- Why is it necessary to maintain constant terminal voltage for variable frequency variable voltage control of induction motor drive above base speed?
- Why is the slip power recovery scheme suitable mainly for drives with a low speed range?
- Draw and explain the simplified speed-time curve of train movement.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- Derive the steady state stability criteria of drive system and explain with the help of characteristic curves of load torque and developed electromagnetic torque.
- For a separately excited dc motor, the speed is controlled by a single phase fully controlled rectifier when the motor current is discontinuous. The input ac supply voltage is 110 V (rms), firing angle $\alpha = 30^\circ$ and the back emf is 90 V. Assuming the armature resistance of the motor to be 0.3Ω , find the average current and torque for a speed of 1000 rpm. The motor circuit does not have inductance.
- A drive has the following parameters: $J = 10 \text{ Kg-m}^2$, $T = 15 + 0.05N$, N-m and $T_L = 5 + 0.06N$, N-m, where N is the speed in rpm. Initially the drive is working in the steady state. Now the drive is braked by electrical braking. Torque of the motor in braking is given by $T = -10 - 0.04N$, N-m. Calculate time taken by the drive to stop.
- Why is CSI fed induction motor operated at constant rated flux?

- e) A separately excited dc motor is supplied from a 220 V, 50 Hz ac mains by a half wave controlled rectifier. The motor develops a torque of 25 Nm at a speed of 400 rpm. The motor has a constant of 3.5 V-sec./rad. It has an armature resistance of 0.5 Ω . Determine the firing angle of for the rectifier and speed fluctuation of the motor. Assume a coasting period of 150° between the pulses.
- f) Explain the working principle of current regulated voltage source inverter control of 3-phase induction motor with relevant diagram and waveforms. Give its advantage over CSI fed induction motor drive.
- g) Explain the 4 quadrant operation of a motor driving a hoist load indicating the torque and speed convention in the quadrantal diagram.
- h) A dc shunt motor is running at 500 rpm driving a load whose torque is same at all speeds. Armature current is 90 A. The armature resistance drop can be neglected and field circuit can be assumed to be linear. If source voltage is reduced to 80 %, calculate the motor speed and armature current.
- i) Explain with suitable block diagram, the variable frequency control of multiple synchronous motors.
- j) An electric train weighing 500 tonnes climbs up gradient with $G = 8$ and following speed -time curve (i) uniform acceleration of 2.5 Km/hr/sec for 60 sec. (ii) constant speed for 5 min. (iii) coasting for 3 min. (iv) Dynamic braking at 3 Km/hr/sec to rest.
The train resistance is 25N/tonne, rotational inertia effect 10% and combined efficiency of transmission and motor is 80%.
Calculate the specific energy consumption.
- k) What are the requirements of drive motors for various stages in the textile mill?
- l) What are the disadvantages of the low power factor and supply current harmonic distortion in the traction drives?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** How is the rating of an electric motor decided for short time duty? (16)
A motor has a continuous duty rating of 100 kW. The heating and cooling time constants are 50 and 70 minutes respectively. The motor has a maximum efficiency at 80% full load and is employed in an intermittent periodic load cycle consisting of a load period of 10 min followed by a no load period of 10 min. Calculate the value of the load in kW during the load period.
- Q4** Define the coefficient of adhesion. In what way it is different from the coefficient of friction? What are the factors which influence the value of coefficient of adhesion? (16)
- Q5** A 440V, 50Hz, 970 rpm, 6 pole, Y connected, 3-Ph wound rotor induction motor (16)
has 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. Motor speed is controlled by Static Scherbius drive. Drive is designed for a speed range of 25% below the synchronous speed. Maximum value of firing angle is 165°.
Calculate
(i) Transformer turn ratio.
(ii) Torque for a speed of 780 rpm and $\alpha = 140^\circ$.
Dc link inductor has a resistance of 0.01 Ω .
- Q6** Describe the application of microprocessor in controlling the drive characteristic in (16)
steel rolling mill with relevant control block diagram.