Code No: R1932021 **R19** **SET - 1**

III B. Tech II Semester Regular Examinations, June-2022

ELECTRIC DRIVES

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) An electric motor developed torque and required load torques are expressed using the following equations: [8M]

$$T_m = a\omega + b,\ T_L = c\omega^2 + d$$

where a, b, c, d are positive coefficients. Deduce the relation among these coefficients to start the motor and load together and have an equilibrium operating speed. Calculate that equilibrium speed.

b) Explain about different components of electric drive. [7M]

(OR)

2. a) List out the advantages of electric drive. What is the concept of load equalization? [8M]

b) How can you differentiate active and passive load torques? Compare these two torques. [7M]

UNIT-II

3. a) Explain the operation of a separately excited DC motor supplied from 1-phase fully controlled rectifier with necessary diagrams. [8M]

b) A 250 V, 900 rpm, 100 A separately excited DC motor has armature and field resistances of 0.05 and 200 Ω respectively. Load torque is given by $TL = 400 - 0.25x$ N-m. Where 'x' is the speed in rpm. Armature is fed from a three phase full controlled rectifier with AC source voltage (phase) of 220 V, 50 Hz and field is fed from a full controlled single phase rectifier with a single phase source voltage of 220 V, 50 Hz. Drive operates in continuous conduction. Calculate the firing angles for speeds of 600 rpm and 1200 rpm. [7M]

(OR)

4. a) Explain the operation of dual converter controlling the separately excited DC motor. [8M]

b) Draw and explain the speed-torque characteristics at different firing angles for a fully converter feeding a DC series motor. Draw the quadrant diagram also. [7M]

UNIT-III

5. a) List the advantages offered by DC chopper drives over line-commutated converter controlled DC drives. [5M]

b) A 230 V, 960 rpm and 200 A separately excited DC motor has an armature resistance of 0.02 Ω. The motor is fed from a chopper, which is capable of providing both motoring and braking operations. The source has a voltage of 230 V. Assuming continuous conduction: [10M]
   (i) Calculate the time ratio of chopper for the motoring action at rated torque and 350 rpm.
   (ii) Determine the maximum possible speed, if maximum value of time ratio is 0.95 and maximum permissible motor current is twice the rated value.

(OR)

6. a) Class-A chopper, operating in time-ratio control, is supplying the armature of the separately excited DC motor. Derive the motor speed-torque relation. [8M]
   b) Derive the expressions for average motor current, I_{max} and I_{min} and average torque for chopper fed DC separately excited motor. [7M]

UNIT-IV

7. a) What are the disadvantages of using AC voltage controllers when they are used in induction motor control? [5M]
   b) A 440V, 3 phase, 50Hz 6 pole 945 rpm delta connected induction motor has the following parameters referred to the stator. R_s=2.0W, $R_r^{'}$ = 2.0W, X_s = 3W, X_r = 4W. When driving a fan load at rated voltage, it runs at rated speed. The motor speed is controlled by stator voltage control. Determine motor terminal voltage, current and torque at 600 rpm. [10M]

(OR)

8. a) Explain the significance of (V/f) speed control method of an induction motor. [8M]
   b) A 3 phase, 4 pole, 50 Hz squirrel cage Induction motor has the following circuit parameters: r_1 = 0.05 Ω, r_2 = 0.09 Ω, $X_1 + X_2$ = 0.55 Ω. The motor is star connected and rated voltage is 400 V. It drives a load whose torque is proportional to the speed and is given as T_l = 0.05 N-m. Determine the speed and torque of the motor for a firing angle of 450 of the AC Voltage Controller on a 400 V, 50 Hz supply. [7M]

UNIT-V

9. a) Describe self-controlled and load-commutated inverter controlled synchronous motor drives in detail. [8M]

   b) Draw the circuit diagram and explain the working of a slip power recovery system using static Scherbius system for a three phase induction motor. [7M]

(OR)

10. a) In variable frequency control of a synchronous motor why (V/f) ratio is maintained constant up to base speed and V constant above the base speed. Explain briefly with necessary waveforms. [8M]

    b) A 500 kW, 3-ph, 3.3 kV, 50 Hz, 0.8 (lag) pf, 4 pole star connected synchronous motor has following parameters. X_s = 15 Ω, R_s = 0, rated field current is 10 A. Calculate: (i) Armature current and power factor at half the rated torque and rated field current, (ii) Field current to get unity power factor at the rated torque. [7M]

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ELECTRIC DRIVES

(Electrical and Electronics Engineering)

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UNIT-I

1. a) Explain about the criteria to find the steady state stability of an electric drive. [7M]
   b) Compare different types of electric braking methods used. [8M]

(OR)

2. a) Explain the characteristics of different loads with illustrations. [8M]
   b) Explain the procedure of equalizing load on electric drive. List out the advantages of this procedure. [7M]

UNIT-II

3. a) Explain the operation of a separately excited DC motor supplied from 1-phase half controlled rectifier with necessary diagrams. [8M]
   b) Describe relative merits and demerits of four quadrant DC drives employing non-circulating and circulating dual converters. [7M]

(OR)

4. a) What is a dual converter? Explain the principle of operation of a dual converter in circulating current mode. How the same is used for speed control of DC drive? [8M]
   b) A fully controlled rectifier-fed separately excited DC motor is required to operate in motoring and braking operations in the forward direction. Only one fully-controlled rectifier is available. What switching arrangement will be required? Explain. [7M]

UNIT-III

5. a) Explain the advantages of chopper control of DC drives when compared to converter control of DC drives. [8M]
   b) A 230 V, 960 rpm and 200 A separately excited DC motor has R_a = 0.02 Ω. The motor is fed from a chopper which provides both motoring and braking operations. Assume continuous conduction. Calculate duty ratio of chopper for motoring and braking operations at rated torque and 350 rpm. [7M]

(OR)

6. a) Describe the first quadrant chopper control of DC series motor. [8M]

   b) A 250-V separately excited motor de has an armature resistance of 2.5 Ω. When driving a load at 600 rpm with constant torque, the armature takes 20 A. This motor is controlled by a chopper circuit with a frequency of 400 Hz and an input voltage of 250 V. What should be the value of the duty ratio if one desires to reduce the speed from 600 to 400 rpm, with the load torque maintained constant? [7M]

UNIT-IV

7. a) Draw and explain the speed-torque characteristics of the induction motor under variable frequency control. [8M]

   b) Explain speed control of induction motor by AC Voltage Controllers. [7M]

(OR)

8. a) Draw and explain the speed-torque curves with variable frequency control and operation at constant (v/f) ratio. [8M]

   b) The rotor resistance and stand still reactance referred to stator of a 3 phase, 4 pole, 50 Hz Squirrel cage induction motor is 0.2 Ω and 0.8 Ω per phase respectively. The full load slip of the motor is 4 percent. Neglect stator resistance and leakage reactance. Determine how much stator voltage should be reduced in order to get a speed of 1200 rpm if the load torque remains constant. [7M]

UNIT-V

9. a) Describe the open-loop and closed loop methods of speed control of a synchronous motor using VSI. [8M]

   b) Explain the sub synchronous mode of operation of synchronous motor with necessary equations. [7M]

(OR)

10. a) Draw the circuit diagram and explain the working of a slip power recovery system using Static Kramer drive for a three phase induction motor. [8M]

    b) Describe separate controlled and self-controlled modes of operation of a synchronous motor drive in detail and compare them. [7M]

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Code No: R1932021 **R19** **SET - 3**

III B. Tech II Semester Regular Examinations, June-2022

ELECTRIC DRIVES

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) Explain about the different components of load torque. [8M]
   b) A 220 V, 1200 rpm, 70 A DC separately excited motor has an armature resistance of 0.055 Ω. It is coupled to an overhauling load with a torque of 350 N-m. Determine the speed at which the motor can hold the load by regenerative braking. [7M]

(OR)

2. a) Explain the procedure of regenerative braking employed in electric drives with necessary illustrations. [8M]
   b) Draw the steady stability characteristics and explain the electric drive operation under this state with necessary equations. [7M]

UNIT-II

3. a) Explain the operation of a self-excited DC motor supplied from 1-phase fully controlled rectifier with necessary diagrams. [8M]
   b) A 250 V separately excited DC motor has an armature resistance of 2.5 Ω. When driving a load at 600 rpm with constant torque, the armature takes 40 A. This motor is controlled by a three phase full converter circuit a phase input voltage of 250 V with continuous current. What should be the value of firing angle to reduce the speed from 600 to 400 rpm, with the load torque maintained constant? [7M]

(OR)

4. a) A 220 V, 750 rpm, 200 A separately excited motor has armature and field resistances of 0.05 and 20 Ω respectively. Load torque is given by T_L = 500-0.2N N-m. Where N is the speed in rpm. Armature is fed from a three phase fully controlled rectifier with AC source voltage (line) of 200 V, 50 Hz and field is fed from a half controlled single phase rectifier with a single phase source voltage of 250 V, 50Hz. Drive operates in continuous conduction. Calculate the firing angles for speeds of 500 rpm and 1000 rpm. [8M]
   b) Explain the different speed control methods for DC motors. [7M]

UNIT-III

5. a) Explain with circuit and waveforms of two quadrant chopper fed separately excited DC motor. [8M]
   b) A 220 V, 1000 rpm, and 150 A separately excited DC motor has an armature resistance of 0.04 Ω. The motor is fed from a chopper which provides both motoring and braking operations. The source has a voltage of 220 V. Assuming continuous conduction, calculate duty ratios of chopper for motoring and braking operations at rated torque and 500 rpm. [7M]

(OR)

6. a) Explain the first quadrant chopper controlled separately excited DC motor. [8M]
   b) Derive the speed-torque expression of class-B chopper operating in time ratio control is supplying the armature of the separately excited DC motor. And draw speed torque characteristics. [7M]

UNIT-IV

7. a) Explain why stator voltage control is suitable for speed control of induction motors in fan and pump drives. Draw and explain speed control of 3 phase induction motor using AC Voltage Controller. [8M]
   b) A 2.8 kW, 400 V, 50 Hz, 4-pole, 1370 rpm, delta connected squirrel cage induction motor has the following parameters refereed to the stator. [7M]

   $R_s = 2\ \Omega$, $R_r^{'} = 5\ \Omega$, $X_s = X_r^{'} = 5\ \Omega$, $X_m = 80\ \Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate: (i) Motor terminal voltage, current and torque at 1200 rpm, and (ii) Motor speed, current and torque for the terminal voltage of 300 V.

(OR)

8. a) Explain with the help torque-speed characteristics, why stator voltage control is suitable for speed control of induction motors in fan and pump dives. Draw a neat circuit diagram for speed control of scheme of 3-phase induction motor using AC voltage controller. [8M]
   b) The parameters of a 3-phase 400 Volts, 50 Hz, 6 pole, 960 rpm, and star connected induction motor have the following parameters per phase referred to the stator. $R_1 = 0.4\ \Omega$. $R_2 = 0.20\ \Omega$, $X_1 = X_2 = 1.5\ \Omega$, $X_m = 30\ \Omega$. If the motor is controlled by variable frequency control at a constant flux of rated value, determine the motor speed and the stator current at half the rated torque and 25 Hz. [7M]

UNIT-V

9. a) Describe self-controlled and separate controlled mode of operation of a synchronous motor drive in detail and compare them. [8M]
   b) Describe the open-loop and closed loop methods of speed control of a synchronous motor using VSI. [7M]

(OR)

10. a) Why is the power factor of the slip power recovery scheme of speed control of induction motor low? Give the applications of Scherbius drive. [8M]
    b) Explain the operation of closed-loop speed control of LCI fed synchronous motor drive. [7M]

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III B. Tech II Semester Regular Examinations, June-2022

ELECTRIC DRIVES

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) Explain the operation of electric drive in four quadrants with necessary illustrations. [8M]
   b) Derive the necessary equation to calculate torque developed in an electric drive from fundamentals. [7M]

(OR)

2. a) Explain the different components used in electric drive system. [8M]
   b) Explain the procedure of dynamic braking employed in electric drive system. [7M]

UNIT-II

3. a) Explain the operation of a self-excited DC motor supplied from 1-phase half controlled rectifier with necessary diagrams. [8M]
   b) Derive the relation between speed and torque and draw the corresponding characteristics of a separately excited DC motor using single phase fully controlled rectifier? [7M]

(OR)

4. a) The speed of a separately excited DC motor is controlled by means of a 1-phasefull converter from a 230 V, 50 Hz supply. The motor constants are inductance 10 mH, resistance 0.9 Ω and armature constant 1.5 V/rad/s. Calculate speed of the motor at a torque of 20 Nm when the converter is fired at 55^0. Neglect losses in the converter. [10M]
   b) Discuss the drawbacks of using rectifier controller in DC series motors. [5M]

UNIT-III

5. a) Explain the operation of a four quadrant chopper fed to the D.C series motor and also draw the current and voltage wave forms for continuous current operation. [8M]
   b) When fed by a constant voltage source, regenerative braking below base speed can also be obtained by connecting a step-up chopper. Justify. [7M]

(OR)

6. a) A 220 V, 24 A, 1000 rpm separately excited dc motor having an armature resistance of 2 Ω is controlled by a chopper. The chopping frequency is 500 Hz and the input voltage is 230 V. Calculate the duty ratio for a motor torque of 1.2 times rated torque at 500 rpm. [8M]

b) Give the quadrants in which electric drive can operate using class C and class D choppers respectively. Explain with illustrations. [7M]

UNIT-IV

7. a) Write some of the applications of stator voltage control of three phase induction motor. [8M]

b) A 2.8 kW, 400 V, 50 Hz, 4-pole, 1370 rpm, Y-connected induction motor has the following parameters: R_S = 1.9 Ω, R_r' = 4.757 Ω, $X_S = X_r$' = 3 Ω. Load characteristics are matched with motor such that the motor runs at 1370 rpm with full voltage across its terminals. The motor is controlled by terminal voltage control and load torque is proportional to speed. Determine motor terminal voltage and current at half rated speed. [7M]

(OR)

8. a) Draw and explain the closed loop block diagram for automatic speed control of a three phase induction motor using solid state AC voltage controller on stator side. [8M]

b) Explain in detail with speed-torque characteristics of variable voltage and variable frequency (V/F) control of induction motor drive. [7M]

UNIT-V

9. a) Explain static Scherbius drive control for speed control of induction motor. Draw speed -torque characteristics. [8M]

b) A 415 V, 50 Hz, 6 pole star connected slip ring induction motor is controlled by static Kramer drive. The effective phase turns ratio from rotor to stator is 0.7, the transformer turns ratio from l.v side to h.v side is 0.4. The load torque is proportional to the square of the speed and it is equal to 250 N-m at 870 rpm. To operate at 750 rpm calculate: [7M]

(i) rotor rectifier voltage
(ii) delay angle of the inverter
(iii) Efficiency, if the inductor resistance is 0.02 Ω, stator and rotor resistances are 0.01 Ω and 0.03 Ω respectively. Assume losses in diode rectifier, inductor and transformer are negligible.

(OR)

10. a) Draw the circuit diagram and explain the operation of rotor-resistance control of induction motor. Mention the advantages and disadvantages of the above method of control. [8M]

b) Draw the block diagram of closed loop synchronous drive fed from VSI and explain its operation? [7M]

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