Code No: M0221 / R07 **Set No. 1**

IV B.Tech. I Semester Regular Examinations, November 2010
POWER SEMICONDUCTOR DRIVES
(Electrical & Electronics Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any Five Questions
All Questions carry equal marks
****

1 a) A single-phase fully controlled thyristor converter is supplying a separately excited DC Motor. Draw the relevant waveforms and explain various operating modes of the drive both in motoring and regenerative braking. [8]

b) A 220 V, 970 rpm, 120 A dc separately excited motor has an armature resistance of 0.05ohms. It is braked by plugging from an initial speed of 1000rpm. Calculate resistance to be placed in armature circuit to limit braking current to twice the full load value and Braking torque. [8]

2 a) Explain the operation of 3-Φ six pulse converter feeding DC series motor with neat diagram and relevant waveforms. [8]

b) A 220V, 1440rpm, 120A separately excited DC motor with armature resistance of 0.7 Ω is fed from 3-Φ, fully controlled converter with an ac source line voltage 440V, 50 Hz supply. A star connected transformer is used to feed the armature so that motor terminal voltage equals rated voltage when converter firing angle is zero. Calculate the value of firing angle when motor is running at 1200 rpm at rated torque. [8]

3 a) Discuss plugging and regenerative braking employed for Dc Motors. With neat diagram and relevant waveforms. [8]

b) A 220V, 200A, 800rpm DC separately excited motor has an armature resistance of 0.06Ω. The motor armature is fed from a variable voltage source with an internal resistance of 0.04 Ω. Calculate internal voltage of the variable voltage source when the motor is operating in regenerative braking at 80% of the rated motor torque and 600rpm. [8]

4 a) Explain the operation of two quadrant chopper feeding to a separately excited DC motor and also draw the current and voltage wave forms for continuous current operation. [8]

b) Draw the block diagram and explain the operation of closed loop speed control scheme of DC Motor for speeds below the base speed. [8]

5 a) Explain briefly why stator voltage control is an inefficient method for speed control of Induction Motor. [6]

b) Briefly discuss the speed torque characteristics of 3-Φ Induction Motor obtained by stator voltage variation. [10]

6 a) Explain why in an Induction Motor V/f ratio is maintained constant when the motor is operated below the base speed. [8]

b) Explain the principle of varying the speed of an Induction motor by variable frequency control of stator voltage. Draw the speed torque characteristics for motoring and braking modes. [8]

7 a) Briefly discuss the speed control techniques exclusively used for Wound Rotor Induction Motor drives. [8]

b) A 440V, 50Hz, 1050rpm, 6-pole, Star connected, 3phase wound rotor induction motor has following parameters referred to the stator: R_s = 0.2 Ω, R'_r = 0.05 Ω, X_s =0.3 Ω and X'_r = 0.5Ω, 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 160^o. Calculate transformer turns ratio and torque for a speed of 750 rpm at firing angle is 140^o. [8]

8 a) Describe the operation of self-controlled Synchronous Motor drives in detail. [8]

b) Compare the advantages and disadvantages of VSI and CSI fed cyclo converter drives. [8]

Code No: M0221 / R07

Set No. 2

IV B.Tech. I Semester Regular Examinations, November 2010
POWER SEMICONDUCTOR DRIVES
(Electrical & Electronics Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any Five Questions
All Questions carry equal marks
****

1 a) Explain the concept of Electric Drives. Illustrate your answer with example. [8]

b) A 220 V, 1200 rpm, 120 A separately excited DC motor is fed from 1-Φ, fully controlled converter with an ac source 230V, 50 HZ supply. The thyristor is triggered continuously by a DC signal. The resistance of armature circuit is 0.07 Ω. Find the firing angle of the converter for rated motor torque and 700 rpm. [8]

2 a) Draw the block diagram and explain the operation of closed loop speed control of DC Motor with inner current loop and field weakening. [8]

b) A 220V, 1200rpm, 60A separately excited DC motor with armature resistance of 0.6Ω, is fed from 3-Φ, fully controlled converter with an ac source line voltage 415V, 50 Hz supply. A star connected transformer is used to feed the armature so that motor terminal voltage equals rated voltage when converter firing angle is zero. Calculate transformer turns ratio. [8]

3 a) Explain briefly the following methods of braking of a D.C Motor [8]
(i) Dynamic braking
(ii) Plugging.

b) A 400V, 750 rpm, 70A dc shunt motor has an armature resistance of 0.3 Ω. When running under rated conditions, the motor is to be braked by plugging with armature current limited to 90A. What external [8]

resistance should be connected in series with the armature? Calculate the initial braking torque and its value when the speed has fallen to 300rpm.

4 a) Explain the principle of speed control of a DC Motor and show how it can be achieved by a chopper. [8]

b) Draw and discuss in detail of motoring and regenerative braking operation of chopper control of separately excited DC motor. [8]

5 a) Draw and explain the circuit diagrams of AC Voltage Controller for delta connected Controller. How it is possible to change the direction of rotation of 3-Φ Induction motor by using AC Voltage Controllers. [8]

b) Briefly discuss the speed control techniques employed for Induction motors fed from stator side. [8]

6 a) Explain why in an Induction Motor, the terminal voltage is maintained constant, when the drive is operated above base speed. Draw relevant speed torque characteristics. [8]

b) Discuss in detail the role of Cyclo-converters for speed control of Induction motor. Draw neat circuit diagram for speed control of 3-Φ Induction motor using Cyclo-converters. Mention the merits and limitations of the above scheme. [8]

7 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. [8]

b) A 3-Φ, 400V, 6-pole, 50Hz, delta-connected, slip-ring induction motor has rotor resistance of 0.2 ohms and leakage reactance of 0.9 ohms per phase referred to stator. When driving a fan load it runs at full load with 5% slip. What resistance must be inserted in the rotor circuit to obtain a speed of 850 rpm. Neglect stator impedance and magnetizing branch. Stator to rotor turns ratio is 2. [8]

8 a) Explain the operation of Load commutated CSI fed Synchronous motor drive. [8]

b) List out advantage and disadvantage of synchronous motor drive fed from VSI and CSI. [8]

Code No: M0221 / R07 **Set No.3**

IV B.Tech. I Semester Regular Examinations, November 2010
POWER SEMICONDUCTOR DRIVES
(Electrical & Electronics Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any Five Questions
All Questions carry equal marks
****

1 a) Explain Speed-torque characteristics of a 1-Φ fully controlled converter connected to separately excited D.C motor with continuous current operation. Draw the relevant waveforms. [8]

b) A 220V, 1200rpm, 120A separately excited DC motor is fed from 1-Φ, fully controlled converter with an ac source 230V, 50 HZ supply. The thyristor is triggered continuously by a dc signal. The resistance of armature circuit is 0.07 Ω. Find the firing angle for rated motor torque and (-700) rpm. [8]

2 a) Explain the speed-torque characteristic of 3-Φ fully controlled converter feeding DC series motors with relevant waveforms. [8]

b) A 220V, 1500rpm, 120A separately excited DC motor with armature resistance of 0.7Ω, is fed from 3-Φ, fully controlled converter with an ac source line voltage 440V, 50 Hz supply. A star connected transformer is used to feed the armature so that motor terminal voltage equals rated voltage when converter firing angle is zero. Calculate the value of firing angle when motor is running at 800 rpm at twice rated torque. [8]

3 a) Explain the operation of closed loop speed control of separately excited DC motor with block diagram. [8]

b) A 220 V, 190 A dc series motor has armature and field resistances of 0.03 and 0.02 Ω respectively. Running on no load as a generator with field winding connected to a separate source gave following magnetization characteristic at 500rpm. Motor is controlled by a chopper in dynamic braking with a braking resistance of 2. [8]

Armature Current (Amps)	40	80	120	160	200
Terminal Voltage (volts)	52	108	148	176	189

Calculate motor speed for a duty ratio of 0.6 and motor current of 160A.

Code No: M0221 / R07

Set No.3

4 a) Briefly discuss the advantages offered by dc chopper drives over line-commutated converter controlled dc drives. [8]

b) Explain the operation of four quadrant chopper fed to the D.C series motor and also draw the current and voltage wave forms for continuous current operation. [8]

5 a) Discuss the relative merits and demerits of stator voltage control employed for Induction Motor drives. [8]

b) A 3.2 kW, 415V, 50Hz, 4 pole, 1440 rpm, delta connected squirrel-cage Induction Motor has following parameters referred to the stator: $R_s = 2\Omega$, $R'_r = 5\Omega$, $X_s = X'_r = 5\Omega$ and $X_m = 75\Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate motor terminal voltage, current and torque at 1200 rpm. [8]

6 a) Briefly explain the conventional methods of controlling the speed of an Induction Motor. [8]

b) Compare the merits and demerits of VSI and CSI fed Induction Motor drives. [8]

7 a) Define Slip power and its significance. Discuss various methods used for slip power recovery in Induction Motors. [8]

b) Explain the operation of static scherbius drive employed for Wound Rotor Induction Motor drive. [8]

8 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. [8]

b) Discuss the important features and applications of load commutated synchronous Motor drive. [8]

Code No: M0221 / R07

Set No. 4

IV B.Tech. I Semester Regular Examinations, November 2010
POWER SEMICONDUCTOR DRIVES
(Electrical & Electronics Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any Five Questions
All Questions carry equal marks
****

1 a) Define an Electric drive and its significance in practical applications. List out the essential parameters of an Electrical Drive. [8]

b) A 220V, 1050 rpm, 120A separately excited DC motor is fed from 1-Φ, fully controlled converter with an ac source 230V, 50 HZ supply. The thyristor is triggered continuously by a DC signal. The resistance of armature circuit is 0.07Ω. Find the motor speed for firing angle 160^{o} and rated torque. [8]

2 a) Explain the operation of 3-Φ half-controlled rectifier feeding DC separately excited motor. Draw its speed-torque curve. [8]

b) A 220V, 1440rpm, 120A separately excited DC motor with armature resistance of 0.7 Ω, is fed from 3-Φ, fully controlled converter with an ac source line voltage 440V, 50 Hz supply. A star connected transformer is used to feed the armature so that motor terminal voltage equals rated voltage when converter firing angle is zero. Calculate the value of firing angle when motor is running at (-900) rpm at rated torque. [8]

3 a) Discuss in detail counter current and dynamic braking operations of D.C shunt motors. [8]

b) The speed of a separately excited dc motor is controlled by means of a 3-Φ semi-converter from a 3-Φ 415V 50Hz supply. The motor constants are inductance 10mH, resistance 0.9Ω and armature constant 1.5v/rad/sec. Calculate speed of the motor at a torque of 50 N-m when the converter is fired at 45^{0}. Neglect losses in the converter. [8]

4 a) Explain the principle of speed control of a DC Motor and show how it can be achieved by a chopper. [8]

b) Draw the block diagram and explain the operation of closed loop speed control scheme of DC Motor for speeds below the base speed. [8]

5 a) Explain why stator voltage control is suitable for speed control of Induction motors in fan and pump drives. [8]

b) A 3.2 kW, 415V, 50Hz, 4 pole, 1440 rpm, delta connected squirrel-cage induction motor has following parameters referred to the stator: $R_s = 2\Omega$, $R'_r = 5\Omega$, $X_s = X'_r = 5\Omega$ and $X_m = 75\Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate motor speed, current and torque for the terminal voltage of 330V. [8]

6 a) Discuss in detail the role of voltage source inverter for speed control of Induction motor. Explain the operation of speed control of 3 phase Induction motor using voltage source inverter. Mention the merits and limitations of the scheme. [10]

b) Explain why in an Induction Motor V/f ratio is maintained constant when the motor is operated below the base speed. [6]

7 a) Draw and explain the equivalent circuit of a wound rotor induction motor when voltage is injected in the rotor circuit. [8]

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

8 a) Discuss in detail self-controlled synchronous motor drive employing load commutated thyristor inverter. [8]

b) State and explain the role of a damper winding in a synchronous motor. [8]