

Code No: M0221/R07

Set No. 1

IV B.Tech I Semester Regular Examinations, November 2012
POWER SEMICONDUCTOR DRIVES
(Electrical & Electronic Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. With neat sketch and necessary waveforms explain how continuous current operation is obtained with single phase full controlled converter fed to D.C series drive. Also derive output current and voltage expressions. [16]
2. Derive the speed and torque expressions for a three phase fully controlled converter connected to a dc series motor. [16]
3. (a) Discuss in detail with suitable circuit diagrams and waveforms, the speed control operations of a separately excited d.c.motor using a circulating current dual converter.
 (b) A 230 Volts, 870 rpm, 100 A separately excited d.c.motor has an armature resistance of 0.05 ohm. It is coupled to an over hauling load with a torque of 400 N-m. Determine the speed at which motor can hold the load by regenerative braking. [8+8]

4. A 220V, 70A D.C series motor has combined resistance of armature and field is 0.12 ohms running on no-load with the field winding connected to a separate source. It gave following magnetization characteristics at 600 rpm

Field Current (A)	10	20	30	40	50	60	70	80
Terminal Voltage (V)	64	118	150	170	184	194	202	210

Motor is controlled in regenerative braking by a chopper with a source voltage of 220V.

- (a) Calculate motor speed for a duty ratio of 0.5 and motor braking torque equal to rated motor torque.
 - (b) Calculate maximum allowable motor speed for a maximum permissible current of 70A and maximum permissible duty ratio of 0.95.
 - (c) What resistance must be inserted in armature circuit for the drive to run at 1000 rpm without exceeding armature current beyond 70 A? the duty ratio of the chopper has a range from 0.05 to 0.95.
 - (d) To What extent the number of turns in field winding should be reduced to run at 1000 rpm without exceeding armature current beyond 70 A? [16]
5. A 3ϕ , 4 pole, 50Hz SCIM has the following circuit parameters $r_1=0.05\Omega$ $r_2 = 0.09\Omega$, $x_1 + x_2 = 0.55\Omega$ The motor is star connected and rated voltage is 400v. It drives a load whose torque is proportional to the speed and is given as $T_1 = 0.05\omega$ NW-M. Determine the speed and torque of the motor for a firing angle of 45° of the AC voltage controller on a 400v, 50Hz supply. [16]

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6. Discuss in detail how the variable frequency control of an Induction motor can be achieved using Current source Inverter. Mention the advantages and limitations of the above method. [16]
7. Draw the circuit diagram and explain the operation of rotor- resistance control using chopper. Mention the advantages and disadvantages of the above method of control. [16]
8. In variable frequency control of asynchronous motor why (V/f) ratio is maintained constant up to base speed and V constant above base speed. Draw the relevant characteristics. [16]

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1. Draw and explain the power circuit diagram of semi-converter feeding a separately excited D.C motor. Explain with typical voltage and current waveforms, the operation in continuous armature current Mode. [16]
2. Draw the circuit diagram and explain the operation of three phase, half wave converter drives. [16]
3. With a neat diagram, explain the operation of a dc drive in all four quadrants when fed by a single phase dual converter with necessary waveforms and characteristics. [16]
4. (a) Discuss with the suitable diagrams I quadrant and II quadrant choppers.
(b) A constant frequency TRC system is used for the speed control of dc series traction motor from 220v dc supply. The motor is having armature and series field resistance of 0.025Ω and 0.015Ω respectively. The average current in the circuit is 125A and the chopper frequency is 200Hz. Calculate the pulse width if the average value of back emf is 60 volts. [8+8]
5. An inverter supplies a six pole three-phase cage Induction motor rated at 415V, 50Hz. Determine the approximate voltages required of the inverter for motor speeds 600/800/1500/ 1800 rpm. [16]
6. A 440V,50Hz,4 pole 1420 rpm delta connected Induction motor has the following parameters.
 $R_s = 0.35 \text{ Ohm}$, $R_r' = 0.4 \text{ Ohm}$, $X_s = 0.7 \text{ Ohm}$, $X_r' = 0.8 \text{ Ohm}$. The motor is fed from a Voltage Source Inverter. The drive is operated at a constant (V/f) control upto 50 Hz and at rated voltage above 50 Hz.
Calculate the breakdown torques for a frequency of 75 Hz both for motoring and braking operations. [16]
7. Draw the circuit diagram and explain the operation of rotor- resistance control using chopper. Mention the advantages and disadvantages of the above method of control. [16]
8. Explain the principle of operation of separately controlled synchronous motor fed from VSI source. [16]

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Set No. 3

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1. Derive the Speed, Torque Equations of a fully controlled converter connected to separately excited D.C motor with continuous current operation with necessary waveforms. [16]
2. The speed of a 25 HP 380V 1800 rpm separately excited dc motor is controlled by a three phase semi controlled converter and is fed from a 415V, 50 hz supply .motor parameters are $R_a=0.9\Omega$, $L_a=10\text{mh}$. $K_a=50$.Calculate the speed of the motor at a torque of 50 Nm when the converter is fired at 45° .Neglect losses. [16]
3. With a neat diagram, explain the operation of a dc drive in all four quadrants when fed by a single phase dual converter with necessary waveforms and characteristics. [16]
4. Derive relation between Speed torque, duty ratio and armature current of a D.C series motor using chopper control under
 - (a) Motoring mode
 - (b) Regenerative braking. [16]
5. A 3 phase, 4 pole, 50 Hz Induction motor has rotor resistance of 0.2 ohm and stand still reactance of 0.1 ohm. At full load it operates at a slip of 4%. If the voltage is reduced to 50 %, at what speed will the motor operates with full load torque applied. [16]
6. Explain
 - (a) Why the variable frequency control is of Induction motor is more efficient than stator voltage control.
 - (b) Why the variable frequency control yields high torque to current ratio during starting. [8+8]
7. A 3 Phase,400V,50 Hz,10 KW 960 rpm, 6 pole star connected slip ring Induction motor has the following constants referred to the stator.
 $R_s = 0.4 \text{ Ohm}$, $R'_r = 0.6 \text{ Ohm}$, $X_s = X'_r = 1.4 \text{ Ohm}$. The motor drives a fan load at 960 rpm. The Stator to rotor turns ratio is 2.
 What resistance must be connected in each phase of the rotor circuit to reduce the speed to 800 rpm? [16]
8. (a) Why a self controlled mode is free from hunting oscillations?

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- (b) When operating in true synchronous mode, why the frequency must be changed in small steps? [8+8]

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1. Draw and explain the power circuit diagram of semi-converter feeding a D.C series motor. Explain with typical voltage and current waveforms, the operation in both continuous armature current Mode. [16]
2. (a) Explain how four-quadrant operation is achieved by dual converters each of 3 Φ full wave configuration for d.c. separately excited motor.
(b) Distinguish between circulating current and non-circulating current mode of operation. [8+8]
3. Explain the modes of operation of electric drive. [16]
4. (a) Discuss with the suitable diagrams I quadrant and II quadrant choppers.
(b) A constant frequency TRC system is used for the speed control of dc series traction motor from 220v dc supply. The motor is having armature and series field resistance of 0.025Ω and 0.015Ω respectively. The average current in the circuit is 125A and the chopper frequency is 200Hz. Calculate the pulse width if the average value of back emf is 60 volts. [8+8]
5. Discuss why the rotor of an Induction motor should have very large rotor resistance when it is controlled from a three phase ac voltage controller. [16]
6. A 3 Phase, 1500 rpm Induction motor is developing torque of 3000 Syn. watts at an input frequency of 50Hz. If the motor torque is now reduced to 1500 Syn.watts, determine the new value of stator frequency. The motor is operating in constant HP region. Assume constant rotor frequency and neglect effect of rotor resistance. [16]
7. Draw the circuit diagram and explain the operation of rotor- resistance control using chopper. Mention the advantages and disadvantages of the above method of control. [16]
8. Explain the principle of operation of self control of synchronous motor fed from VSI source. [16]
