Code No: R32025 **R10** **Set No: 1**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

POWER SEMICONDUCTOR DRIVES

(Electrical and Electronics Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. Explain different speed control techniques for DC motors.

2. Explain the speed control of single phase half controlled converter to separately excited DC Motor and write the speed torque expressions for this motor.

3. a) Explain the operation of separately excited dc motor fed by a three- phase half converter.
   b) A 10A 3-ph, 440 V, 900 rpm separately excited dc motor is operating at 450 rpm developing 80% of the rated torque. The motor being controlled by a three-phase three pulse thyristor converter, calculate the triggering angle of the converter if the back emf at rated speed is 400 V. Assume ac input voltage to be 415 V.

4. a) Discuss with the suitable diagrams II quadrant and IV quadrant operation of D.C motor.
   b) Explain briefly the following methods of braking of a D.C Motor
   (i) Regenerative braking (ii) Dynamic braking

5. a). Explain the principle of speed control of a dc motor and show how it can be achieved by a Chopper.
   b). A 230v, 1200rpm, 10A separately excited motor has an armature resistance of 1.2 ohms Motor is operated under dynamic braking with chopper control. Braking resistance has a value of 30 ohms.
   (i) Calculate duty ratio of chopper for motor speed of 1000rpm and braking torque equal to 1.5 times rated motor torque.
   (ii).What will be the motor speed for duty ratio of 0.5 and motor torque equal to its rated torque.

6. a) Draw a block schematic diagram for automatic speed control of 3 phase cage Induction motor using solid state AC Voltage Controller on stator side.
   b) Explain the variable frequency control of voltage source inverter of induction motor and draw speed –torque characteristics of the induction motor.

7. a) Draw a suitable circuit diagram and explain the working of slip - power recovery scheme of induction motor.
   b) Explain about the static Kramer drive with neat sketch. Why it has a low range of speed control?

8. a) Draw the closed loop methods of speed control of a synchronous motor using VSI.
   b) Explain variable frequency speed control of synchronous motor.

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Code No: R32025 **R10** **Set No: 2**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

POWER SEMICONDUCTOR DRIVES

(Electrical and Electronics Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. Explain speed control of different methods of speed control of induction motor.

2. a) Draw and explain the operation of 1-phase full converter feeding a dc series motor. Explain with typical voltage and current waveforms, the operation in both continuous and discontinuous current modes.
   b) A 5 kW, 220 V, 1500 rpm separately excited dc motor is controlled using a single phase full converter. If the ac supply voltage is 230 V, 50 Hz and the motor rated current is 20 A at near full load, find for $\alpha = 60^0$, the speed of the motor and its torque. Assume the armature resistance to be 0.5 ohm and machine constant to be 0.2 V/rpm. Also assume continuous armature current.

3. a) Explain the operation of separately excited dc motor fed by a three- phase full converter.
   b) The speed of a separately excited dc motor is controlled by means of a 3 phase semi converter from a 3 phase 440V 50Hz supply. The motor constants are inductance 10mH, resistance 0.9 ohm and armature constant 1.5v/rad/s. Calculate speed of the motor at a torque of 50 Nm when the converter is fired at 45^0. Neglect losses in the converter.

4. a) Discuss in detail counter current and dynamic braking operations of D.C. shunt motors.
   b) A 400V, 750 rpm, 70A dc shunt motor has an armature resistance of 0.3 when running under rated conditions, the motor is to be braked by plugging with armature current limited to 90A. What external resistance should be connected in series with the armature? Calculate the initial braking torque and its value when the speed has fallen to 300rpm.

5. What is a Chopper? Explain the Chopper control of a D.C series motor in
   i). Motoring Mode
   ii). Regenerative braking mode and also draw the Speed-Torque Curves in each mode.

6. a) Discuss the stator voltage control scheme of induction motor. Also draw and explain the speed- torque characteristics.
   b) A 440 V, 50 Hz, three- phase, 6-pole, 945 rpm delta connected squirrel- cage induction motor has following parameters referred to the stator: $R_S = 3$ *ohm;* $R_r = 3$*ohm;* $X_s = 4$ ohm*;* $X_r = 5$ *ohm*. The load torque is varying linearly with speed. The motor speed is controlled by stator voltage control. Calculate motor terminal voltage, current and torque at 800 rpm.

7. a) Explain the static Scherbius drive for induction motor with neat sketch.
   b) A 3- phase, 400 V, 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 *ohm;* R_r = 0.6 *ohm;* X_s = X_r = 1.4 *ohm.* The motor drives a fan load at 960 rpm. The stator to rotor turns ratio is 2.
   (i) What resistance must be connected in each phase of the rotor circuit to reduce the speed to 800 rpm?
   (ii) When the motor is controlled by static rotor resistance control, calculate the value of external resistance, so that motor runs at 800 rpm for a duty ratio of 0.5.

8. a) Explain the different methods of speed control of synchronous motor.
   b) Draw the block diagram of closed loop control of synchronous motor.

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Code No: R32025 **R10** **Set No: 3**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

POWER SEMICONDUCTOR DRIVES

(Electrical and Electronics Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. Explain the speed control of induction motor in the following ways.
   (i) Stator Voltage and frequency control
   (ii) Rotor resistance control
   (iii) E.M.F injection method

2. a) Draw and explain the operation of 1-phase semi converter feeding a dc series motor and derive speed torque expressions.
   b) The separately excited dc motor is fed from a 220 V, 50 Hz supply via a single phase half controlled bridge rectifier. Armature parameters are inductance 0.05 H, resistance 0.3 ohm, the motor voltage constant is k_a = 0.8 V/A rad/sec and field resistance is R_f = 104 ohm. The field current is also controlled by a semi converter and is set to maximum possible value. The load torque is 50 N-m at 800 rpm. The inductances of armature and field circuits are sufficient enough to make armature and field currents continuous and ripple free. Compute,
   (i) Field current
   (ii) Firing angle of converter in the armature circuit
   (iii) Input power factor.

3. Explain the operation of dc series motor fed by a three- phase full converter with speed torque characteristics.

4. 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.

5. a) Explain the operation of a four- quadrant transistorized chopper drive for control of dc separately excited dc motor.
   b). A dc chopper is used to control a 230 V separately excited dc motor takes 50A at rated speed of 800 rpm. It has the armature resistance of 0.4 ohm. The chopper has an input voltage of 230 V and frequency of 500 Hz. assuming continuous conduction, calculate the speed and torque for duty ratios 0.4 and 0.6.

6. a) Draw the circuit diagrams of AC Voltage Controller for delta connected Controller and star connected Controller. How it is possible to change the direction of rotation of 3phase Induction motor using AC Voltage Controllers?
   b) Explain about the closed loop operation of VSI fed induction motor drive with a neat sketch.

7. a) Explain about the static Kramer drive with neat sketch. Why it has a low range of speed control?
   b) In which way a static Kramer Control is different from static Scherbius drive discuss in detail.

8. a) Write the differences between true synchronous mode and self control mode of variable frequency control of synchronous motor.
   b) A 20 kW, 3-phase 440V, delta connected, 4-pole, 50 Hz, power factor is 1.0 synchronous motor has Xs = 5 ohm and Rs = 0. Rated Field current is 50 A. Machine is controlled by variable frequency control at constant v/f ratio up to the base speed and at constant voltage above base speed. Determine
   (i) Torque angle and armature current, 750 rpm at half full load torque.
   (ii) Torque angle and armature current, 1500 rpm at half full load torque.

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Code No: R32025 **R10** **Set No: 4**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

POWER SEMICONDUCTOR DRIVES

(Electrical and Electronics Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. Explain the speed control of induction motor in the following ways.
   (i) Stator Voltage and frequency control
   (ii) Rotor resistance control
   (iii) E.M.F injection method

2. A 230 V, 750 rpm, 100 A separately excited dc motor has an armature resistance and inductance of 0.08 ohm and 8 mH respectively. Motor is controlled by a single- phase half controlled rectifier with source voltage of 230 V, 50 Hz. Identify the modes and calculate speed for
   (i) $\alpha = 60^0$ and torque = 1200 N-m
   (ii) $\alpha = 120^0$ and torque = 1200 N-m

3. A 220V, 1500 rpm, 50A separately excited motor with armature resistance of 0.5Ω, is fed from a three phase controlled rectifier. Available A.C source has a line voltage of 440V, 50Hz. A Star-Delta connected transformer is used to feed the armature so that motor terminal voltage equals rated voltage when converter firing angle is zero.
   (i) Transformer turns ratio
   (ii) Determine the value of firing angle when (a) motor is running at 1200 rpm and rated torque;(b) When motor is running at -800 rpm and twice the rated torque.

4. Describe the relative merits and demerits of the following types of braking for dc motors: mechanical braking, dynamic braking and regenerative braking with neat diagram.

5. a) Explain the operation of a four- quadrant transistorized chopper drive for control of dc series excited motor.
   b). A dc chopper is used to control a 220 V separately excited dc motor takes 40A at rated speed of 1000 rpm. It has the armature resistance of 0.4 ohm. The chopper has an input voltage of 220 V and frequency of 500 Hz. assuming continuous conduction, calculate the speed and torque for duty ratios 0.4 and 0.6.

6. a) Explain about the closed loop operation of VSI fed induction motor drive with a neat sketch.
   b) Explain the PWM control of voltage source inverter.

7. a) Explain about the static rotor resistance control with neat sketch. Why the rotor resistance control is preferred in low power crane drives.
   b) Explain about the static Kramer drive with neat sketch. Why it has a low range of speed control.

8. a) Explain the different methods of speed control of synchronous motor.
   b) A 6 MW, 3-phase 11 kV, star connected, 6-pole, 50 Hz, 0.9 (leading) power factor synchronous motor has Xs = 9 ohm and Rs = 0 . Rated Field current is 50 A. Machine is controlled by variable frequency control at constant v/f ratio up to the base speed and at constant voltage above base speed. Determine
   (i) Torque and Field current for the rated armature current, 750 rpm and 0.8 leading power factor.
   (ii) Armature current and power factor for half the rated motor torque, 1500 rpm and rated Field current.

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