

III B.Tech. II Semester Supplementary Examinations, January -2014

POWER SEMICONDUCTOR DRIVES

(Electrical and Electronics Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

1. (a) What is base speed of dc motors?
(b) Explain the various schemes of d.c motor speed control. [5+10]
2. (a) Draw and explain the torque-speed characteristics at a different firing angle of a full converter fed separately excited d.c motor drive.
(b) What are the advantages and disadvantages of single-phase semi converter fed dc motor drive? [8+7]
3. (a) Explain the Speed - torque Characteristics of a dc series motor connected to a three phase full controlled converter.
(b) Explain the operation of three phase semi converter drive with necessary wave forms. [8+7]
4. Explain briefly the following methods of braking a d.c motor
(a) Regenerative braking (b) Dynamic braking (c) Plugging [5+5+5]
5. A class-A chopper, operating in time-ratio control, is supplying the armature of the separately excited dc motor. Show that the motor speed-torque relationship is

$$\omega_m = \frac{\delta V}{K} - \frac{R_a}{K^2} T_a$$
 Where V - chopper input voltage, Ra - Armature resistance, Ta - motor torque, K- torque constant. [15]
6. A 440V, 50Hz, 4 pole 1420 rpm delta connected Induction motor has the following parameters.
Rs = 0.45 Ohm, Rr' = 0.6 Ohm, Xs = 0.8 Ohm, Xr'=0.9 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 70 Hz both for motoring and braking operations. [15]
7. (a) Explain the speed control and performance characteristics of the static Kramer's drive.
(b) Give the different modes of operation of static scherbis drive. [8+7]
8. (a) What is self control mode of synchronous motor?
(b) How is the output voltage of a VSI improved by PWM techniques? Explain how you will use this converter for speed control of a synchronous motor. [5+10]

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1. Give two methods of speed control normally employed for dc motors. Hence, sketch the characteristics of a separately excited dc motor based on these two methods. [15]
2. (a) Give the general circuit layout for single-phase dc drive. Enumerate the various types of single-phase dc drives with their circuit configurations?
(b) What are the advantages and disadvantages of single-phase semi converter fed dc motor drives? [7+8]
3. The speed of a separately excited dc motor is controlled by means of a 3 phase semi converter from a 3 phase 415V 50Hz supply. The motor constants are inductance 12mH, resistance 0.8 ohm and armature constant 1.3 V/rad/s. calculate speed of the motor at a torque of 60 Nm when the converter is fired at 45° . Neglect losses in the converter. [15]
4. (a) Explain the principle of closed-loop control of a dc drive using suitable block diagram.
(b) Explain how four-quadrant operation is achieved by dual converters each of three phase full wave configuration for d.c. separately excited motor. [7+8]
5. A dc chopper controls the speed of a separately excited motor. The armature resistance is $R_a=0.07$. The back emf constant is $K_v=1.547$ V/A-rad/s. The rated field current is $I_f=2.8$ A. The dc input voltage to the chopper is $V_s=500$ V. If it is required to maintain a constant developed torque of $T_d=527$ N-m, plot the motor speed against the duty cycle k of the chopper. [15]
6. Draw and explain the speed-torque curves with variable frequency control for two different modes.
(i) Operation at constant flux.
(ii) Operation at constant (v/f) ratio. [8+7]
7. (a) Draw the circuit diagram and explain the working of slip power recovery system using solid state scherbius system.
(b) Compare the performance of static scherbius drive & static kramer drive. [8+7]
8. (a) What are the advantages of voltage source inverter fed drives?
(b) Draw and explain the servo-control and a permanent magnet synchronous motor with a PWM inverter. [7+8]

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1. (a) What is base speed of dc motors?
(b) Explain the various schemes of d.c motor speed control. [5+10]
2. (a) Explain various relative operational merits and demerits of single phase semi controlled converters fed to DC motors.
(b) Describe, with appropriate voltage and current waveforms, the working of a single phase full converter fed dc drive [7+8].
3. A 230V, 980rpm and 400A separately excited dc motor has an armature resistance of 0.05. The motor is fed from a chopper, which is capable of providing both motoring and braking operations. The source has a voltage of 230V. Assuming continuous conduction: When motor is operated in Dynamic braking, with Braking resistance of 5 ohms.
(a) Calculate Duty ratio of chopper for a motor speed of 850 rpm and braking torque of twice the rated value
(b) What will be the motor speed for a duty ratio of 0.5 and motor torque equal to twice its rated value? [8+7]
4. Explain briefly the following methods of braking a d.c motor
(a) Regenerative braking (b) Dynamic braking (c) Plugging [5+5+5]
5. (a) Derive relation between Speed torque, duty ratio and armature current of a D.C series motor using chopper control under motoring mode.
(b) Derive the expressions for average motor current, current I_{\max} and I_{\min} and average torque for chopper-fed dc separately excited motor. [7+8]
6. (a) What are the torque-speed characteristics of induction motor under V/t control? [6+9]
(b) A 3 phase, 4 pole, 50 Hz Induction motor has rotor resistance of 0.5 ohm and stand still reactance of 0.8 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.
7. (a) Describe static rotor resistance control method for the speed control of a three phase induction motor.
(b) In static rotor resistance control of a three phase Squirrel Cage Induction Motor, each diode in the rotor circuit conducts for 120° . Assuming ripple free rotor current, derive expressions for rms value of rotor current referred to stator, fundamental component of rotor current and its value referred to stator. [7+8]

8. (a) What is the basic difference between true synchronous mode and self control mode for variable frequency control of Synchronous motor?
(b) Draw and explain the block diagram of a self-controlled synchronous motor fed from a three-phase inverter. [8+7]

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1. Give two methods of speed control normally employed for dc motors. Hence, sketch the characteristics of a separately excited dc motor based on these two methods. [15]
2. (a) Explain various relative operational merits and demerits of single phase fully controlled converters fed to DC motors.
(b) With neat circuit diagram and waveforms, explain dynamic braking of separately excited motor by single phase converter. [8+7]
3. (a) Explain the Speed - torque Characteristics of a dc series motor connected to a three phase fully controlled converter.
(b) Describe the use of a three-phase semi converter for the speed control of a dc series motor. [7+8]
4. (a) Explain the principle of closed-loop control of a dc drive using suitable block diagram.
(b) Explain how four-quadrant operation is achieved by single phase dual converters fed d.c. separately excited motor. [8+7]
5. A 220V, 60A D.C series motor has combined resistance of armature and field is 0.15 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)	62	112	138	160	180	191	200	207

Motor is controlled by a chopper with source voltage equal to 220V. calculate

- (a) Motor Speed for a duty ratio of 0.6 and motor current of 50A
 - (b) Torque for a speed of 400 rpm and duty ratio of 0.64. [8+7]
6. (a) Draw the various types of AC voltage controllers which are used for speed control of Induction motor.
(b) Show that a variable frequency Induction motor drives develops at all frequencies the same torque for a given slip-speed when operating at constant flux. [7+8]
 7. (a) Why is the power factor of the slip recovery scheme of speed control of Induction motor is low? Explain. [8+7]
(b) In which way a static Kramer Control is different from static Scherbius drive?
 8. (a) When operating in true synchronous mode, why the frequency must be changed in small steps?
(b) Draw the block diagram of a closed loop synchronous motor drive fed from VSI and explain. [7+8]
