Code No: R1632021   **R16**   SET - 1

III B. Tech II Semester Regular Examinations, April/May - 2019
POWER ELECTRONIC CONTROLLERS AND DRIVES
(Electrical and Electronics Engineering)

Time: 3 hours   Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
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PART –A

1.	a)	What are advantages of electrical drive?	[2M]
	b)	What is the significance of line commutated converter.	[2M]
	c)	Give the advantages of chopper fed dc drives over rectifier fed dc drives.	[2M]
	d)	Can V/f ratio maintain constant for above base speed?	[3M]
	e)	Write the importance of slip power.	[3M]
	f)	Compare between VSI and CSI.	[2M]

PART -B

2. a) Explain the multi-quadrant operation of an electric motor with relevant characteristics when the motor is driving a hoist load? [7M]

b) A 220V, 960 rpm, 90A DC separately excited motor has an armature resistance of 0.06Ω.It is coupled to an overhauling load with a torque of 300 N-m. Determine the speed at which the motor can hold the load by regenerative braking. [7M]

3. a) Explain the operation of DC series motor operated with 1-phase full converter. Describe its speed control characteristics with respect to change of firing angle. [7M]

b) A 200V, 875rpm, 150A separately excited dc motor has an armature resistance of 0.06ohm. It is fed from a single phase fully controlled rectifier with an ac source of 220V, 50Hz. Assuming continuous conduction, calculate [7M]
(i) Firing angle for rated motor torque and 750rpm.
(ii) Motor speed for $\alpha=160^{0}$ at rated torque.

4. a) Explain first quadrant chopper fed separately excited DC motor with circuit and waveforms. [7M]

b) A DC chopper is used for regenerative braking of a separately excited DC motor. The supply input voltage is 400 V, armature resistance is 0.25 Ω, K_m=1.2V-sec/rad. The average armature current during regenerative braking is kept constant at 200 A. For a duty cycle of 60% of chopper, determine the following: (i) power fed back to the supply. (ii) Minimum and maximum braking speeds. (iii) Speed during regenerative braking. [7M]

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

b) A 440V, 3 phase, 50Hz 6 pole 945 RPM delta connected induction motor has the following parameters referred to the stator. R_1=2.0 Ω, R_2 = 2.0 Ω, X_1 = 3 Ω, X_2 = 4 Ω .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. [7M]

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6. a) A 440V, 50 Hz, 970rpm, 6-pole, star connected, three phase wound rotor induction motor has following parameters referred to the stator: Rs = 0.1 Ω, Rr' = 0.08 Ω, Xs=0.3 Ω, Xr' = 0.4 Ω, the stator to rotor turns ration 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 165^0. Calculate
   (i) Turns ratio of transformer.
   (ii) Torque for a speed of 780 rpm and α=140^0. [7M]

   b) Draw the circuit diagram and explain the working of Static Kramer drive for speed control of a three phase induction motor. [7M]

7. a) Explain closed loop speed control of synchronous motor drive fed from VSI. [7M]
   b) Describe the operation of self-controlled Synchronous Motor drives in detail. [7M]

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(Electrical and Electronics Engineering)

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
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PART –A

1.	a) Compare active torque and passive torques.	[2M]
	b) Compare circulating and non-circulating mode of dual converters.	[2M]
	c) Give the disadvantages of chopper fed dc drives over rectifier fed dc drives.	[2M]
	d) Describe the method of speed control of induction motor in the flux weakening region.	[3M]
	e) Define slip power and its significance.	[3M]
	f) How thristors are commutated in load commutated inverter?	[2M]

PART -B

2. a) Discuss the different modes of operation of electric drive with suitable examples?   [7M]

b) A 220V, 900 rpm, 70 A DC separately excited motor has an armature resistance of 0.05 Ω. It is coupled to an overhauling load with a torque of 200 N-m. Determine the speed at which the motor can hold the load by regenerative braking.   [7M]

3. a) Obtain the speed-torque characteristics of separately excited DC motor operated with 1-phase semi-converter and describe the effect of firing angle?   [7M]

b) A separate excited dc motor of 220V, 1200 rpm, 8A has armature resistance 0.75 ohms. It is fed from a single fully controlled bridge rectifier whose source voltage is 230V, 50 Hz. Assume load current to be continuous. Determine the following:
i) Motor speed at $\alpha=45^0$ and torque of 8 N-m.
ii) Developed torque at $\alpha=45^0$ and speed of 800 rpm.   [7M]

4. a) Derive the speed-torque expression of class-B chopper operating in time ratio control, supplying to the armature of the separately excited dc motor and draw speed- torque Characteristics.   [7M]

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

5. a) Explain the closed loop operation of induction motor drive with the help of block diagram?   [7M]

b) A 440V, 3 phase, 50Hz 6 pole 945 RPM delta connected induction motor has the following parameters referred to the stator. R_1=2.0 Ω, R_2 = 2.0 Ω, X_1 = 3 Ω, X_2= 4 Ω. 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 800 RPM.   [7M]

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6. a) Draw the circuit diagram and explain the operation of rotor- resistance control of Induction motor. [7M]

    b) A 400V, 50 Hz, 950rpm, 6-pole, star connected, three phase wound rotor induction motor has following parameters referred to the stator: Rs = 0.2 Ω, Rr' = 0. 07 Ω, Xs = 0.4 Ω, Xr' = 0.4 Ω, the stator to rotor turns ration 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 150^0. Calculate [7M]
        (i) Turns ratio of transformer
        (ii) Torque for a speed of 750 rpm and α=130^0.

7. a) Explain closed loop speed control of synchronous motor drive fed from CSI. [7M]

    b) Describe the operation of separate controlled Synchronous Motor drives in detail. [7M]

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Time: 3 hours   Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
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PART –A

1.	a)	Write the components of basic electrical drive system.	[2M]
	b)	Write the difference between half controlled converter and full controlled converter.	[2M]
	c)	Give the advantages of chopper fed dc drives.	[2M]
	d)	Give the disadvantages of AC voltage controller fed induction motor drive.	[3M]
	e)	What are the advantages of static rotor resistance control method?	[3M]
	f)	Compare between separate controlled mode and self-controlled mode for variable frequency control of Synchronous motor?	[2M]

PART -B

2.	a)	Develop a criterion for finding the steady state stability of an electric drive?	[7M]
	b)	Explain the working of electric drive with different types of load torques.	[7M]
3.	a)	Describe relative merits and demerits of four quadrant dc drives employing non-circulating and circulating dual converters.	[7M]
	b)	A separately excited DC motor is operating from a single phase semi converter at a speed of 1200 rpm, with input voltage of 320 V and back emf of 100 V. The converter is fired symmetrically with $\alpha=45^0$. The armature resistance of 5 Ω. Calculate average current and the motor developed torque?	[7M]
4.	a)	Explain two-quadrant operation consisting of forward motoring and regenerative braking of chopper fed dc drive with speed-torque characteristics.	[7M]
	b)	A 230 V separately excited DC motor takes 50 A at a speed of 800 rpm. It has armature resistance of 0.4 Ω. This motor is controlled by type-C chopper with an input voltage of 230 V and frequency of 800 Hz. Assuming the continuous conduction mode, calculate speed of motoring operation at duty ratios of 0.3 and 0.6.	[7M]
5.	a)	Explain why stator voltage control is suitable for speed control of induction motors in fan and pump drives.	[7M]
	b)	For a 3-phase delta connected 6-pole 50 Hz 400 V, 925 rpm squirrel cage induction motor is having $R_1 = 0.2$ Ω, $R_2 = 0.3$ Ω, $X_1 = 0.5$ Ω and $X_2 = 1.1$ Ω. The motor is operated from voltage source inverter with constant V/f ratio form 0 to 50 Hz and having the constant voltage of 400 V above 50 Hz frequency. Calculate: i). speed for a frequency of 35 Hz with half full load torque. ii). Torque for a frequency of 35 Hz for a speed of 650 rpm.	[7M]

6. a) What are the advantages of static rotor resistance control over conventional methods of rotor resistance control? [7M]

    b) A three phase, 400V, 6-pole, 50 Hz, delta connected slip ring induction motor has rotor resistance of 0.2 ohms and leakage reactance of 1 ohms per phase referred to stator. When driving a fan load it runs at full load of 4% 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 2.2. [7M]

7. a) Draw the block diagram and Explain the operation of Load commutated CSI fed Synchronous motor drive. [7M]

    b) Describe the operation of separate controlled Synchronous Motor drives in detail. [7M]

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SET - 4

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Time: 3 hours   Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) Explain about fundamental torque equation. [2M]
   b) Write the difference between circulating current mode and Non-circulating mode of operation in dual converter. [2M]
   c) Give the disadvantages of chopper fed dc drives. [2M]
   d) Give the advantages of AC voltage controller fed induction motor drive. [3M]
   e) Compare between static scherbius drive and static Kramer drive. [3M]
   f) What is the basic difference between separate controlled mode and self-controlled mode for variable frequency control of Synchronous motor? [2M]

PART -B

2. a) Explain electrical braking methods in detail. [7M]
   b) Draw the block diagram of electric drive and explain each component in detail. [7M]

3. a) Obtain the speed-torque characteristics of separately excited DC motor operated with 1-phase full converter and describe the effect of firing angle? [7M]
   b) A 220V, 1200 rpm, 80A separately excited dc motor has an armature resistance of 0.2 ohm. It is fed from a single phase fully controlled rectifier with an ac source of 230V, 50Hz. Assume continuous conduction. Calculate
   (i) Firing angle for rated motor torque and -700rpm.
   (ii) Motor speed for $\alpha=150^0$ and half rated torque. [7M]

4. a) Discuss with suitable diagrams the first-quadrant and fourth-quadrant DC-DC converters? [7M]
   b) A 230 V separately excited DC motor takes 50 A at a speed of 800 rpm. It has armature resistance of 0.4 Ω. This motor is controlled by type-C chopper with an input voltage of 230 V and frequency of 800 Hz. Assuming the continuous conduction mode, calculate speed of regenerative braking operation at duty ratios of 0.7 and 0.4. [7M]

5. a) Explain speed control of induction motor by AC Voltage Controllers. [7M]
   b) For a 3-phase delta connected 6-pole 50 Hz 440 V, 905 rpm squirrel cage induction motor is having $R_1 = 0.2$ Ω, $R_2 = 0.3$ Ω, $X_1 = 0.5$ Ω and $X_2 = 1.1$ Ω. The motor is operated from voltage source inverter with constant V/f ratio form 0 to 50 Hz and having the constant voltage of 440 V above 50 Hz frequency. Calculate :
   (i). Speed for a frequency of 25 Hz with half full load torque
   (ii). Torque for a frequency of 25 Hz for a speed of 600 rpm. [7M]

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6. a) Explain speed –torque characteristics of a static Scherbius drive control for speed control of induction motor. [7M]

   b) A 440 V, 50 Hz, 6-pole Y-connected wound rotor motor has the following parameters: $R_s = 0.5\ \Omega$, $R_r' = 0.4\ \Omega$, $X_s = X_r' = 1.2\ \Omega$, $X_m = 50\ \Omega$, stator to rotor turns ratio is 3.5. Motor is controlled by static rotor resistance control. External resistance is chosen such that the breakdown torque is produced at standstill for a duty ratio of zero. Calculate the value of external resistance. [7M]

7. a) Draw the block diagram and explain the operation of Load commutated VSI fed Synchronous motor drive. [7M]

   b) Describe the operation of self-controlled Synchronous Motor drives in detail. [7M]

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