Code No: RT32026 **R13** SET - 1

III B. Tech II Semester Regular/Supplementary Examinations, April- 2017
POWER SEMICONDUCTOR 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. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	How do you define passive and active load torques? What are the differences between the two?	[4M]
	b)	Compare conventional and static Ward-Leonard systems.	[4M]
	c)	Give the advantages of chopper fed dc drives.	[3M]
	d)	Give the disadvantages of AC voltage controller fed induction motor drive.	[4M]
	e)	Write short notes on slip power.	[4M]
	f)	Explain true synchronous mode operation of synchronous motor drive.	[3M]

PART -B

2	a)	Explain about steady state stability of an electric drive.	[8M]
	b)	Compare three electric braking methods.	[8M]
3	a)	Describe relative merits and demerits of four quadrant dc drives employing non-circulating and circulating dual converters.	[8M]
	b)	Explain in detail the operation of a 3-phase full converter feeding a d.c series motor with reference to voltage and current waveforms, assume motor current is continuous.	[8M]
4	a)	Explain two-quadrant operation consisting of forward motoring and regenerative braking of chopper fed dc drive with speed-torque characteristics.	[8M]
	b)	A 230 V, 960 rpm, and 200 A separately excited dc motor has an armature resistance of 0.02Ω. The motor is fed from a chopper which provides both motoring and braking operations. The source has a voltage of 230 V. assuming continuous conduction. Calculate duty ratios of chopper for motoring and braking operations at rated torque and 350 rpm.	[8M]
5	a)	Discuss how v/f speed control scheme of a induction motor is similar to the armature voltage control method of a DC motor.	[8M]
	b)	Why stator voltage control is an inefficient method of induction motor speed control.	[8M]
6	a)	Draw a suitable circuit diagram and explain the working of slip-power recovery scheme using static Scherbius drive.	[8M]
	b)	A 440 V, 50 Hz, 6-pole Y-connected wound rotor motor has the following parameters: Rs=0.5 Ω, Rr'=0.4 Ω, Xs=Xr'=1.2 Ω, Xm=50 Ω, 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.	[8M]
7	a)	Draw and explain the speed-torque curves of asynchronous motor with variable frequency control of synchronous motor.	[8M]
	b)	With block diagram explain closed loop speed control of self-controlled synchronous	[8M]

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POWER SEMICONDUCTOR DRIVES

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	Explain what do you understand by the steady-state stability?	[4M]
	b)	Among armature resistance & armature voltage control methods, which one is efficient?	[4M]
	c)	Give the advantages of chopper fed dc drives over rectifier fed dc drives.	[3M]
	d)	Variable voltage control method of induction motor is not suitable for constant torque loads. Justify.	[4M]
	e)	Compare slip power control and slip power recovery.	[4M]
	f)	How do you start a synchronous motor?	[3M]

PART -B

2	a)	Explain the four quadrant operation of electric motor driving hoist load.	[8M]
	b)	Write short notes on components of load torque.	[8M]
3	a)	Draw and explain the speed-torque characteristics at different firing angles for a fully converter feeding a d.c series motor. Draw the quadrant diagram also.	[8M]
	b)	A fully controlled rectifier –fed separately excited dc motor is required to operate in motoring and braking operations in the forward direction. Only one fully-controlled rectifier is available. What switching arrangement will be required? Explain.	[8M]
4	a)	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.	[8M]
	b)	Derive the speed-torque expression of class-B chopper operating in time ratio control is supplying the armature of the separately excited dc motor. And draw speed torque characteristics.	[8M]
5	a)	Explain why stator voltage control is suitable for speed control of induction motors in fan and pump drives.	[7M]
	b)	Variable frequency control of induction motor has higher efficiency and better low speed performance when fed from a PWM inverter instead of 6-step inverter. Explain.	[9M]
6	a)	Draw a suitable circuit diagram and explain the working of slip-power recovery scheme using commutator-less Kramer drive.	[8M]
	b)	A 3-phase, 440 V, 50 Hz, 6-pole, 970 rpm, Y-connected induction motor has the following parameters referred to stator: Rs=0.2 Ω, Rr'=0.15 Ω, Xs=Xr'=0.4 Ω, stator to rotor turns ratio is 3.5. Motor is controlled by static Scherbius drive. The drive is designed for a speed range of 30% below the synchronous speed. The maximum value of firing angle is 170^0. Calculate turns ratio of transformer and torque for a speed of 750rpm and $\alpha=140^0$.	[8M]
7	a)	When operating in true synchronous mode, why the frequency must be changed in small steps?	[8M]

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(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

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2. Answering the question in **Part-A**is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	List out three common load torques experienced in practice& draw the speed-torque curves.	[4M]
	b)	Three phase converter controlled dc drives offer small discontinuous operating region compared to single phase converter fed dc drives. Justify.	[4M]
	c)	Give the quadrants in which electric drive can operate using class C & class D choppers respectively.	[3M]
	d)	How do you get linear relation between voltage and frequency in v/f control of induction motor at low frequency operation?	[4M]
	e)	Give the advantages of rotor side control of induction motor over stator side.	[4M]
	f)	Write short notes on modes of variable frequency control.	[3M]

PART -B

2	a)	Short notes on load equalization.	[8M]
	b)	Explain each block of the electric drive with block diagram.	[8M]
3	a)	Explain in detail the operation of a 3-phase full converter feeding a d.c separately excited motor with reference to voltage and current waveforms, assume motor current is continuous.	[8M]
	b)	A 220 V, 1500 rpm, 50 A separately excited motor with armature resistance is fed from a 3-phase fully-controlled rectifier. Available ac source has a line voltage of 440 V, 50 Hz. 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. Determine the value of firing angle when motor is running at -800 rpm and twice the rated torque.	[8M]
4	a)	Derive the speed-torque expression of class-A chopper operating in time ratio control is supplying the armature of the separately excited dc motor. And draw speed torque characteristics.	[8M]
	b)	When fed by a constant voltage source, regenerative braking below base speed can also be obtained by connecting a step-up chopper. Justify.	[8M]
5	a)	Draw a neat circuit diagram for speed control of 3-phase induction motor in four quadrants using AC voltage controller and draw the relevant speed-torque characteristics.	[8M]
	b)	For variable frequency control of induction motor for speeds below base speed V/f ratio is maintained constant, why?	[8M]
6	a)	What are the advantages of static rotor resistance control over conventional methods of rotor resistance control?	[8M]
	b)	A 3-phase, 400 V, 50 Hz, 4-pole, 1400 rpm, Y-connected wound-rotor induction motor has the following parameters referred to stator: Rs=2Ω, Rr'=3Ω, Xs=Xr'=3.5Ω, stator to rotor turns ratio is 2. Motor sped is controlled by static Scherbius drive. The inverter is directly connected to the source. Determine the speed range of the drive when $\alpha_{max}=165^0$ and the firing angle for 0.4 times the rated motor torque and a speed of 1200 rpm.	[8M]
7	a)	Why the LCI fed synchronous motor drive is found suitable for high speed and high power applications?	[8M]

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Code No: RT32026 **R13** SET - 4

III B. Tech II Semester Regular/Supplementary Examinations, April- 2017

POWER SEMICONDUCTOR DRIVES

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	Define constant torque & constant power drive with examples.	[4M]
	b)	Compare circulating and non-circulating mode of dual converters.	[4M]
	c)	Using choppers, regenerative braking is possible down to zero speed though drive is fed by fixed dc voltage. Justify.	[3M]
	d)	Can V/f ratio maintain constant for above base speed? Above base speed is flux weakening region, explain	[4M]
	e)	State major features of rotor resistance control of wound rotor induction motor.	[4M]
	f)	Why synchronous motor is not self start?	[3M]

PART -B

2	a)	Classify and explain the load torques in detail.	[8M]
	b)	With neat block diagram explain the operation of electric drive.	[8M]
3	a)	A 220 V, 1500 rpm, 50 A separately excited motor with armature resistance is fed from a 3-phase fully-controlled rectifier. Available ac source has a line voltage of 440 V, 50 Hz. 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. Calculate transformer turns ratio. Determine the value of firing angle when motor is running at 1200 rpm and rated torque.	[8M]
	b)	Draw and explain the speed-torque characteristics at different firing angles for a 3-phase fully converter feeding a separately excited d.c motor.	[8M]
4	a)	Explain the operation of four quadrant chopper fed dc separately excited in detail with neat sketches. Take any control scheme. Assume continuous current.	[8M]
	b)	A 250-V separately excited motor de has an armature resistance of 2.5 Ω. When driving a load at 600 rpm with constant torque, the armature takes 20 A. This motor is controlled by a chopper circuit with a frequency of 400 Hz and an input voltage of 250 V. What should be the value of the duty ratio if one desires to reduce the speed from 600 to 400 rpm, with the load torque maintained constant?	[8M]
5	a)	Explain in detail with speed-torque characteristics of variable voltage and variable frequency (V/F) control of induction motor drive.	[8M]
	b)	Explain closed loop operation of slip controlled PWM inverter fed induction motor drives.	[8M]
6	a)	Why is the power factor of the slip power recovery scheme of speed control of induction motor low? Give the applications of Scherbius drive.	[8M]
	b)	A 440 V, 50 Hz, 6-pole Y-connected wound rotor motor has the following parameters: Rs=0.5 Ω, Rr'=0.4 Ω, Xs=Xr'=1.2 Ω, Xm=50 Ω, 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.	[8M]
7	a)	Explain the operation of closed-loop speed control of LCI fed synchronous motor drive.	[8M]