Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (OLD) - EXAMINATION – SUMMER 2017

Subject Code: 150903 **Date: 01/05/2017**

Subject Name: Power Electronics - I

Time: 02:30 PM to 05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Critically compare power MOSFET and SCR in terms of its control, characteristics, ratings and applications.	**07**
	(b)	Explain the turn-on and turn-off characteristics of an SCR.	**07**
Q.2	**(a)**	List the various turn-on methods used to trigger an SCR. Which turn-on method is the most popular and why? Briefly explain the method.	**07**
	(b)	Discuss the static characteristics of a triac and hence explain how it can be used for AC phase control applications.	**07**
		OR	
	(b)	List the various protections required for operating an SCR safely and reliably. Also, explain Crowbar protection using a neat circuit diagram.	**07**
Q.3	**(a)**	Explain the working of single phase fully controlled bridge converter connected to an R-L load. Draw suitable waveforms and derive the RMS output voltage and average output voltage equations.	**07**
	(b)	A single-phase semi-converter is supplied by 200V, 50Hz and it is connected with a RLE load where R=15Ω, E=80V and L is very large so that the load current is ripple free. Determine (a) average output voltage, (b) average output current, (c) average and rms value of thyristor current, (d) average and rms value of diode current, (e) circuit turn-OFF time at $\alpha = 35°$.	**07**
		OR	
Q.3	**(a)**	Explain the basic principle of a dual converter. Hence show how two-3 phase full converters can be connected back to back to form a circulating current type of dual converter. Discuss its operation with the help of voltage waveforms across (i) each converter and (ii) across the load	**07**
	(b)	With relevant waveforms, explain how the operation of a single-phase half-controlled (semi-controlled) converter differs from that of fully-controlled converter. Also, mention the advantages of half-controlled converter over fully-controlled converter.	**07**
Q.4	**(a)**	What is the need of connecting SCRs in parallel? Indicate problems associated with it and discuss the common methods of current sharing of parallel connected SCRs.	**07**
	(b)	With neat circuit diagram and waveforms, explain the operation of a two-quadrant chopper capable to give forward motoring and forward regenerative operation.	**07**
		OR	
Q.4	**(a)**	Explain the working of a step-up chopper and derive the equation of average output voltage in terms of input voltage and duty cycle.	**07**

	(b)	A step-down chopper used for ON-OFF control of a separately excited DC motor is fed with a DC supply voltage of 230V. The ON time and OFF time are 8ms and 12ms, respectively. Armature resistance is 3Ω. Assuming continuous conduction of the motor current, calculate the average load current when the motor runs at a speed of 1200rpm. Motor voltage constant is kv=0.5V/rad/s.	**07**
Q.5	**(a)**	Explain how regenerative braking can be achieved for a separately excited DC motor using DC-DC converter.	**07**
	(b)	With the help of appropriate waveforms and equations, show how the source inductance reduces the average output voltage of a single phase fully-controlled converter.	**07**

OR

Q.5	**(a)**	Discuss the two zone operation in context to the speed control of DC separately excited motor. Clearly show the constant torque and constant power region and comment on the speed-control methods that must be utilized for a respective zone.	**07**
	(b)	It is intended to operate a DC separately excited motor in 1st and 4th quadrant. Name an appropriate AC-DC phase controlled converter which can achieve this objective. With relevant waveforms and circuit diagram, explain the operation of this DC drive.	**07**

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