Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER– I (Old course)• EXAMINATION – SUMMER 2015

Subject Code: 714501N **Date: 11/05/2015**

Subject Name: Power Electronics – I

Time: 10:30 AM – 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all the questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Notations and symbols used have usual technical meaning.**

Q.1 **(a)** Draw only the basic structure of a DIAC. Draw only the basic structure of a TRIAC. Explain triggering of TRIAC using DIAC with neat circuit diagram and waveforms. Derive the RMS output voltage equation having firing angle (α). **07**

(b) A 100A SCR is to be connected in parallel with a 150A SCR. The on state voltage drop of the SCRs are 2.1V and 1.75V respectively. **07**

(i) Calculate the series resistance to be connected with each SCR in order to share a total current of 180A in proportion to their ratings. Also calculate the total power dissipation in the external resistances.

(ii) Calculate the series resistance to be connected with each SCR in order to share a total current of 180A equally. Assume that the resistance with 150A SCR is double than that with 100A SCR. Also calculate power dissipation in the external resistances.

Q.2 **(a)** Explain the basic structure of a Power BJT and briefly explain its various operating regions. **07**

(b) For an inverter controlled by single pulse width modulation technique; prove that selective harmonic (n) can be eliminated from the inverter output voltage using this technique by adjusting firing angle (α) = 90°/n, using Fourier analysis. **07**

OR

(b) A thyristor string is formed by series & parallel connection of thyristors. The voltage and current ratings of the string are 5kV and 2kA respectively. Available thyristors have voltage and current ratings of 1kV and 500A respectively. The de-rating factor of 14% is to be kept for both series & parallel connections. Calculate the number of thyristors to be connected in series & parallel. If the maximum blocking current is 15mA and the maximum difference in their reverse recovery charge is 25εC; then calculate the value of resistance in static equalizing circuit and the value of capacitance in dynamic equalizing circuit. **07**

Q.3 **(a)** Explain Class-D commutation of SCR with necessary waveforms. **07**

(b) Explain the operation of boost converter with neat diagram and waveforms. **07**

OR

Q.3 **(a)** Explain unipolar switching scheme of a 1-phase sinusoidal PWM inverter with neat diagram and waveforms by considering 5 cycles of the carrier signal. **07**

(b) Explain the operation of 3-phase bridge inverter with Y-connected resistive load in 120° conduction mode with neat diagram and waveforms. **07**

Q.4	**(a)**	Explain the operation of fly-back converter with neat diagram and waveforms.	**07**
	(b)	An SCR has Vg-Ig characteristics given as Vg = 2.1+3.5Ig. In a certain application, the gate voltage consists of rectangular pulses of 15V and of duration 30εs with 70% duty cycle. Determine the value of series resistor (Rg) in gate circuit to limit the peak power dissipation in the gate to 2.5W. Calculate average power dissipation in the gate and maximum switching frequency.	**07**

OR

Q.4	**(a)**	Explain the need of Heat-sink. Explain its selection process.	**07**
	(b)	Derive the equation for duty cycle in terms of supply voltage & load voltage for cuk converter with necessary diagram & waveforms.	**07**
Q.5	**(a)**	Explain the operation of a 6-pulse converter with neat circuit diagram and waveforms.	**07**
	(b)	Explain center-tapped 1-phase to 1-phase cycloconverter with neat circuit diagram and waveforms for the conversion of 3 input cycles to 1 output cycle.	**07**

OR

Q.5	**(a)**	Explain dual converter with circulating current control mode.	**07**
	(b)	Explain the principle of operation of integral cycle control type 1-phase voltage controller with neat diagram and waveforms. Also derive the expression for the RMS output voltage in terms of duty cycle.	**07**

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