Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 714501N Date: 08/12/2015
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, symbol and V-I characteristic of a GTO. Briefly explain Turn-ON and Turn-OFF mechanism of GTO using its equivalent 2-transistor model. **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**

Q.2 **(a)** Draw only the basic structure of a TRIAC. Enlist all the possible triggering modes of TRIAC. Briefly explain its most sensitive triggering mode with neat diagram. **07**

(b) A 100A SCR is to be connected in parallel with a 150A SCR. The on state voltage drop of the SCRs are 2V and 2.5V respectively. **07**

(i) Calculate the series resistance to be connected with each SCR in order to share a total current of 200A 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 190A equally. Assume that the resistance with 150A SCR is double than that with 100A SCR. Also calculate power dissipation in the external resistances.

OR

(b) A thyristor string is formed by series and parallel connection of thyristors. The voltage and current ratings of the string are 10kV and 3kA respectively. Available thyristors have voltage and current ratings of 2kV and 500A respectively. The derating factor of 18% is to be kept for both series and parallel strings. Calculate the number of thyristors to be connected in series and parallel strings. If the maximum blocking current is 12mA and the maximum difference in their reverse recovery charge is $20\varepsilon C$; 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-A commutation of SCR with necessary waveforms. **07**

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

OR

Q.3 **(a)** Explain the operation of boost converter with neat diagram and waveforms. **07**

(b) Explain the operation of 3-phase bridge inverter with Y-connected resistive load in 180° conduction mode with neat diagram and waveforms. **07**

Q.4 **(a)** Explain the operation of push-pull converter with neat diagram and **07**

waveforms.

(b) An SCR has Vg-Ig characteristics given as Vg = 2.3+3.2Ig. In a certain application, the gate voltage consists of rectangular pulses of 15V and of duration 40εs with 60% duty cycle. Determine the value of series resistor (Rg) in gate circuit to limit the peak power dissipation in the gate to 2.2W. Calculate average power dissipation in the gate and maximum switching frequency. **07**

OR

Q.4 **(a)** 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) = $\pi/2n$, using Fourier analysis. **07**

(b) Derive the equation for duty cycle in terms of supply voltage and load voltage for Cuk converter with necessary diagram & waveforms. **07**

Q.5 **(a)** Explain the operation of a 12-pulse converter with neat circuit diagram and waveforms. **07**

(b) Explain the principle of operation of integral cycle control type 1-phase AC voltage controller with neat diagram and waveforms. Also derive the expression for the RMS output voltage in terms of duty cycle. **07**

OR

Q.5 **(a)** Explain dual converter with circulating current control mode. **07**

(b) Explain the need of Heat-sink. Explain its selection process. **07**

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