Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER I (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2714501 **Date: 17/05/2016**

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.**
4. **Notations and symbols used have usual technical meaning.**

Q.1 **(a)** In a 1-phase AC voltage controller; output voltage is 20% of the input voltage. What will be the firing angle (α)? **07**

(b) Neatly draw the output voltage (Vo) waveform from the description tabulated below. Carry out Fourier analysis up to 25 harmonic components for the output voltage (Vo) waveform to calculate %THD. **07**

Positive half-cycle of output voltage (V_O) waveform:

θ (degree)	0	0	45	45	135	135	180	180
V_O (V)	0	50	50	100	100	50	50	0

Negative half-cycle of output voltage (V_O) waveform:

θ (degree)	180	180	225	225	315	315	360	360
V_O (A)	0	-50	-50	-100	-100	-50	-50	0

Q.2 **(a)** Explain center-tapped 1-phase to 1-phase cycloconverter with neat circuit diagram and waveforms for the conversion of 7 input cycles to 1 output cycle. **07**

(b) A 200A SCR is to be connected in parallel with a 250A SCR. The on state voltage drop of the SCRs are 2.5V and 2.75V respectively. **07**

(i) Calculate the series resistance to be connected with each SCR in order to share a total current of 400A 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 400A equally. Assume that one resistance is double than another resistance. Also calculate the total power dissipation in the external resistances.

OR

(b) An SCR has Vg-Ig characteristics given as Vg = 2.3+1.5Ig. In a certain application, the gate voltage consists of rectangular pulses of 12V and of duration 50μs with 75% duty cycle. Calculate: **07**

(i) Value of series resistor in gate circuit to limit the power dissipation to 3.25W

(ii) Average power dissipation in the gate circuit

(iii) Switching frequency of SCR

Q.3 **(a)** Explain the basic structure of a Power MOSFET and briefly explain its principle of operation with neat diagram. **07**

(b) Explain Cuk converter with neat circuit diagram and necessary waveforms. **07**

OR

Q.3 **(a)** Explain the principle of operation of integral cycle control type 1-phase AC voltage controller with neat circuit diagram and waveforms. Also derive the expression for RMS value of output voltage in terms of duty cycle. **07**

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

Q.4 **(a)** Explain any one operating mode of TRIAC with neat diagram. **07**

(b) Explain the operation of fly-back converter with neat circuit diagram and necessary waveforms. **07**

OR

Q.4 **(a)** Explain buck-boost converter with neat circuit diagram and necessary waveforms. **07**

(b) Draw only the basic structure, symbol and V-I characteristic of a GTO. Explain Turn ON and Turn OFF mechanism of GTO with neat diagrams. **07**

Q.5 **(a)** Explain Class-C commutation of SCR. **07**

(b) A buck converter has an input voltage = 12V, required average output voltage = 5V, peak-to-peak output ripple voltage = 8mV, switching frequency = 20kHz and load resistance = 125Ω. The peak-to-peak ripple current of inductor is limited to 0.35A. Calculate: **07**

(i) Duty cycle
(ii) Filter inductor
(iii) Filter capacitor
(iv) Critical values of L & C

OR

Q.5 **(a)** Explain bipolar switching scheme of a 1-phase sinusoidal PWM inverter with neat circuit diagram. **07**

(b) A thyristor string is formed by series and parallel connection of thyristors. The voltage and current ratings of the string are 5kV and 3kA respectively. Available thyristors have voltage and current rarings of 1kV and 700A respectively. The de-rating factor of 12% is kept for both series and parallel connections. How many thyristors are required to form this string? **07**

If the maximum blocking current is 8mA and the maximum difference in their reverse recovery charge is 12μC; then calculate the value of resistance in static equalizing circuit and the value of capacitance in dynamic equalizing circuit.

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