Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 710702N **Date: 09-01-2013**

Subject Name: Advanced Power Electronics

Time: 02.30 pm – 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. **Support your answer with necessary circuit diagram and waveforms, if required.**

Q.1 (a) Compare GTO, IGBT and power BJT. 07

(b) i. What is the need of isolation in driver circuit? Discuss the basic two ways of isolating gate signal. 07

ii. Discuss salient features of IGBT.

Q.2 (a) What are the limitations of the single stage conversion in Switching mode regulators? Explain the working of Buck regulators with the help of circuit diagram and various waveforms. 07

(b) Derive the expressions for the peak to peak ripple current, peak to peak capacitor voltage and critical values of inductor and capacitor for continuous mode in a Buck-Boost regulator. 07

OR

(b) A Boost regulator has an input voltage of 5 V. The average output voltage is 15 V and average load current is 0.5 A. The switching frequency is 25 kHz. If inductor is 150 μH and Capacitor is 225 μF, determine (i) duty cycle, (ii) ripple current of inductor, ripple voltage of filter capacitor and (iii) Critical values of L and C for continuous mode. 07

Q.3 (a) Compare 120^0 and 180^0 modes of firing schemes in a 3-phase inverter. Discuss any one in details with the help of necessary diagram and waveforms. 07

(b) Discuss single pulse and multi-pulse width modulations to reduce harmonics in a 1-phase inverter. Also derive the expression to eliminate a particular harmonic in single pulse width modulation. 07

OR

Q.3 (a) Compare voltage source inverter and current source inverter. 07

(b) Discuss the transformer connections to eliminate (i) a particular harmonic and (ii) any two harmonics simultaneously in a 1-phase inverter with the support of necessary waveforms and equations. 07

Q.4 (a) Derive the expression for the r.m.s. output voltage of a 3-phase, 3-wire star connected AC controller with resistive load. Also draw the necessary circuit and waveforms for firing angle of 60^0. 07

(b) In a 3-phase full wave AC star connected voltage regulator has the following data: 07

Input r.m.s. voltage (line to line) = 210 V, 50 Hz, firing angle $\alpha = \pi/3$ and load resistance R_L = 10 ohm. Determine output r.m.s. voltage and power factor.

OR

Q.4	(a)	Compare cycloconverter and dc link converter. Describe 3-phase to 3-phase cycloconverter with relevant circuit using 18 thyristors.	07
Q.4	(b)	Explain the basic principle of operation of a cycloconverter with a neat circuit diagram. Prove that the fundamental r.m.s. value of per phase output voltage of low frequency for an m-pulse cycloconverter is given by $E_{or} = E_{ph}\left(\frac{m}{\pi}\right)\sin\left(\frac{m}{\pi}\right)$.	07
Q.5	(a)	With the help of block diagram explain the basic principle of operation of SMPS.	07
	(b)	A 3-phase to 1-phase cycloconverter employs three pulse positive and negative group converters. Each converter is supplied from delta/star transformer with per phase turns ratio of 3:1. The supply voltage is 410 V, 50 Hz. The load has resistance of 4 ohm and at low output frequency, the inductive reactance is 3 ohm. The commutation overlap and thyristor turn-off time limit the firing in the inversion mode to 160^0. Calculate: (i) the r.m.s. output voltage, (ii) r.m.s. output current and (iii) output power.	07

OR

Q.5	(a)	State the main requirements and advantages of a good current transformer. Also state different types of core materials.	07
	(b)	Discuss the salient features of transformer and dc inductor design for an ac-dc converter.	07

****