Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. IST Semester–Remedial Examination – July- 2011

Subject code: 710702N

Subject Name: Advanced Power Electronics

Date:08/07/2011 **Time: 10:30 am – 01:00 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)** Compare SCR, Power MOSFET, and IGBT with respect to their construction, ratings available, switching characteristics, switching speeds, applications etc. **07**

(b) Explain forward converter with relevant circuits and waveforms. Derive the equation of output voltage in terms of duty ratio. Also explain the significance of third winding in this topology. **07**

Q.2 **(a)** List the steps involved in space vector control of 3-phase bridge inverter. Also, show that the amplitude of output voltage with this technique is 15.5 % higher than that obtained with sine-triangle PWM technique. **07**

(b) Draw the buck-boost converter topology. With relevant waveforms explain its operation in discontinuous mode of operation. Also, derive expression of output voltage in terms of duty ratio in the discontinuous mode. **07**

OR

(b) Draw the circuit of a Cuk converter and explain its operation with relevant waveform and analysis. **07**

Q.3 **(a)** In relation to inverter operation, what does one mean by unipolar modulation? How is it different from bi-polar modulation? What is the effect of these two schemes on the output voltage's harmonic spectrum? **07**

(b) A flyback SMPS supplies a load of 40 A at 5V. The source voltage is 240 V dc and the transformer initial magnetizing current is 0.4 A. The power MOSFET is operating at a frequency of 50 kHz with a duty cycle of 0.4. Determine the transformer turns ratio from primary to secondary and its inductance. Assume ideal components and no ripple in load voltage. Find also the open circuit voltage across the semiconductor device. **07**

OR

Q.3 **(a)** Explain the operation of 3-phase bridge inverter for 150° conduction mode and comment on the levels in the output phase and line-line voltage. **07**

(b) What does one mean by 'Area Product'?. Obtain the area-product for high frequency transformer used with forward converter. **07**

Q.4 **(a)** Draw the circuit for 3-phase to 3-phase 3-pulse cyclo-converter and discuss its principle of operation in brief. Clearly show how the firing angle is varied over a period. **07**

(b) With neat waveforms and circuit diagram, explain the operation of single-phase auto-sequential CSI. **07**

OR

Q.4	**(a)**	Classify the inverters and distinguish between CSI and VSI.	**07**
	(b)	State the need for reduction of harmonics in inverters. Discuss the various methods for reduction of harmonics in inverter output.	**07**
Q.5	**(a)**	With relevant waveforms and circuit, explain the operation of 3-phase bi-directional delta connected AC voltage controller with $\alpha = 60°$.	**07**
	(b)	Explain the method of providing electrical isolation between control circuit and driver circuit using transformer when the switching frequency is very less. Draw relevant waveforms and circuit diagram.	**07**

OR

Q.5	**(a)**	Write a brief note on the design criteria to be considered for in the design of SMPS.	**07**
	(b)	Discuss in brief the on-off control and phase control techniques for AC voltage controller.	**07**

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