# **GUJARAT TECHNOLOGICAL UNIVERSITY ME – SEMESTER-1 (OLD) EXAMINATION – WINTER 2016**

# Subject Code: 710702N **Subject Name: Advanced Power Electronics** Time:10:30 Am to 1:00 Pm

# Date:18/11/2016

**Total Marks: 70** 

## Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- (a) Compare SCR, Power MOSFET, and IGBT with respect to their construction, 07 0.1 ratings available, switching characteristics, switching speeds, applications etc.
  - (b) With neat diagram and necessary waveforms, explain how paralleling of flyback 07 converters can help in improving the performance of SMPS.
- In a buck-boost converter operating at 20 kHz, L = 0.05 mH. The output capacitor is 07 **O.2** (a) sufficiently large and input voltage  $V_{in} = 15V$ . The output is to be regulated at 10V and the converter is supplying a load of 10W. Calculate the duty cycle D.
  - (b) With neat diagram and necessary waveforms, explain the working of Sepic 07 converter. How is it different from C'uk converter?

#### OR

- (b) With neat waveforms and circuit diagram, explain the operation of single-phase 07 auto-sequential Current Source Inverter.
- Q.3 In relation to inverter operation, what does one mean by unipolar modulation? 07 **(a)** How is it different from bi-polar modulation? What is the effect of these two schemes on the output voltage's harmonic spectrum?
  - (b) One is interested in eliminating  $3^{rd}$ ,  $5^{th}$  and  $7^{th}$  harmonics from the output 07 voltage of the inverter. With relevant waveform and analysis, discuss the control scheme which can realize the above objective.

#### OR

- Q.3 (a) A single phase full wave ac voltage controller working on ON-OFF control 07 technique has supply voltage of 230V, 50Hz. It supplies a resistive load of  $50\Omega$ . The controller is ON for 30 cycles and off for 40 cycles. Calculate (i) RMS output voltage (ii) Input P.F (iii) Derive the average thyristor current equation and hence calculate it.
  - With relevant waveforms and circuit, explain the operation of 3-phase bi-07 **(b)** directional (full wave) AC voltage controller operating with firing angle  $\alpha$  =  $60^{\circ}$  and feeding star connected resistive load.
- Explain the operation of 3-phase bridge inverter for 150° conduction mode and 07 0.4 (a) comment on the levels in the output phase and line-line voltage.
  - (b) Draw the circuit for 3-phase to 3-phase 3-pulse cyclo-converter and discuss its 07 principle of operation in brief. Clearly show how the firing angle is varied over a period.

#### OR

Draw the circuit for 3-phase to 1-phase cyclo-converter and discuss its 07 0.4 (a) principle of operation in brief.

- (b) Explain the need of isolation for driving the power switches. Also, discuss few 07 schemes of providing electrical isolation for driving MOSFET.
- Q.5 (a) With necessary discussions and derivation justify the following statement: 07
  "While operating with modulation index less than or equal to 1, output voltage of SVPWM is about 15% higher than that operating with SPWM".
  - (b) State the important differences in the functioning and design of transformers 07 and inductors used for DC-DC converters. Also list the steps involved in the design inductor of DC-DC converters.

## OR

- Q.5 (a) In light of SMPS design comment on the following (i) foldback current limiting 07 (ii) limiting inrush current.
  - (b) Derive the 'Area Product' equation for high frequency transformer of a forward 07 converter.

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