Date: 09/12/2015

**Total Marks: 70** 

# **GUJARAT TECHNOLOGICAL UNIVERSITY**

M.E. SEMESTER I (old course)–EXAMINATION (Remedial) – WINTER 2015

Subject code: 712902N

**Subject Name: Power Processing Circuits** 

Time: 10:30 AM to 1:00 PM

## 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) Explain V-I characteristics of Power BJT in various operating regions. 07 Enlist various differences between Power BJT and signal BJT.
  - (b) An SCR has Vg-Ig characteristics given as Vg = 1.5+4Ig. In a certain 07 application, the gate voltage consists of rectangular pulses of 15V and of duration 50 s with 60% duty cycle. Determine the value of series resistor (Rg) in gate circuit to limit the peak power dissipation in the gate to 3.5W. Also calculate average power dissipation in the gate.
- Q.2 (a) Explain the operation of 3-phase bridge inverter with Y-connected 07 resistive load in 180° conduction mode.
  - (b) A 1-phase PWM inverter is controlled by single pulse width modulation 07 technique. Using Fourier analysis; prove that a selective harmonic (n) can be eliminated from the inverter output voltage using this technique by adjusting firing angle ( $\alpha$ ) = /2n. Also derive the expression for RMS output voltage.

#### OR

- (b) Carry out Fourier analysis (up to 25 harmonics) of a 1-phase single 07 pulse width modulated inverter output voltage having firing angle ( $\alpha$ ) = 18°. Also calculate %THD (up to 25 harmonics).
- Q.3 (a) Explain Class-A commutation of SCR with necessary waveforms. Also 07 enlist its drawbacks.
  - (b) A 1-phase half-wave controlled rectifier is having a purely resistive 07 load of 10 $\Omega$ . Transformer secondary voltage is 100V (peak), 50Hz. Output voltage is controlled with firing angle ( $\alpha$ ) = 60°. Do as directed:
    - (i) Derive the equation of average output voltage and calculate the same.
    - (ii) Derive the equation of RMS output voltage and calculate the same.
    - (iii) Calculate Ripple Factor
    - (iv) Calculate PIV

### OR

- Q.3 (a) Explain the operation of cuk converter with neat circuit diagram and 07 waveforms.
  - (b) Explain gate driver circuit for a Power MOSFET. 07
- Q.4 (a) Explain the operation of buck-boost converter and derive the output 07 voltage equation in terms of duty cycle.
  - (b) Compare SCR, Power BJT, Power MOSFET and IGBT in a tabular 07

form.

- Q.4 (a) Explain bipolar switching scheme of a 1-phase sinusoidal PWM 07 inverter with neat circuit diagram. Also draw the neat waveforms for the equal magnitude of reference signal and carrier signal. What is the relationship between carrier signal and the most significant harmonic component?
  - (b) What are the advantages and drawbacks of CSI? Also compare VSI & 07 CSI.
- Q.5 (a) Explain 4-quadrant operation of a 1-phase dual converter. What are the 07 advantages and drawbacks of circulating current mode?
  - (b) What are the advantages and disadvantages of a 1-phase AC voltage 07 controller working on the principle of integral cycle control? One such AC voltage regulator is operating with a resistive load of 10á and supply voltage is 230V<sub>(RMS)</sub>, 50Hz. The controller remains

of 10á and supply voltage is  $230V_{(RMS)}$ , 50Hz. The controller remains ON for 40 cycles and OFF for 60 cycles. Calculate RMS output voltage and input power factor.

#### OR

- Q.5 (a) Explain the working principle of a 1-phase light dimmer with power 07 saving feature. Also derive the RMS output voltage equation.
  - (b) Explain center-tapped 1-phase to 1-phase cycloconverter with neat 07 circuit diagram and waveforms for the conversion of 5 input cycles to 1 output cycle.

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