



SE-7409

**B. E. - IV (Sem. VII) (Elect.) Examination**  
**April / May - 2011**  
**Industrial Power Electronic**

Time : 3 Hours]

[Total Marks : 100

**Instruction :**

(1)

नीचे दशांशक निशानीवाणी विगतो उत्तरवडी पर अवश्य कभवी.  
Fillup strictly the details of signs on your answer book.

Name of the Examination :  
B. E. - 4 (Sem. 7) (Elect.)

Name of the Subject :  
Industrial Power Electronics

Subject Code No. : 7 4 0 9 Section No. (1, 2,.....) : 1&2

Seat No. :

Student's Signature

- (2) Answers to the two sections must be written in separate answer books.
- (3) Make suitable assumptions, wherever necessary.
- (4) Figures to the right indicate full marks.
- (5) Answer all questions.

**SECTION-I**

- 1 (a) Answer the following : (each question carries two marks) 10
- (1) Why pulse train is preferred to an elongated gate for triggering purpose ?
  - (2) Define holding current.
  - (3) List the turn ON methods for triggering an SCR.
  - (4) What is the typical value of intrinsic stand-off ratio of UJT ?
  - (5) What is the relation between the firing angles of the two converters of a dual converter ?
- (b) Draw and explain static V-I characteristics of an SCR. 5
- (c) Explain the use of pulse transformer in triggering circuit. 5

- 2 (a) Describe the working of a 1 phase fully controlled bridge converter in the following modes : 8
- (i)  $\alpha = 30$
- (ii)  $\alpha = 150$ .
- (b) The parameters of a relaxation oscillator using UJT are : 7
- $\eta = 0.72$ ,  $I_p = 0.6mA$ ,  $V_v = 1.0V$ ,  $V_p = 18.0V$ ,  $I_v = 2.5mA$ ,  
 $R_{BB} = 5K\Omega$ , normal leakage current with emitter open = 4.2mA, the firing frequency is 2 KHz. For  $C = 0.04\mu F$ , compute the values of R, R1, R2.

**OR**

- 2 (a) Draw and explain in detail the turn off characteristics of thyristor. 8
- (b) A single phase full bridge diode rectifier is supplied from 230V, 50Hz source. The load consists of  $R = 10\Omega$  and a large inductance so as to render the load current constant. Determine : 7
- (1) Average value of output voltage and output current.
- (2) Average and RMS value of diode current.
- (3) RMS values of output and input current and supply pf.
- 3 Answer the following : (any three) 15
- (1) Explain the effect of source inductance on the average output voltage for a single phase ac-dc converter.
- (2) Write a brief note on snubber circuit.
- (3) Write a short note on characteristics and principle of operation of power MOSFET.
- (4) Explain AC phase control using triac.
- (5) Discuss in brief the current rating of an SCR.

**SECTION : II**

- 4 (a) Answer the following questions in a sentence or two : 1
- (1) List the control strategies for operating chopper. 1
- (2) What are the disadvantages of a single-phase half-bridge inverter ? 2

- (3) What types of devices are generally used low power choppers. 1
- (4) If thyristors are used for a step-up cyclo-converter, what is the specific requirement for its control ? 2
- (5) State the connections at the triac terminals for having an operation in mode I-. 1
- (6) State the limitations of the voltage commutated chopper. 2
- (7) What is a modulation index ? What is its range ? 2
- 5 (a) Draw the circuit for two quadrant type-B chopper. Show the quadrants in which it operates. With relevant diagrams explain how the average output voltage can be varied in this chopper. 6
- (b) Show that for a step-down dc to dc converter, the critical inductance of the filter is given by :

$$L = \frac{V_o^2 (V_s - V_o)}{2fV_s P_o}$$

Where  $V_o$ ,  $V_s$ ,  $P_o$  and  $f$  are the load voltage, source voltage, load power and frequency respectively.

- 6 (a) With neat diagrams explain the working of a bridge inverter operating in  $120^\circ$  mode. Also sketch the phase and line voltages. Clearly show the firing sequence of the SCRs. What is the need for diodes in parallel to the switches ? What types of switches are generally preferred in these inverters ? 10
- (b) A triac based single-phase voltage controller feeds power to a resistive load of 3 ohms from a supply of 230 V, 50 Hz. Calculate the values of average and rms current through the device for a firing angle  $\alpha = 30^\circ$ . 5

OR

- 6 (a) For harmonic reduction in single phase inverters the secondary winding for two transformers are used in series. Explain, with relevant diagrams, how the inverters should be operated to eliminate the third harmonic. Assume that the voltage in the secondary windings and each other. 7

- (b) For a single phase half bridge inverter dc link voltage is 230 V de and the period of the ac cycle is 1 ms. The load consists of RLC in series with  $R=1.0\Omega$ ,  $\omega L=6\Omega$  ( $1/\omega C$ )= $7\Omega$ .
- (i) Sketch the waveforms for load voltage  $V_o$  3  
fundamental component of output current  $I_o$ , source current  $I_s$ .
- (ii) Indicate the deives that conduct during different intervals of one cycle. 1
- (iii) Find rms value of the fundamental component of load current. 1
- (iv) Find power delivered to load due to the fundamental component. 2
- (v) Check whether forced communcation is required or not  $T_{OFF}=100\mu s$ . 1
- 7 Write short notes on any three : 15
- (1) Derive the equation for an average output voltage for a step-up chopper. State the assumptions made if any. What will be the value of output voltage for duty cycle=1 ?
- (2) Explain the working of single phase half bridge inverter and carry out the fourier analysis for the output voltage.
- (3) A star connected load of  $15\ \Omega$  per phase is fed from 420 V dc source through a 3-phase bridge inverter operating in  $120^\circ$  mode. Determine (i) rms value of load current (ii) rms value of thyristor current and (iii) load power.
- (4) (i) Draw the circuit diagram of s step-down voltage commutated chopper. 2  
(ii) Show a circuit diagram for an asymmetrical ac voltage regulator. 1  
(iii) Besides minimizing the amplitudes of lower order harnonics, what is the other advantage of sinusoidal - triangle PWM technique. 2
- (5) Classify the ac voltage controllers and explain them in brief.