



RN-7409

**B. E. - IV (Sem. VII) (Electrical) Examination**  
**May / June - 2010**  
**Industrial Power Electronics**

Time : 3 Hours]

[Total Marks : 100

**Instructions :**

(1)

नीचे दशविवेक निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<b>B. E. - 4 (Sem. 7) (Electrical)</b>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<b>Industrial Power Electronics</b>	<input type="text"/>
Subject Code No. : <input type="text"/> 7 <input type="text"/> 4 <input type="text"/> 0 <input type="text"/> 9	Section No. (1, 2,.....): <input type="text"/> 1&2
	Student's Signature

- (2) Answer 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**

- Q.1 Answer the following questions in a sentence or two.**
- (a) List the turn on methods for triggering a thyristor. (1)
- (b) SCR can be turned off by removing gate supply. State true or false. Justify if true and correct if false. (2)
- (c) Snubber circuit is used for \_\_\_\_\_. Complete the statement. (1)
- (d) State the governing equation of dual converter which relates the firing angles of the two converters used in it. (1)
- (e) \_\_\_\_\_ device has features of both MOSFET and BJT. (1)
- (f) Derating of SCR is \_\_\_\_\_ for sine wave than square or rectangular wave. (1)
- (g) State the typical limiting value for  $di/dt$ . (1)
- (h) What is the typical value for the intrinsic stand-off ratio of an UJT. (1)
- (i) State the firing angle range of a full-controlled, full-bridge converter, for which it operates as a line commutated inverter. (1)
- Q.2**
- (a) Draw and explain the static V-I characteristics of an SCR. (5)
- (b) Draw the circuit diagram for a single phase fully controlled converter and explain its operation with relevant wave forms when operating with resistive load. (5)
- Q.3**
- (a) Discuss the need for a dual converter. Classify and explain the working of the dual converters. Also draw the relevant waveforms. (9)
- (b) A thyristor is connected in series with a resistance of 100 ohm and an ac supply of 230V at 50Hz. Compute the average current and power delivered if the thyristor is triggered at  $45^\circ$  in every positive half cycle. (6)

**OR**

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**[Contd...**

- Q.3** (a) Draw circuit diagram of line synchronized UJT triggering scheme and explain it with relevant waveforms. (8)
- (b) A single phase half wave controlled rectifier circuit is fed by a transformer whose secondary voltage is  $325\sin\omega t$  It supplies a resistance load of 20 ohm for the firing angle of  $45^\circ$  Calculate (7)
- dc voltage  $V_o$  and current  $I_o$
  - rms voltage  $V_{or}$  and current  $I_{or}$
  - the dc power  $P_{dc}$ , the ac power  $P_{ac}$  and rectification efficiency
  - form factor & ripple factor
  - Transformer utilization factor
- Q.4** Attempt any THREE from the following (15)
- Discuss the design procedure for Snubber circuits. Explanation related to the need of snubber is not required.
  - Write a brief note on the principle of operation and characteristics of Power MOSFET.
  - Discuss the effect of source inductance on the average output voltage for a single phase ac-dc converter.
  - Write a brief note on the heat sink selection.
  - Write a brief note on two-transistor analogy of an SCR.

### SECTION - II

- Q 4** Answer the following questions in a sentence or two.
- (a) Answer the terms in relation to inverter. (1)
- Define modulation index (1)
  - State two differences between VSI and CSI. (2)
  - What are the disadvantages of a single-phase half-bridge inverter as compared to the full-bridge inverter? (2)
- (b) For a step-down chopper, state the value of duty cycle for which the inductor current has a maximum ripple. (1)
- (c) Define duty-cycle in relation to chopper. (1)
- (d) Write the mathematical relation (formula) representing the output voltage of the step-down chopper in terms of the input voltage and the duty cycle. (1)
- (e) Which device(s) is/are popular for low power chopper applications? (1)
- (f) State the major disadvantage of an asymmetric AC voltage controller (1)
- Q 6** (a) Draw the output voltage waveform for a full-bridge inverter and obtain fourier series that represents the output voltage waveform. (5)
- (b) For a step-down chopper, derive an equation of representing the output voltage of the chopper in terms of its input voltage and switching frequency (or duty cycle). State the assumptions made during this derivation. (5)
- Q 7** (a) Where does one require a two-quadrant chopper? Draw a circuit diagram of a two-quadrant chopper and explain its operation in the two possible modes. (8)
- (b) A single phase half-bridge inverter feeds a resistive load of 10 ohms. When supplied from a DC source of 220V, determine (i) the rms output voltage at fundamental frequency (ii) the output power (iii) the average and peak currents of the switch (iv) the peak reverse blocking voltage and (v) the THD of the output voltage. (7)

OR

- Q 7** (a) Why is modulation required in inverter circuits? Describe sine-triangle PWM control technique for operating an inverter. Also discuss the relative merits of the scheme over the other the other PWM schemes. (9)
- (b) A single-phase bridge inverter delivers power to RLC load with  $R=3 \Omega$  and  $X_L=12 \Omega$ . The bridge operates with a periodicity of 0.2 ms. Calculate the value of C so that load commutation is achieved for the thyristors. Turn-off time for thyristors is  $12 \mu s$ . Factor of safety is 2. Assume the load current to contain only the fundamental component. (6)

- Q 8**      **Attempt any three from the following**      **(15)**
- 1) Explain the method of harmonic reduction by transformer connection.
  - 2) Write a brief note on the various control strategies of chopper.
  - 3) Draw the circuit representing the various modes of operation for current commutated chopper. Explanation is not required.
  - 4) 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) Write a brief note on the limitations of the power electronic devices and its use.
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