

**Code : 031709**

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**B.Tech 7th Semester Exam., 2017**

**POWER ELECTRONICS**

Time : 3 hours

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Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

✓ 121. Choose the correct option (any seven) :

2×7=14

- (a) In the SCR structure, the gate terminal is located
  - (i) near the anode terminal
  - ✓ (ii) near the cathode terminal
  - (iii) in between the anode and cathode terminal
  - (iv) None of the above
- (b) The latching current is \_\_\_\_\_ the holding current.
  - (i) lower than
  - ✓ (ii) higher than
  - (iii) same as
  - (iv) negative of

**( 2 )**

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- (c) When a diode is connected in series with an AC source and  $R$  load, the conduction time per cycle is
  - (i) 0
  - (ii)  $2\pi$
  - (iii)  $\pi$
  - (iv)  $\pi/2$
- (d) In a single-phase half-wave circuit with RL load and a freewheeling diode, the freewheeling period is
  - (i) 0 to  $\pi$  akubihar.com
  - (ii)  $\alpha$  to  $\pi + \alpha$
  - (iii)  $\pi$  to  $2\pi + \alpha$
  - (iv)  $\pi/2$  to  $2\pi - \alpha$
- (e) A three-phase three-pulse M-3 type controlled converter has firing angle for one of the SCRs set as  $15^\circ$ . This SCR would start conducting at
  - (i)  $0^\circ$
  - (ii)  $15^\circ$
  - (iii)  $30^\circ$
  - (iv)  $45^\circ$

( 3 )

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- (f) Find the output voltage for a step-up chopper when it is operated at a duty cycle of 50% and  $V_s = 240V$ .
- (i) 240 V
  - (ii) 480 V
  - (iii) 560 V
  - (iv) 120 V
- (g) In the 180° mode VSI, \_\_\_\_\_ devices conduct at a time.
- (i) 5                      (ii) 2
  - (iii) 3                    (iv) 4
- (h) In AC voltage controllers, the
- (i) variable AC with fixed frequency is obtained akubihar.com
  - (ii) variable AC with variable frequency is obtained
  - (iii) variable DC with fixed frequency is obtained
  - (iv) None of the above
- (i) The single-phase bridge-type cyclo-converter uses \_\_\_\_\_ number of SCRs.
- (i) 4                      (ii) 8
  - (iii) 6                    (iv) None of the above

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( 4 )

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- (j) A single full converter alone can give a
- (i) four-quadrant operation
  - (ii) three-quadrant operation
  - (iii) two-quadrant operation
  - (iv) None of the above

2. (a) Describe the different modes of operation of a thyristor with the help of its static V-I characteristic. 8
- (b) With the help of a neat diagram, explain the two-transistor analogy of an SCR. 6

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3. (a) Explain the working of an oscillator employing an UJT. Derive expression for the frequency of triggering. 7
- (b) A relaxation oscillator using a UJT is to be designed for triggering an SCR. The UJT has the following data :
- $\eta = 0.72$ ,  $I_P = 0.6 \text{ mA}$ ,  $V_P = 18V$ ,  
 $V_V = 1V$ ,  $I_V = 2.5 \text{ mA}$ ,  $R_{BB} = 5 \text{ k}\Omega$
- Normal leakage current with emitter open = 4.2 mA. The firing frequency is 2 kHz. For  $C = 0.04 \mu F$ , compute the values of  $R$ ,  $R_1$  and  $R_2$ . 7

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4. (a) A single-phase half-wave controlled converter is operated from a 120 V, 50 Hz supply. Load resistance  $R = 10\Omega$ . If the average output voltage is 25% of the maximum possible average output voltage, determine—
- (i) firing angle;
  - (ii) r.m.s. and average output currents;
  - (iii) average and r.m.s. SCR currents.

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6

- (b) Explain the operation of single-phase half-controlled bridge converter (symmetrical configuration) with resistive load along with suitable waveforms. Also derive the expressions for average load voltage, average load current and RMS load voltage.

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8

5. A three-phase fully controlled converter is connected to a resistive load. Show that the average output voltage is given by

$$E_{dc} = \frac{3\sqrt{3}}{2\pi} E_m \cos\alpha, \quad \text{for } 0 < \alpha < \frac{\pi}{6} \text{ and}$$

$$E_{dc} = \frac{3}{2\pi} E_m \left[ 1 + \cos\left(\alpha + \frac{\pi}{6}\right) \right], \quad \text{for } \frac{\pi}{6} < \alpha < \frac{5\pi}{6}$$

14

6. (a) With the help of neat circuit diagram and associated waveforms, explain the operation of single-phase half-bridge voltage-source inverter with resistive load.
- (b) The single-phase half-bridge inverter has a resistive load of  $10\Omega$  and the center-tap DC input voltage is 96 V. Compute—
- (i) RMS value of the output voltage;
  - (ii) fundamental component of the output voltage waveform;
  - (iii) first five harmonics of the output voltage waveform;
  - (iv) RMS power consumed by the load.
8. (a) Draw the schematic of step-down and step-up choppers and derive an expression for output voltage in terms of duty cycle for a step-up and step-down choppers.
- (b) Draw the schematic of class E chopper and explain the working of the same.
8. Describe the basic principle of working of a single-phase to single-phase cycloconverter for both continuous and discontinuous conduction for a bridge-type cycloconverter. Mark the condition of various thyristors also.

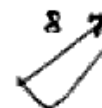
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9. (a) For a single-phase full-wave a.c. voltage controller feeding a resistive load, draw the waveforms of source voltage, gating signals, output voltage, source and output currents and voltage across SCRs. Describe its working with reference to the waveforms drawn. 10

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- (b) A single-phase full-wave a.c. voltage controller feeds power to a resistive load of  $4\ \Omega$  from 230 V, 50 Hz source. Determine the peak values of average and RMS thyristor currents for any firing angle  $\alpha$ . 4

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