Code : 031609

B.Tech 6th Semester Exam., 2016

POWER ELECTRONICS

Time : 3 hours *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.*

1. Choose the correct option (any *seven*) : 2×7=14

(a) A single-phase one pulse diode rectifier is feeding an RL load with freewheeling diode across the load. For conduction angle β, the main diode and freewheeling diode would, respectively, conduct for

(i) π, $\pi - \beta$

(ii) π, $\beta - \pi$

(iii) β, π

(iv) $\beta - \pi$, π

(b) When a thyristor is forward biased, the number of blocked *p-n* junctions is

(i) 1

(ii) 2

(iii) 3

(iv) 4

(c) During forward blocking state, a thyristor is associated with

(i) large current, low voltage

(ii) low current, large voltage

(iii) medium current, large voltage

(iv) low current, medium voltage

(d) When a UJT is used for triggering an SCR, the wave shape of the voltage obtained from UJT circuit is a

(i) sine wave

(ii) sawtooth wave

(iii) trapezoidal wave

(iv) square wave

(e) In a commutation circuit employed to turn off an SCR, satisfactory turn-off is obtained when

(i) circuit turn-off time < device turn-off time

(ii) circuit turn-off time > device turn-off time

(iii) circuit time constant > device turn-off time

(iv) circuit time constant < device turn-off time

(f) A step-up chopper has V_s as the source voltage and α as the duty cycle. The output voltage for this chopper is given by

(i) $V_s(1+\alpha)$

(ii) $V_s/(1-\alpha)$

(iii) $V_s(1-\alpha)$

(iv) $V_s/(1+\alpha)$

(g) In an inverter with fundamental output frequency of 50 Hz, if third harmonic is eliminated, then the frequencies of other components in the output voltage wave, in Hz, would be

(i) 250, 350, 450, high frequencies

(ii) 50, 250, 350, 450

(iii) 50, 250, 350, 550

(iv) 50, 100, 200, 250

(h) A cycloconverter is a frequency converter from

1. higher to lower frequency with one-stage conversion
2. higher to lower frequency with two-stage conversion
3. lower to higher frequency with one-stage conversion
4. AC at one frequency to DC and then DC to AC at different frequencies

From these, the correct statement(s) is/are

(i) 2, 4

(ii) 1 only

(iii) 2, 3

(iv) 1, 3

(i) If, for a single-phase half-bridge inverter, the amplitude of output voltage is V_s and the output power is P, then their corresponding values for a single-phase full-bridge inverter are

(i) V_s, P

(ii) $2V_s$, P

(iii) $2V_s$, $2P$

(iv) $2V_s$, $4P$

(j) In DC choppers, the waveforms for input and output voltages are respectively

(i) discontinuous, continuous

(ii) both continuous

(iii) both discontinuous

(iv) continuous, discontinuous

2. (a) Briefly discuss the *V-I* characteristic of SCR. 6

(b) Explain the turn-on and turn-off characteristics of SCR with neat waveforms. 8

3. *(a)* Explain the operation of three-phase half-wave controlled converter for a firing angle less than 30° and feeding *R* load. Also derive the expression for its average output voltage. 8

(b) The specification sheet for an SCR gives maximum rms on-state current as 35 A. If this SCR is used in a resistive circuit, compute average on-state current rating for half sine wave current for conduction angle of 180°. 6

4. *(a)* Explain the effect of source inductance in the operation of single-phase fully controlled converter. 8

(b) With neat circuit diagram and waveform, explain the working principle of single-phase AC voltage controller with *R-L* load. 6

5. *(a)* Explain the principle of operation of three-phase inverter with 180° conduction mode with necessary waveforms and circuit. 8

(b) A step-up chopper has input voltage of 220 V and output voltage of 660 V. If the conducting time of thyristor-chopper is 100 μs, compute the pulse width of output voltage. In case output-voltage pulse width is halved for constant frequency operation, find the average value of new output voltage. 6

6. *(a)* Explain the two-transistor analogy of a thyristor. 7

(b) Discuss the various mechanisms that can be used to trigger thyristors. 7

7. *(a)* Discuss the operation of step-up chopper and prove that its output voltage is greater than input voltage. 8

(b) Snubber circuit for an SCR should primarily consist of capacitor only. But, in actual practice, a resistor is used in series with capacitor. Discuss. 6

8. *(a)* With neat circuit diagram and waveform, explain the operating principle of 1-ϕ to 1-ϕ step down mid-point type cycloconverter, with continuous load current. Assume the loads to be *R* and *L* in series. 8

(b) A single-phase half-wave AC voltage controller feeds a load of $R = 20\ \Omega$ with an input voltage of 230 V, 50 Hz. Firing angle of thyristor is 45°. Determine—

(i) rms value of output voltage;

(ii) average input current. 6

9. Briefly discuss the different types of PWM schemes available for voltage control in an inverter. 14

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