B.Tech.
(SEM. V) ODD SEMESTER THEORY EXAMINATION, 2015-16
POWER ELECTRONICS

Time : 3 Hours   **Max. Marks : 100**

SECTION – A

1. Attempt all the questions. $(2 \times 10 = 20)$

   a. Discuss the techniques which result in random turn-ON of a thyristor.

   Ans. Refer Q. 1.2, Page SQ–1A, 2 Marks Questions, Unit-1.

   b. A forward voltage is applied to an SCR soon after reverse recovery current drops nearly to zero value. Discuss, in brief, what would happen to SCR ?

   Ans. Refer Q. 1.3, Page SQ–1A, 2 Marks Questions, Unit-1.

   c. A step down chopper switched at 1 kHz with a duty ratio $\alpha = 0.5$. Find out the peak to peak ripple in load current.

   Ans. Refer Q. 2.13, Page SQ–6A, 2 Marks Questions, Unit-2.

   d. A number of SCRs each with a rating of 2000 V are to be used in series to handle 11 kV. For a derating factor of 0.2, calculate the number of SCRs to be used in string.

   Ans. Refer Q. 2.6, Page SQ–5A, 2 Marks Questions, Unit-2.

   e. Show the variation of converter output average voltage as a function of firing angle for
   i. semi- converter and
   ii. full converter.

   Ans. Refer Q. 3.7, Page SQ–9A, 2 Marks Questions, Unit-3.

   f. Discuss the advantages of using freewheeling diode in phase controlled rectifiers.

   Ans. Refer Q. 3.4, Page SQ–8A, 2 Marks Questions, Unit-3.

   g. What is the disadvantage of using pulse gating scheme in AC voltage controller when the load is R-L ?

   Ans. Refer Q. 4.6, Page SQ–12A, 2 Marks Questions, Unit-4.

   h. What is a cycloconverter ? Enumerate some of its industrial applications.

Ans. Refer Q. 4.9, Page SQ–12A, 2 Marks Questions, Unit-4.

i. **What is the purpose of connecting diodes in antiparallel with thyristors in inverter circuits ?**

Ans. Refer Q. 5.4, Page SQ–14A, 2 Marks Questions, Unit-5.

j. **What is a line commutated inverter ?**

Ans. Refer Q. 5.2, Page SQ–14A, 2 Marks Questions, Unit-5.

SECTION – B

Attempt any five of the following. $(10 \times 5 = 50)$

2. a. **Explain the two transistor analogy of thyristor and derive the expression of anode current.**

Ans. Refer Q. 1.22, Page 1–27A, Unit-1.

b. **The SCR has $V_g - I_g$ characteristics given as $V_g = 1.5 + 8 I_g$. In a certain configuration, the gate voltage consists of rectangular pulses of 12 V and of duration 50 µs with duty cycle of 0.2.**

i. **Find the value of R_g series resistor in gate circuit to limit peak power dissipation in the gate circuit to 5 W.**

ii. **Calculate the average power dissipation in the gate circuit.**

Ans. Refer Q. 1.24, Page 1–29A, Unit-1.

3. **Why does unequal sharing takes place among series connected SCRs during steady state and dynamic state ? Draw the static and dynamic equalizing circuits for two series connected SCRs.**

Ans. Refer Q. 2.11, Page 2–18A, Unit-2.

4. **Describe the principle of step up chopper. Derive an expression for the average output voltage in terms of input voltage and duty cycle. A step up chopper has output voltage of two to four times the input voltage. For a chopping frequency of 2000 Hz, determine the range of off-periods for the gate signal.**

Ans. Refer Q. 2.19, Page 2–29A, Unit-2.

5. **A single-phase semi-converter connected to 230 V, 50 Hz source is feeding a load $R = 10$ ohms in series with a large inductance that makes the load current ripple free. For a firing angle of 45 degree, calculate the output performance parameters of this converter.**

Ans. Refer Q. 3.11, Page 3–16A, Unit-3.

6. **Describe the working of a single-phase fully controlled bridge converter in the rectifying and inversion mode, with the help of relevant waveform. Derive the expressions for average output voltage and rms output voltage.**

Ans. Refer Q. 3.9, Page 3–12A, Unit-3.

7. **Discuss the operation of a 1ϕ AC voltage controller with R-L load, when firing angle is less than or equal to load phase angle. Show that for firing angle less than load phase angle, output voltage of AC voltage controller cannot be regulated.**

Ans. Refer Q. 4.6, Page 4–9A, Unit-4.

8. **Discuss the neat circuit diagram of 3ϕ to 1ϕ cycloconverter feeding R-L load. Draw the output voltage waveforms.**

Ans. Refer Q. 4.13, Page 4–25A, Unit-4.

9. **Describe with neat circuit diagram and relevant waveforms, the working of a series inverter. Also indicate the merits and demerits of this inverter.**

Ans. Refer Q. 4(b), Page SQ–5A, Solved Paper 2013-14.

SECTION – C

Note : Attempt any two questions from this section. $(15 \times 2 = 30)$

10. **Discuss the effect of source inductance on the performance of a three-phase full converter with the help of phase voltage waveforms. Indicate the sequence of conduction of various thyristors and sketch load current waveforms. Derive an expression for its output voltage in terms of supply voltage, source inductance, load current etc.**

Ans. Refer Q. 3.20, Page 3–28A, Unit-3.

11. **Describe with neat circuit diagram and relevant waveforms the working of three-phase bridge inverter under 180° mode of conduction for a balanced star connected resistive load. Also state its merits and demerits over 120° mode.**

Ans. Refer Q. 5.5, Page 5–10A, Unit-5.

12. **Write short notes on :**

a. **Desired characteristics of a controllable switch.**

Ans. Refer Q. 1.4, Page 1–4A, Unit-1.

b. **Working of a class D chopper in first and fourth quadrant.**

Ans. Refer Q. 2(a), Page SQ–2A, Solved Paper 2013-14.

c. **Integral cycle control in AC controllers.**

Ans. Refer Q. 4.1, Page, 4–2A, Unit-4.

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