BIEE-024

B.Tech. – VIEP – ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

June, 2016

00226

BIEE-024 : POWER ELECTRONICS

Time : 3 hours   *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Missing data may be suitably assumed. Use of scientific calculator is permitted.*

1. (a) Explain the I – V characteristics of SCR.   5

 (b) What is the difference between a thyristor and a TRIAC ? Draw and explain the V – I characteristics of TRIAC.   5

2. (a) What is reverse recovery time of the power semiconductor diode ? The forward voltage drop of a power diode is $V_D = 1.2$ V at $I_D = 300$ A. Assuming that n = 2 and $V_T = 25.7$ mV, find the reverse saturation current (I_S).   5

 (b) What is the purpose of dv/dt protection ? What is the common method of dv/dt protection ?   5

3. (a) Differentiate between semi-converter and full converter circuit. Draw any one semi-converter and full-converter circuit. *5*

(b) Explain gate trigger controller circuit of SCR. *5*

4. Draw the two-transistor model of a thyristor. Explain the turn-off and turn-on characteristics of a thyristor. *5+5*

5. Ten thyristors are used in a string to withstand a d.c. voltage of V_s = 15 kV. The maximum leakage current and recovery charge differences of the thyristors are 10 mA and 150 μC, respectively. Each thyristor has a voltage-sharing resistance of R = 56 kΩ and capacitance of C_1 = 0·5 μF. Determine

(a) the maximum steady state voltage sharing $V_{DS\ (max)}$,

(b) the steady state voltage derating factor,

(c) the maximum transient voltage sharing $V_{DT\ (max)}$, and

(d) the transient voltage derating factor. *10*

6. Draw and explain the working of a single-phase dual converter. Also draw its V – I characteristics. What is the cause of circulating current in dual converters ? *5+3+2*

7. What are the main effects of source inductance for a full-converter ? A three-phase full-converter is fed by 400 volts, three-phase, 50 Hz supply. The average load current is 150 A and the load is highly inductive. For a firing angle of 60°, find the output power, average output voltage, rms and peak current through the thyristors and peak inverse voltage. *3+7*

8. With the help of a neat circuit diagram and waveforms, explain briefly the operation of a transistorised 3-phase bridge inverter with resistive load in 180° conduction mode. *10*

9. Circuit in Figure 1 employing complementary commutation has V_s = 200 V, R_1 = 10 Ω and R_2 = 100 Ω. Determine the

    (a) peak value of current through thyristors T_1 and T_2,

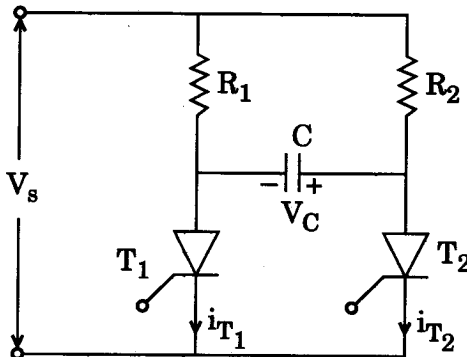   (b) value of capacitor C if each thyristor has a turn-off time of 40 μs. Take a factor of safety 2. *10*

Figure 1

10. Write short notes on any *two* of the following : *2×5=10*

    (a)   Thyristor Firing Circuits

    (b)   Series and Parallel Connections of Diode

    (c)   Impulse Commutation

    (d)   Sinusoidal Pulse Width Modulation (SPWM)

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