5E3123

B.Tech. Vth Semester (Main/Back) Examination, Dec. 2010/Jan. 2011
Electrical Engineering
5EE1 Power Electronics - III (Common with 5EX1)

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 24

Instructions to Candidates:

*Attempt overall **five questions** selecting **one question from each unit**. All questions carry **equal marks**. (Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.)*

Use of following supporting material is permitted during examination. (Mentioned in form No. 205).

1.   Graph Papers.

Unit - I

1. a) What is IGBT? What are its other names? Give its basic structure and working. (8)

    b) Explain the constructional details and working of low power MOSFET and power MOSFET and bring out the differences between two. (8)

OR

2. a) How does a GTO differs from a conventional thyristor. Give its circuit symbol and static V-I characteristics. Under what conditions, it may work as a low gain transistor? (8)

    b) Discuss the two transistor model of thyristor. (8)

Unit - II

3. a) Draw switching (or dynamic) characteristics of a thyristor during its turn on and turn off processes. Show the variation of voltage across the thyristor and current through it during these two dynamic processes. Indicate clearly the various intervals into which turn-on and turn off times can be subdivided. (8)

(1)   [Contd....

b) Define string efficiency for series/parallel connected SCR's show that string efficiency of two series connected SCRs is usually less than one. Derive an expression for the resistance used for static voltage equalization for a series connected string. **(8)**

OR

4. a) Discuss how a thyristor may be subjected to internal and external overvoltages. Describe the methods adopted for suppressing such overvoltages in thyristor systems. **(8)**

b) Explain the working of an oscillator employing an VJT. Derive expressions for the frequency of triggering and firing angle delay in terms of eta and charging resistance. **(8)**

Unit - III

5. a) A single phase one pulse SCR controlled converter feeds an RL load with a freewheeling diode across the load. Discuss how freewheeling diode comes into play when supply voltage is passing through zero and becoming negative. Sketch waveforms for supply and load voltages, load current, supply current, freewheeling diode current and voltage across the SCR. **(8)**

b) A 230 V, 50 Hz, one pulse SCR controlled converter is triggered at a firing angle of 40° and load current extinguishes at an angle of 210°. Find the circuit turn off time, average output voltage and average load current for

   i) $R = 5\Omega$ and L = 2 mH

   ii) $R = 5\Omega$, L = 2 mH and E = 110V. **(8)**

OR

6. a) Describe the operation of a single phase two pulse mid point converter with relevant voltage and current waveforms. Discuss how each SCR is subjected to a reverse voltage equal to double the supply voltage in case turns ratio from primary to each secondary is unity. **(8)**

b) For a 3 phase full converter, explain how the output voltage wave, for a firing angle of 30° is obtained by using phase voltages. **(8)**

Unit - IV

7. a) Explain the extinction angle control scheme used for power factor improvement in converters. **(8)**

b) Discuss the effect of source inductance on the performance of a single phase full converter indicating clearly the conduction of various thyristors during one cycle. Derive expressions for its output voltage in terms of

   i) maximum voltage V_m, firing angle α and overlap angle and

   ii) V_m, α_r, L_s and load current I_o. Here L_s is the source inductance. **(8)**

OR

8. a) Explain sinusoidal pulse width modulation control scheme used for power factor improvement in converters. **(8)**

b) A single phase semiconverter bridge feeds RLE load. Discuss how freewheeling diode comes into operation and holds the output voltage to almost zero for a given firing angle delay. Sketch the time variation of supply voltage, E, load voltage and current, freewheeling diode current and current through each pair consisting of SCR and diode. Find also the circuit turn off type. Assume the load current continuous. **(8)**

Unit - V

9. a) Describe the principle of step up chopper. Derive an expression for the average output voltage in terms of input dc voltage and duty cycle. State the assumptions made. **(8)**

b) A step up chopper has input voltage of 220 V and output voltage of 660 V. If the non conducting time of thyristor chopper is 100 μs, compute the pulse width of output voltage. In case pulse width is halved for constant frequency operation, find the new output voltage. **(8)**

OR

10. a) What are the four basic types of switching mode regulators. Explain the working principle of buck regulator with neat sketches and necessary derivations. **(8)**

b) The buck regulator has an input voltage of V_s =12V. The required average output voltage is V_a = 5V at R = 500Ω and the peak to peak output ripple voltage is 20 mV. The switching frequency is 25 KHz. If peak-to-peak ripple current of inductor is limited to 0.8 A, determine

   i) Duty cycle

   ii) The filter inductance and

   iii) The filter capacitor. **(8)**