W 2682

M.E. DEGREE EXAMINATION, JANUARY 2007.

First Semester

Power Electronics and Drives

PE 1602 — ADVANCED POWER SEMICONDUCTOR DEVICES

(Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What do you mean by on–state and switching losses?

2. List a few members of thyristor family.

3. Define turn–on and turn–off times as applied to power MOSFET.

4. Give any two differences between BJT and power MOSFET.

5. What are the advantages of GTO over thyristor?

6. List various mounting techniques for power semiconductor devices.

7. A thyristor is triggered by a train of pulses of frequency 4 KHz and of duty cycle 0.2. Calculate the pulse width.

8. How do you relate thermal and electrical quantities?

9. What is the difference between RCT and FCT?

10. What are the problems associated with the parallel operation of power electronic devices?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Describe different modes of operation of a power diode with the help of its static V-I characteristics. (8)

(ii) Draw the dynamic characteristic curve and explain the switching nature of power diode. (8)

Or

(b) Explain in detail the following terms :

(i) Safe operating area

(ii) On–state losses and switching losses

(iii) E.M.I. due to switching

(iv) Rating of the switching device. (4 + 4 + 4 + 4)

12. (a) (i) Describe with a sketch the effect of gate current on the forward breakover voltage of an SCR. (6)

(ii) Show that string efficiency of two series connected SCRs is usually less than one. (6)

(iii) What are converter grade and inverter grade thyristors? (4)

Or

(b) (i) Compare BJT and thyristor. (8)

(ii) Derive an expression for the resistance and capacitance in the equalizing circuit of series connected SCRs. (8)

13. (a) (i) Explain the construction and principle of power MOSFET. (8)

(ii) Draw and explain steady state and dynamic models of MOSFET. (8)

Or

(b) Explain the features of

(i) GTO

(ii) MCT

(iii) FCT

(iv) RCT. (4 + 4 + 4 + 4)

(a) (i) List the various abnormal conditions against which thyristors must be protected. (8)

(ii) Discuss with the help of a circuit diagram the functions of various components used for the protection of gate circuit. (8)

Or

(b) (i) Draw the gate drive circuit for MOSFET and explain its operation. (8)

(ii) Describe electronic crowbar protection scheme employed for the overcurrent protection of power converters. (8)

15. (a) (i) Define conduction, convection and radiation. (6)

(ii) Write a note on liquid cooling and vapour phase cooling. (10)

Or

(b) (i) What are the different types of heat sinks and explain the method of designing heat sinks for power electronic devices. (10)

(ii) What is thermal resistance? Draw the thermal equivalent circuit for an SCR and discuss the various parameters involved in it. (6)