Reg. No. | | | | | | | | | | | | |

Question Paper Code : 66273

M.E. DEGREE EXAMINATION, DECEMBER 2015/JANUARY 2016

First Semester

Power Electronics and Drives

PX7104 : ADVANCED POWER SEMICONDUCTOR DEVICES

(Regulations – 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. What is an ideal switch ?
2. What are the parameters that affect the life time and performance of power semiconductor devices ?
3. What are converter grade and inverter grade thyristors ?
4. Brief the phenomenon of secondary breakdown in BJTs.
5. What are the features of Field Controlled Thyristors ?
6. Sketch the VI characteristics of MCT.
7. How the gate of a thyristor is protected against over voltages and over currents ?
8. Give the comparison between BJT and MCT in terms of gate circuit.
9. Give the significance of intelligent power modules.
10. The provision of heat sink improves the heat dissipation capability of the power device. Justify by modeling the system.

PART – B (5 × 13 = 65 Marks)

11. (a) Explain the steady state and reverse recovery characteristics of a power diode. **(13)**

OR

(b) (i) Explain the EMI phenomenon due to switching. What are the different methods to reduce it ? **(7)**

(ii) Differentiate static and dynamic behavior of a static and dynamic switch and explain how a practical switch deviates from an ideal switch behavior. **(6)**

12. (a) Explain the two transistor transient model of a thyristor. **(13)**

OR

(b) Explain the switching characteristics of BJT and give the reason for storage time in power transistors. **(13)**

13. (a) (i) Elaborately explain the turn-on and turn-off process of a power MOSFET. (7)

(ii) Explain with a neat diagram the structure of an IGBT. (6)

OR

(b) (i) Explain the basic principle of operation of a GTO. (6)

(ii) What are the factors to be considered while operating MOSFETs in parallel ? (7)

14. (a) (i) What is the need for isolating power circuit and control circuit ? Explain the principle of operation of an optocoupler in isolating power electronic circuits. (6)

(ii) What is a snubber circuit ? Give the design procedure of a snubber circuit for a thyristor. (7)

OR

(b) (i) A micro-controller gives a square wave signal with an amplitude of 5V at 10 kHz. It is to be applied to an IGBT switch. Draw and explain a driver circuit for an IGBT. (7)

(ii) Explain the use of pulse transformer and pulse amplifier in a control circuit. (6)

15. (a) (i) Explain in detail, with the help of neat sketch, the electrical equivalent circuit of thermal model of a power device. (6)

(ii) Explain the various thyristor mounting techniques with diagrams. (7)

OR

(b) Explain the various types of heat sinks, the parameters for heat sink selection and the design of heat sinks. (13)

PART – C (1 × 15 = 15 Marks)

16. (a) (i) Two thyristors are connected in parallel to share a total load current of 600 A. The ON state voltage drop of one thyristor is 1V at 300A and that of other thyristor is 1.5 V at 300 A. Determine the values of series resistances to force current sharing with 10% difference. Total voltage is 2.5 V. (5)

(ii) Explain the terms (i) Reverse recovery time (ii) Peak inverse current and (iii) S-factor. Also derive the expressions for reverse recovery time and peak inverse current. (10)

OR

(b) (i) What are the causes of latch-up in an IGBT ? How it can be avoided ? (5)

(ii) Explain the terms thermal resistance and thermal impedance in detail and give its significance. (5)

(iii) The β of a bipolar junction transistor varies from 12 to 75. The load resistance is 1.5 Ω. The DC supply voltage is 40V and the input voltage to the base circuit is $V_B = 6$ V. If $V_{CE(sat)} = 1.2$ V, $V_{BE(sat)} = 1.6$ V and $R_B = 0.7\ \Omega$, determine (a) the over drive factor (b) the forced β and (c) the power loss in the transistor. (5)

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