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Question Paper Code : 13935

M.E. DEGREE EXAMINATION, JANUARY 2015.

First Semester

Power Electronics and Drives

PX 7104 — ADVANCED POWER SEMICONDUCTOR DEVICES

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by softness factor of a diode?
2. Schottky diodes have no turn on transient and very little turn off transient. Comment on this statement.
3. Why is the current gain of a power transistor relatively small? Give the required modifications to improve the same.
4. What are the different types of thyristors?
5. What are the advantages of IGBTs over MOSFETs and BJTs?
6. What is meant by 'latch- up' mode of an IGBT?
7. How can the gate of a thyristor be protected against over voltages and over currents?
8. What is the need for isolating the control circuit from the power circuit?
9. What are the advantages of using intelligent power modules?
10. What are the precautions to be taken while mounting a device on a heat sink?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Classify the power diodes. (4)

(ii) Explain the static and dynamic characteristics of a power diode. (12)

Or

(b) (i) Define safe operating area (SOA). Sketch the SOA for any one power device. (4)

(ii) Explain in detail about the device selection strategy based on the power rating of the load. (8)

(iii) Sketch the waveforms of voltage, current, and power during turn On and turn Off for a non-ideal switch. (4)

12. (a) Draw the VI characteristics of an NPN power transistor and discuss quasi saturation effect.

Or

(b) (i) Explain the need for static and dynamic equalizing circuits for series connected SCRs. (10)

(ii) Explain the turn-on mechanism of the thyristor using two transistor analogy and obtain the condition for turn-on and turn-off. (6)

13. (a) (i) Draw the MOSFET circuit model during cut-off mode, saturation mode and ohmic mode of operation. (6)

(ii) Draw the switching characteristics of IGBT and compare the same with MOSFET. (10)

Or

(b) (i) With the help of a neat structural diagram and suitable waveforms, explain the operation of an IGBT. (10)

(ii) What is MCT? Discuss its advantages over other devices. (6)

14. (a) (i) What are the various gate drive circuits for a thyristor? Explain how the gate gets triggered with a high dv/dt. (8)

(ii) What is a snubber circuit? How does it protect a thyristor from over voltages? (8)

Or

(b) (i) What are the base drive techniques for increasing switching speeds of power transistors? Explain any one technique with a diagram. (8)

(ii) Discuss the protection method employed to protect the SCR from transient and over currents. (8)

15. (a) How will you calculate the average power loss in a semiconductor switch. How does the heat sink selection is made for a particular rating of a fast recovery power diode?

Or

(b) (i) Explain how the selection of a particular heat sink affects the $I_{F(av)}$ rating of a thyristor. (8)

(ii) A thyristor with its heat sink has a thermal resistance of 0.5°C/W steady state and 100ms value of 0.065°C/W. What power loss can the thyristor tolerate for 100ms? The junction temperature should not exceed 125°C with an ambient temperature of 35°C. If the power loss is 400W, what is the 100ms value of thermal resistance? (8)
