(Pages : 3) **8690**

Reg. No. : .....

Name : .....

Combined First and Second Semester B.Tech Degree Examination, December 2015
(2013 Scheme)
13.109 SEMICONDUCTOR DEVICES (AT)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **2** marks.

1. Show the energy bond structure of metal, dielectrics and a semiconductor.
2. Electrical neutrality must be satisfied in a Semiconductor. Justify.
3. Illustrate the effect of doping an intrinsic semiconductor by an external n type impurity atom.
4. What kind of mechanisms cause current flow in a PN junction diode ?
5. Show the energy bond diagram of ohmic and rectifying contacts.
6. Briefly explain the avalanche multiplication in collector base junction of a NPN transistor.
7. What is the effect of real surfaces in MOS capacitor ?
8. How does a solar all work ?
9. State the principle of operation of Hetero junction LED.
10. Draw the structure and equivalent circuit of VJI. **(10×2=20 Marks)**

PART – B

Answer **one** question from **each** Module. **Each** question carries **20** marks.

Module – I

11. a) Explain the energy momentum relation for electrons in solids.

    b) Explain when does a doped semiconductor make a transition from extrinsic behavior to intrinsic behavior. Find the temperature for silicon doped with boron at 3.0E + 15 cm^{-3}. Use Eg = 1.12 eV, Nc = 2.78 × 10^{25} m and Nv = 9.84 × 10^{24} m^{-3} to estimate the transition temperature.

12. a) Derive Einstein relation for holes in the valence band.

    b) Explain High field effects in semiconductors.

Module – II

13. a) Find the builtin potential for a p-n Si junction at room temperature if the bulk resistivity of Si is 1 Ω cm. Electron mobility in Si at RT is 1400 cm^2 V^{-1}, μn / μp = 3.1, ni = 1.05 × 10^{10} cm^{-3}. Also calculate the width of the space charge region of the applied voltage V = – 10, 0 and 0.3V, ε Si = 11.9.

    b) Describe the zener break down in detail.

14. a) For a $p^+ – n$ Si junction with $N_d = 10^{16}$ cm^{-3}, the break down voltage is 32V. Calculate the maximum electric field at the break down. ε Si = 11.9.

    b) Explain the energy bond diagram, operation and application of Hetero junctions.

Module – III

15. a) Explain why are junction transistors called bipolar devices and why BJT is not suitable at very low temperature.

    b) Draw the structure of a PNP bipolar transistor. Explain :

    i) What are the doping levels of E, B and C ?

    ii) How does the doping affect the emitter efficiency and the base transport factor ?

    iii) Define Punch Through and Latch up.

16. a) Discuss about MOS capacitor.

b) An n channel Si JFET has a donor concentration of $2 \times 10^{21}/m^3$ and a channel width of 4μ m. If the dielectric constant of Si is 12. Find the Pinch off voltage. If the FET operates with Vgs as – 2V, Find V_{Dsat}.

Module – IV

17. a) Explain the significance of channel length modulation, velocity saturation and Body effect in MOSFET.

b) Discuss about light absorbing properties of materials and operation of photo detectors.

18. a) Explain the operation and static characteristics of DIAC and IGBT.

b) At room temperature an ideal solar cell has a short circuit current of 2A and an open circuit voltage of 0.5V. How does the open circuit voltage change if the short circuit current drops by a factor of 2, 5 or 10 ? **(4×20=80 Marks)**