



(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 band 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 band 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 cell work ?
9. State the principle of operation of Hetero junction LED.
10. Draw the structure and equivalent circuit of VJL. **(10×2=20 Marks)**

P.T.O.



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 $3.0E + 15 \text{ cm}^{-3}$. Use $E_g = 1.12 \text{ eV}$, $N_c = 2.78 \times 10^{25} \text{ m}$ and $N_v = 9.84 \times 10^{24} \text{ m}^{-3}$ 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 built-in potential for a p-n Si junction at room temperature if the bulk resistivity of Si is $1 \Omega \text{ cm}$. Electron mobility in Si at RT is $1400 \text{ cm}^2 \text{ V}^{-1}$, $\mu_n/\mu_p=3.1$, $n_i = 1.05 \times 10^{10} \text{ cm}^{-3}$. Also calculate the width of the space charge region of the applied voltage $V = -10, 0$ and 0.3V , $\epsilon_{\text{Si}} = 11.9$.
b) Describe the zener break down in detail.
14. a) For a $p^+ - n$ Si junction with $N_D = 10^{16} \text{ cm}^{-3}$, the break down voltage is 32V . Calculate the maximum electric field at the break down. $\epsilon_{\text{Si}} = 11.9$.
b) Explain the energy band diagram, operation and application of Hetero junctions.

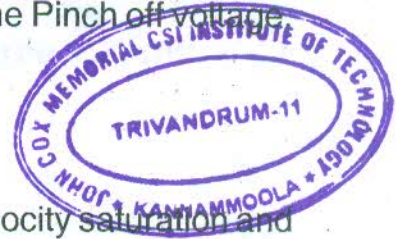
Module – III

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 $2 \times 10^{21}/\text{m}^3$ and a channel width of $4 \mu\text{m}$. If the dielectric constant of Si is 12. Find the Pinch off voltage. If the FET operates with V_{gs} 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)**