Reg. No. : .....

Name : .....

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D – 5360

Combined First and Second Semester B.Tech. Degree Examination, March 2018
(2013 Scheme)
13.109 : SEMICONDUCTOR DEVICES (AT)

Time : 3 Hours

Max. Marks : 100

PART – A

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

1. Determine the values of n_o and p_o for Si at 300 K, if the fermi level is 0.22 eV above the valence band energy. Given $n_i = 1.5 \times 10^{10}/cm^3$.
2. What is Hall coefficient ? Mention its application.
3. How does a p-n junction capacitance differ from simple metal plate dielectric capacitor ?
4. Draw the hole and electron current components in a PN junction under forward bias and reverse bias.
5. A BJT with $\beta = 74$ is connected in the common base configuration. What will be the maximum collector current for an emitter current of 5 mA ?
6. Draw the energy band diagram of a MOS capacitor under conditions of accumulation and inversion.
7. Can a solar cell be used in place of photo diode or vice versa ? Justify your answer.
8. Why UJT is said to have a negative resistance region in characteristics.
9. A certain semiconductor has an energy gap of 2.48 eV. Determine the range of wavelengths that are a) absorbed and b) transmitted by semiconductor.
10. Define the terms μ, g_m and r_d in case of FETs. How are they related ?

(10×2=20 Marks)

P.T.O.

PART – B

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

Module – 1

11. a) Prove that at equilibrium, fermi level is invariant at a junction of any two materials.
    b) A sample of Si is doped with 10^{17} Phosphorous atoms/cm^3. What is the Hall voltage if sample has thickness 100μm and current along length 1 mA and axial magnetic field is 10^{-5} Wb/cm^2. Find the resistivity of the sample.
12. a) Derive continuity equation for p type material.
    b) Why do mobility and effective mass of electrons and holes differ even though they have equal magnitude of charge ?

Module – 2

13. a) Write down the expression for voltage current characteristic of a p-n junction diode. Why does reverse saturation current vary with temperature ? How does applied bias affect reverse current ?
    b) A Ge p-n diode has $N_a = 5 \times 10^{17}/cm^3$ and $N_d = 10^{17}/cm^3$. Calculate the built in voltage at 300 K. At what temperature does the built in voltage decrease by 1% ?
14. a) In a p-n junction diode, how do majority and minority carriers contribute towards total current ?
    b) A planar p^+–n Silicon diode has a n-side doping of $N_d = 10^{15}/cm^3$ at T = 300 K. Determine (i) approximate break down voltage of diode (ii) depletion width at break down voltage.

Module – 3

15. a) Explain the CV characteristics of MOS capacitor.
    b) A MOS capacitor has p type Silicon with uniform doping of $N_a = 10^{17}/cm^3$. Calculate the surface potential needed to cause strong inversion.
16. a) How does BJT amplify signals ? What is the role of base width in amplification ?
    b) An n-p-n transistor has a base transport factor of 0.998, an emitter injection efficiency of 0.997 and I_{cp} = 10 nA. (i) calculate CE and CB current gains. (ii) if $I_B = 0$, what is I_c ?

Module – 4

17. a) What do you mean by hot electron effect ? How can it be minimised ?
    b) Explain the characteristics of UJT with the help of structure and equivalent circuit. Can UJT be used as an amplifying device ?
18. a) How is heterojunction LED better than homojunction LED ?
    b) Explain the rectifying action of SCR. Compare it with the rectifying action of p-n diode with the help of waveforms. **(4×20=80 Marks)**