Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

BSCP 1207

Third Semester Back Examination – 2014

PHYSICS OF SEMICONDUCTOR DEVICES

BRANCH(S) : AEIE, BIOTECH, CSE, EC, EEE, EIE, ELECTRICAL, ETC, IEE, IT

QUESTION CODE : L 344

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

(a) Define Compensated semiconductor.

(b) Write the relation between Fermi – Dirac function and Maxwell Boltzmann approximation.

(c) Determine the total number of energy states in GaAs between E_c and $E_c + kT$ at $T = 300K$.

(d) What is meant by effective mass in a semiconductor ?

(e) Define carrier mobility. What is its unit ?

(f) Write the equation for the total current density in a semiconductor.

(g) Define Flat band voltage and Flat band condition.

(h) Define the term Base width modulation.

P.T.O.

(i) What is Schottky barrier diode ?

(j) What do you mean by latch-up condition ?

2. (a) Derive the equation for the density of allowed energy states in a semiconductor. 5

(b) Derive an expression for the thermal equilibrium concentration of electrons in the conduction band using Fermi- Dirac probality function, density of states and other terms. 5

3. (a) What is Fermi energy ? Discuss the variation of Fermi energy with temperature and doping concentration using suitable diagram. 5

(b) Calculate the drift current density in a sample of Si at T = 300K with doping concentration, given $N_d = 10^{15}\ cm^{-3}$ and $N_a = 10^{14}\ cm^{-3}$, if the applied electric field is E = 35 V/cm, mobility of electrons and holes are 1350 cm^2 / v.s and 480 cm^2 / v.s respectively. 5

4. (a) Define and derive the expression of built – in – potential barrier voltage for a pn junction in thermal equilibrium. 5

(b) Calculate the built- in-potential barrier in a Si pn junction at T = 300 K for $N_a = 5 \times 10^{17}\ cm^{-3}$, $N_d = 10^{16}\ cm^{-3}$. Assume that ni = $1.5 \times 10^{10}\ cm^{-3}$. 5

5. (a) Discuss about different breakdown mechanisms in pn junction. 5

(b) Discuss the different modes of operation of npn transistor. 5

6. (a) Derive the expression for the excess minority carrier hole concentration in forward active mode in an pnp bipolar transistor. 5

(b) Consider an uniformly doped silicon bipolar npn transistor with a metallurgical base width of 0.5×10^{-4} cm and a base doping of $N_B = 10^{16}\ cm^{-3}$. Find the maximum collector doping concentration and the collector width to have a punch-through voltage $V_{pt} = 25$ eV. 5

7. (a) What do you mean by specific contact resistance ? Derive its necessary mathematical expression. 5

(b) Draw and explain the energy band diagram of MOS capacitor. 5

8. (a) Draw and explain the IV characteristics of MOSFET. 5

(b) Distinguish between steep retrograde body doping and uniform body doping. 5