B.Tech

(SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10
FUNDAMENTALS OF ELECTRONICS DEVICES

Time : 3 Hours]   *[Total Marks : 100*

Note :   *Attempt all the questions. All questions carry equal marks.*

1   Attempt any **four** parts of the following :

(a)   Derive the formula for Density and lattice constant.

(b)   What is atomic radius and atomic packing factor ? Calculate it for simple cubic structure.

(c)   What do you mean by mobility of carrier ? How does it depend on temperature and doping concentration ?

(d)   Explain the basic crystal growth techniques.

(e)   What is Hall effect and Hall angle ? Show that

$$Q_H = \tan^{-1}\left(\mu_n B_z\right)$$ where symbols have their usual meaning.

(f)   In an intrinsic semiconductor the effective mass of the electron is 0.07 m_0 and that of the hole is 0.4 m_0, where m_0 is the rest mass of the electron. Calculate the intrinsic concentration of change carriers at 300°K given by E_g = 0.7 eV.

2   Answer any **four** parts of the following :

(a)   Find the diffusion coefficients of electrons and holes of a silicon single crystal at 27°C if the mobilities of electrons and holes are 0.17 and 0.025 m^2 $V^{-1}\rho^{-1}$ respectively at 27°C.

(b)   Design a $5\,\mu M$ cds photoconductor with $10\,M\Omega$ dark resistance, 0.5 cm square. Assume $\tau = 10^{-6}s$ and $N_d = 10^{14} cm^{-3}$.

(c)   Obtain relationship between photoconductivity and mobility of carriers.

(d)   Define mobility of a change carrier. Show that

$$\frac{\mu}{D} = \frac{e}{KT}.$$

(e)   Using the concept of diffusion and drift of carriers establish Einsteins relation and modified from of Ohm's law.
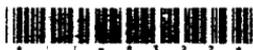
(f)   Define :

(i)   Photoconductivity

(ii)   Luminescense.

3   Attempt any **two** parts of the following :

(a)   What do you mean by zener diode ? Explain how zener diode maintains constant voltage across the load.

(b) Consider a Ge diode with $N_D = N_A$ and with impurity concentration of $8 \times 10^{14} / cm^3$. Assume $\eta_i = 2 \times 10^{13} / cm^3$. At room temperature of 300 K calculate the height of the potential barrier under open-circuit conditions. Assume Boltzmann's constant K = 8.61×10^{-5} eV/k and electron charge $\rho = 1.6 \times 10^{-19} C$. Describe the Schotky diode in detail.

(c) What do you mean by reverse bias break down ? Calculate the thermal equilibrium electron and hole concentration in a compensated P-type silicon semiconductor at 300°K in which

$$N_A = 10^{16} cm^{-3}, \ N_D = 3 \times 10^{15} \ cm^{-3} \ \text{and}$$

$$\eta_i = 1.6 \times 10^{10} \ cm^{-3}.$$

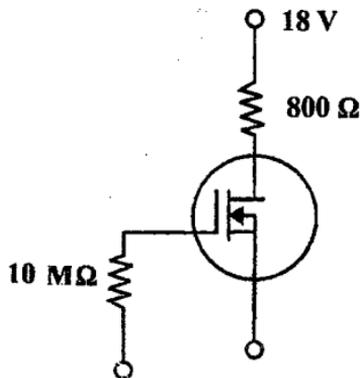Attempt any **two** parts of the following :

(a) Prove that the transconductance g_m of JFET is given by

$$g_m = \frac{2}{|V_P|} \sqrt{I_{DS} \ I_{DSS}}$$

(b) What is a MOSFET ? How many types of MOSFETs are there ? Point out the basic difference between the FET and BJT ?

(c) For the N-channel zero biased D-MOSFET circuit of figure below calculate the V_{DS} if $J_{DSS} = 10\,mA$ and $V_{GS(off)} = -6V$

5   Attempt any **two** parts of the following :

(a) What is a photodetector ? Describe the working of solar cell. What are the applications of these devices ?

(b) Explain the tunnel diode in detail. What are its applications ?

(c) Describe the characteristics and application of SCR and P-N-P-N diode.