Printed Pages—3 **TEC—403**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3083 **Roll No.**

B.Tech.

FOURTH SEMESTER EXAMINATION, 2005-2006

SEMICONDUCTOR MATERIALS AND DEVICES

Time : 3 Hours *Total Marks : 100*

Note : *(i)* *Attempt* ***ALL*** *questions.*

(ii) *All questions carry equal marks.*

(iii) *In case of numerical problems assume data wherever not provided.*

(iv) *Be precise in your answer.*

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1. Attempt *any four* parts of the following : **(5x4=20)**

(a) Sketch the lattice structure of

(i) simple cubic

(ii) body centered cubic

(iii) face-centered cubic

(b) What do you understand by Miller indices ? How this is obtained that describes a plane in a crystal ?

(c) Obtain the volume density of Si atoms with its lattice constants of 5.3 Å.

(d) What is the concept of hole ? What do you understand by covalent bonding ?

(e) What do you mean by mobility of a carrier. How does it depend on temperature and doping concentrations.

(f) What properties of a semiconductor are determined from Hall effect experiment ? Discuss the effect in detail. Derive the expression for Hall angle.

2. Attempt *any four* parts of the following : **(5x4=20)**

(a) It is observed in a semiconductor that three quarters of current is carried by electrons and the rest part by holes. What is the ratio of electrons to holes if the drift velocity of the electrons is three times the drift velocity of holes ?

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

(c) What is doping ? How does it affect the conductivity of the parent semiconductor material ?

(d) Obtain the relation $\frac{D_p}{\mu_p} = \frac{KT}{q}$.

(e) What type semiconductor material is suited for luminescence effect ? Explain excitation and recombination of photoluminescence with trap level for electrons.

(f) What is recombination ? Derive the expression for minority carrier life time.

3. Attempt *any two* parts of the following : **(10x2=20)**

(a) Draw the physical structure, symbolic representation and I-V characteristics of the majority charge carrier diode.

(b) What is the contact potential ? Obtain the value of contact potential of an abrupt junction at room temperature of intrinsic concentration $n_i = 1.5 \times 10^{16}/m^3$ with doping level of $N_D = N_A = 10^{21}/m^3$.

(c) What is he basic difference between GUNN diode and the IMPATT diode ?

4. Attempt *any two* parts of the following : **(10x2=20)**

(a) What is the difference between homojunction and heterojunction ? Explain them with neat sketches.

(b) Explain different components of currents flow through the structure of a n-p-n transistor. How the emitter injection efficiency and base transport factor influences the amplification factor ?

(c) Draw the physical structure and equivalent circuit of the IGFET. Explain its special feature. Draw its I-V characteristic.

5. Attempt *any two* parts of the following : **(10x2=20)**

(a) Enumerate the special feature of MESFET. Explain its working and discuss difference in its characteristics from the characteristics of the MOSFET.

(b) Why p-i-n diode detector does not provide gain ? How can it be made more sensitive to low level intensity of light ? What material should be used to detect light of wave length $\lambda = 0.6\mu m$?

(c) Obtain I-V characteristics of tunnel diode with special reference to its negative resistance starting from equilibrium condition to forward and reverse bias condition.

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