Printed Pages : 4 **TEC – 403**

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

PAPER ID : 3083 Roll No.

B. Tech.

(SEM. IV) EXAMINATION, 2007-08

SEMICONDUCTOR MATERIALS & DEVICES

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

Note : *(1) Answer **all** questions.*

*(2) **Suitable data** can be assumed, if missing.*

1 Answer any **four** from the following : **5x4=20**

(a) How simple cubic, centered cubic, and face-centered cubic structures differ from one another?

(b) What are advantages and disadvantages of impurities in semiconductor solids ? Explain them with suitable examples.

(c) Obtain lattice constant and radius of the atom having simple cubic lattice and volume density of $3 \times 10^{22} / cm^3$ assuming that the atoms are hard spheres with each atom touching its nearest neighbour.

(d) Calculate the surface density of atom in face centered cubic structure with lattice constant of $4.75 \overset{o}{A}$ for 111 plane.

(e) What is Fermi level ? How does it depend on temperature ?

(f) Obtain the inherent RC time constant of sample of thickness t and area A in terms of its conductivity σ and the permitivity ε.

2 Answer any **four** parts from of the following : **5x4=20**

(a) Obtain an equation for photocurrent in terms of lifetime and transit time of carriers in a sample dominated by μ_n.

(b) What is photoconductivity ? Show that photocurrent is proportional to the lifetime (τ_n) and inversely proportional to transit time (τ_t) of carrier.

(c) What is IGBT ? Draw its equivalent circuit and enumerate its special features ?

(d) Obtain equation of diffusion current in terms of lifetime of the carrier and other parameters.

(e) Why optical fiber has become these days so important ?

3 Answer any **two** parts from the following: **10x2=20**

(a) What happens to the contact potential and the depletion width with increasing reverse and forward biases ?

(b) How semiconductor differs from that of the metal and insulators on the basis of band gap ?

(c) Which is the hot carrier diode ? Describe its special advantages and disadvantages. Draw its symbol and I-V characteristics.

4 Answer any **two** parts from the following : **10x2=20**

(a) How heterojunction improves the performance of the junction ? Explain it in comparison to the homojunction.

(b) What are the factors that affect the amplification factor of the BJT ?

(c) How do you define light emitting materials ? What are the voltage drop and current limits of a general LED ? What determines the emission of colour of the LED ?

5 Answer any **two** parts from the following : **10x2=20**

(a) Three n-p-n transistors are identical except that transistor 2 has base region twice as long as transistor 1, and transistor 3 has the base region doped twice as heavily as transistor 1. Rest parameters of all transistors are identical. Which transistor has largest value of

(i) emitter injection efficiency

(ii) base transport factor

(iii) punch through voltage

(iv) common emitter current gain ?

(b) What is the advantages of the MESFET ? Draw its structure and explain its working.

(c) What determines the peak tunneling voltage V_p of a tunnel diode ? Calculate the minimum forward bias at which the tunneling through it occurs when the trapping level (E_t) is located 0.3V above the valence band. Assume $E_G = 1V$, $E_{Fn} - E_C$ on the n-side equals the $E_{I'} - E_{Fp}$ on p-side and is equal to **0.1 V**.
