

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

PAPER ID : 0322

Roll No.

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B.Tech.

(SEM. III) ODD SEMESTER THEORY

EXAMINATION 2013-14

FUNDAMENTALS OF ELECTRONICS DEVICES

Time : 3 Hours

Total Marks : 100

Note :- Attempt all questions. All questions carry equal marks.

1. Attempt any **four** parts of the following : (5×4=20)
 - (a) Describe briefly the band structure of Si with suitable sketch.
 - (b) What do you understand by Miller indices ? How is it used to describe a plane and direction in a crystal ?
 - (c) Derive the expression for the effective mass of an electron in an energy band in terms of wave vector.
 - (d) Calculate the volume density of Ga and As atoms with its lattice constant 5.65 \AA in $G < As$.
 - (e) Define Fermi level and plot the Fermi function at 0°C . Calculate the probabilities of finding electrons and holes at the energy level of 0.1 eV above and below the Fermi level at temperature 0 K and 300 K .

- (f) Derive the expression for the minimum conductivity σ_{\min} .
Also calculate σ_{\min} for Si at 300 K.

2. Attempt any **two** parts of the following : (10×2=20)

- (a) What do you mean by luminescence ? Explain the different types of luminescence.
- (b) Describe drift and diffusion of carriers. Derive the expression $\frac{D}{\mu} = \frac{KT}{q}$.
- (c) A Si wafer has a doping concentration of 10^{16} phosphorous atoms/cm³ and 2×10^{15} Boron atoms/cm³. What concentration of boron or phosphorous atoms must be added to the wafer to make the conductivity equal to $5.0 (\Omega\text{-cm})^{-1}$? Calculate the position of E_F before and after doping.

3. Attempt any **two** parts of the following : (10×2=20)

- (a) What is the Contact Potential ? Obtain the value of contact potential of an abrupt junction at room temperature with intrinsic concentration $1.5 \times 10^{16}/\text{m}^3$ and equal doping level of $10^{21}/\text{m}^3$.
- (b) What do you mean by space charge region at a junction ? Derive an expression for width of space charge region in a p-n junction at thermal equilibrium condition.
- (c) What do you mean by capacitance of p-n junctions ? Derive the expression for capacitance of reverse biased junction in terms of dopings and applied voltage.

4. Attempt any **two** parts of the following : (10×2=20)

- (a) Discuss briefly the principle of operation of a GaAs MESFET with suitable sketch showing its construction. Draw the characteristics.
- (b) What is MOSFET ? How many types of MOSFETs are there ? Point out the basic difference between MOSFET and BJT.
- (c) Explain how a Bipolar Junction Transistor can be used as an amplifier. Explain how the emitter injection efficiency affects the amplification factor.

5. Attempt any **two** parts of the following : (10×2=20)

- (a) What are the basic constructional differences between a conventional p-n junction diode and a tunnel diode ? Explain briefly the operation and characteristics of a tunnel diode.
- (b) What is Photo Diode ? Explain. How is it used as solar cell ? Describe the working of solar cell.
- (c) Explain the operation and characteristics of Silicon Controlled Rectifier. Also describe the applications of the device.