

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

PAPER ID : 131653

Roll No.

--	--	--	--	--	--	--	--	--	--

**B.Tech.**

(SEM. VI) THEORY EXAMINATION 2013-14

**ADVANCED SEMICONDUCTOR DEVICES**

*Time : 2 Hours*

*Total Marks : 50*

- Note :**
- (1) Attempt all questions.
  - (2) Marks are indicated for each question.
  - (3) Assume the missing data, if any.

1. Attempt any two parts of the following : **(6×2=12)**

- (a)
  - (i) Find the nearest neighbor distance in a diamond lattice.
  - (ii) Define the saturation range of temperature in semiconductor. What is the equilibrium electron concentration of an extrinsic semiconductor in this range.
- (b) Write down the expression for Fermi-Dirac distribution function. Explain the meaning of each parameter. Show that the probability that a state  $\Delta E$  above the Fermi level,  $E_F$  is filled, equals the probability that a state  $\Delta E$  below  $E_F$  is empty.
- (c) Define diffusion coefficient and mobility of a carrier. Derive an expression for electron mobility in terms of diffusion coefficient of electron.

2. Attempt any **two** parts of the following : (6×2=12)

- (a) What is diffusion potential ? Find the value of diffusion potential of an abrupt silicon p-n junction with equal doping level of  $10^{21}$  impurity atoms/ $\text{m}^3$  at room temperature. Derive the expression used if any.
- (b) What do you mean by a rectifying contact ? State the condition for which the junction between a metal and n-type semiconductor will work as a rectifying contact. Draw the energy band diagram of a rectifying contact formed between a metal and n-type semiconductor at equilibrium condition.
- (c) Describe the physical mechanism for p-n junction breakdown. Draw a circuit which uses a breakdown diode to regulate the voltage across a load. Explain its operation.

3. Attempt any **two** parts of the following : (6×2=12)

- (a) What is transferred electron effect ? Describe a device based on this effect with suitable diagram in detail. Also draw its characteristics.
- (b) What is photodetector ? Explain the operation of a p-i-n photodetector. What are the suitable materials for it ? How can it be made more sensitive to low level intensity of light ?
- (c) Draw a schematic diagram of TRAPATT diode and discuss its working principle. Calculate the avalanche-zone velocity for a TRAPATT diode having the acceptor doping concentration in the p-region  $N_a = 10^{15}/\text{cm}^3$  and current density  $J = 8 \text{ kA}/\text{cm}^2$ .

4. Attempt any **two** parts of the following : (7×2=14)

- (a) Discuss briefly, the operation of normally- ON and normal-OFF MESFET with suitable diagram and characteristics. What are the special features of MESFETs. Explain.

- (b) A 1000 Å thick layer of  $\text{SiO}_2$  is grown on uniformly doped Si with  $10^{15}$  Boron atoms/ $\text{cm}^3$  to make an ideal MOS capacitor. Calculate the threshold voltage and major points on the C-V curve. The relative dielectric constants for Si and  $\text{SiO}_2$  are 11.8 and 3.9 respectively. Also given permittivity of free space is  $8.85 \times 10^{-12}$  Farad/meter.
- (c) With suitable schematic diagrams show the input and output arrangements for charge-coupled device and explain charge transfer efficiency of the device. What is a surface channel CCD. Explain.