USN | | | | | | | | | | |

NEW SCHEME

Fifth Semester B. E. Degree Examination, July 2006
EC / TC
Solid State Devices and Technology

Time: 3 hrs.] [Max. Marks:100

Note: 1. Answer *any FIVE full questions.*
2. Assume missing data if any.

1 a. Derive an expression for drift current in a PN diode. **(06 Marks)**

b. A PN + Silicon junction diode is doped with ND = 10^{16} cm^{-3}, NA = 10^{15} cm^{-3} and ni = 1 x 10^{10}.
i) Determine the location of the Fermi levels, with respect to the bottom of the conduction band, in each of P and N.
ii) Determine the width of the depletion layer.
iii) The electric charge in each of the two segments of the depletion region given the area is 0.2 x 0.3 cm, $\in_{Si}$ = 11.8, Eg (300 K) = 1-12 ev. **(08 Marks)**

c. Discuss the conditions in the diode with voltage applied across it, under forward bias and reverse bias. **(06 Marks)**

2 a. List the assumptions in the deviation of the ideal diode equation. **(06 Marks)**

b. Derive the general equation for hole distribution in the N – region of the PN junction diode. **(08 Marks)**

c. Compare the IV characteristics of Germanium, Silicon and Gallium Arsenide highlighting the difference in their characteristics. **(06 Marks)**

3 a. Explain giving reasons why silicon is preferred for the fabrication of semiconductor devices. **(05 Marks)**

b. Discuss the various steps involved in the fabrication of integrated circuits with relevant sketches. **(09 Marks)**

c. How long would it take for a fixed amount of phosphorous distributed over one surface of a 25 μm – thick silicon wafer to become substantially uniformly distributed through out the wafer at 1300^{0}C ? Consider that the concentration is sufficiently uniform if it does not differ by more than 10 percent from that at the surface. Assume D = 1.5 x 10^{-11} cm^2 / sec for P at 1300^{0}C. **(06 Marks)**

4 a. With Energy band diagram representation of a PNP transistor, describe its structure and basic operation. **(06 Marks)**

b. A PNP transistor has the following current components, I_{EP} = 2mA, I_{En} = 0.01 mA, ICP = 1.98 mA, and ICn = 0.001 mA.
Determine i) the basic transport factor. ii) the injection efficiency iii) α and β iv) IB, ICBO and ICEO. **(08 Marks)**

c. Derive the Ebers – Moll model for the PNP transistor. **(06 Marks)**

5 a. What are the effects of limitations on static characteristics of a PNP transistor. **(06 Marks)**

Contd...2

b. Prove that $BV_{CEO} = \frac{BVCBO}{\sqrt[n]{\beta_F}}$

Where BV_{CEO} is the breakdown voltage with base open (IB = 0), BVCBO is the breakdown voltage in common – base configuration, β_F is the common emitter short – circuit (B to C) current gain and n varies from 2 to 7. **(08 Marks)**

c. With a circuit arrangement, derive an expression for the figure of merit of a transistor. **(06 Marks)**

6 a. Describe with a neat sketch, the construction and operation of a JFET, bringing out the effect of gate-to-source voltage and the drain voltage. **(08 Marks)**

b. Derive an expression for the Resistance of the channel in a NJFET structure in terms of the mobility of the electrons, the width of the depletion region and the cross sectional area of the channel. **(06 Marks)**

c. Explain the following secondary effects in JFET.
i) Channel length modulation ii) Breakdown iii) Variation in mobility
iv) Temperature effects. **(06 Marks)**

7 a. Describe the operation of a schottky barrier diode drawing Energy band diagrams for i) Forward bias ii) Reverse bias conditions. **(08 Marks)**

b. Compare between schottky diode and P-N junction diode bringing out salient features. **(06 Marks)**

c. Explain band bending when a voltage is applied to a MOS diode. **(06 Marks)**

8 Write short notes on :

a. The Czuchralski crystal growth.

b. Fabrication of resistors and capacitors in ICS.

c. Punch through phenomenon.

d. The Gummel – Poon model. **(20 Marks)**

*****