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H – 4537

Reg. No. ....

Name : .....

**Third Semester B.Tech. Degree Examination, February 2020**

**08.302 SOLID STATE DEVICES (TA)**

**(2008 Scheme)**

Time : 3 Hours

Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **4** mark.

1. Draw and explain the VI characteristics of PN junction diode.
2. Explain the different types of capacitances associated with a p-n junction.
3. A Si sample is doped with  $10^{17}$  As atoms/cm<sup>3</sup>. What is the equilibrium hole concentration  $p_0$  at 300K? Where is  $E_F$  relative to  $E_i$ ?
4. Explain the effect of temperature on mobility.
5. Draw and explain the energy band diagram of an Ohmic contact.
6. Explain base width modulation with neat diagrams.
7. Illustrate the minority carrier distribution in a PNP transistor in the active mode of operation.
8. Define threshold voltage of MOS capacitor.
9. Explain Sub-threshold conduction in MOSFET.
10. Explain the principle of operation of UJT.

P.T.O.



## PART – B

Answer **any two** full questions from each module. **Each** question carries **10** marks.

### Module – I

11. The Fermi level position in a Si sample at 300K is 0.29eV below  $E_c$ . Determine the carrier concentration and conductivity of the specimen. Given that  $n_i = 1.5 \times 10^{10} \text{cm}^{-3}$ ,  $\mu_n = 1350 \text{cm}^2/\text{Vs}$ ,  $\mu_p = 480 \text{cm}^2/\text{Vs}$ .
12. Derive the expression for equilibrium carrier concentrations.
13. Derive ideal diode equation.

### Module – II

14. Define with expressions (i) Base transport factor (ii) Emitter injection efficiency (iii) Current transfer ratio (iv) Base to collector current amplification factor.
15. Explain with neat diagrams.
  - (i) Zener breakdown.
  - (ii) Avalanche breakdown.
16. A Schottky barrier diode is formed by depositing tungsten on n-type Si. If  $N_D = 10^{15} \text{cm}^{-3}$ ,  $q\phi_m = 4.9 \text{eV}$ ,  $q\chi_s = 4.15 \text{eV}$  (electron affinity of silicon), determine at 300K.
  - (i) Built in Voltage
  - (ii) Width of depletion region and
  - (iii) Maximum electric field?



### Module – III

17. What are the effects of real surfaces on the threshold voltage of a MOS capacitor? Derive the threshold voltage equation of a real MOS capacitor?
18. (a) Draw and explain the drain characteristics of JFET. 5
- (b) An n channel Si JEFT has  $N_a = 10^{19} \text{ cm}^{-3}$ ,  $N_d = 10^{15} \text{ cm}^{-3}$ , and  $a = 4 \mu\text{m}$ . Determine at 300K (i) Pinch off voltage (ii) gate bias required to make thickness of undepleted channel width equal to  $1 \mu\text{m}$  with  $V_{DS} = 0V$ . 5
19. (a) Explain the principle of operation of an IGBT.
- (b) Derive the expression of drain current of MOSFET.

(6 × 10 = 60 Marks)

