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Reg. No. : .....

Name : .....

Combined First and Second Semester B.Tech. Degree Examination, May 2015

(2013 Scheme)

13.109 : SEMICONDUCTOR DEVICES (AT)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **2** marks.

1. What are the different carrier scattering mechanisms in a Semi Conductor ?
2. Define quasi Fermi level. When do they exist ?
3. Explain effective mass.
4. For a Silicon sample at 300 K $p_o = 4 \times 10^{12}\ cm^{-3}$. Determine the electron density.
5. Plot the energy band diagram of a p-n junction under
   a) Forward bias
   b) Reverse bias.
6. What is a punched through diode ? What is its advantage ?
7. What is a Schottky diode ?
8. What is meant by emitter crowding in BJT ?
9. Explain channel length modulation in MOSFET.
10. What is meant by population inversion ? **(10×2=20 Marks)**

PART – B

Answer **any one full** question from **each** Module. **Each** question carries **20** marks.

Module – I

11. a) State and derive Einstein Relation.

    b) The Fermi level position in an n type Ge Film is 0.2 eV above the intrinsic Fermi level. The thickness of the film is 0.5 μ m. Calculate the sheet resistance of the film. Assume $n_i = 2.5\times10^{13}$ cm^{-3} μ_n=3500 cm^2/Vs μ_p=1500 cm^2/Vs KT/q = 0.026V.

OR

12. a) With neat diagram explain direct and indirect band gap semiconductors.

    b) Derive the continuity equation.

Module – II

13. a) Derive the expression for built in potential of an abrupt p-n junction.

    b) Compute the contact potential V_o of a S_i abrupt p-n junction. With $N_D=10^{15}$ cm^{-3} and $N_A=10^{17}$ cm^{-3} at (a) 300 K (b) 450 K.

OR

14. a) Derive the Ideal diode equation.

    b) A Silicon p^+n junction diode has A = 10^{-2} cm^2. The function capacitance vary with the applied bias as $\frac{1}{Cj^2} = 7.5\times10^{18}(7-10\,V_a)$. Determine

    a) V_o

    b) Doping densities N_A and N_D.

Module – III

15. a) Define and write the equations for the following parameters transistor

    i) Injection efficiency

    ii) Base transport factor

    iii) Current gain α

b) An n channel Si JFET has $N_D = 10^{15}$ cm^{-3} $N_A = 10^{18}$ cm^{-3} a = 2.0 μ m. Determine

i) Built in voltage

ii) Pinch off voltage

iii) Threshold voltage

OR

16. a) Describe the structure and working of ideal MOS capacitor.

b) A silicon MOS structure at 300 K in characterised by $N_A = 4 \times 10^{14}$ cm^{-3} tox=0.1 μ m. Oxide is ideal. The metal is brought to a potential of +1V with respect to semiconductor $\epsilon_{rox} = 3.9$.

i) Does inversion occur ?

ii) Calculate voltage across oxide.

Module – IV

17. a) Explain enhancement and depletion. MOSFET. Draw transfer and drain characteristics.

b) An n type MOSFET has tox = 400 A° $\mu_n = 525$ cm^2/Vs $V_T = 0.75$V. Compute the value of W/L ratio if $I_D = 6$mA for $V_{GS} = 2$V.

OR

18. a) Explain the principle of operation of a Solar cell. Describe its structure. What are its applications ?

b) With necessary diagrams, explain the working of UJT. **(4×20=80 Marks)**
