(Following paper code and roll No. to be filled in your answer book)

Paper code: MEC-101 Roll No. [redacted]

M.Tech.

FIRST SEM. EXAMINATION, 2010-11

Time: 3hrs. 40 *Max. Marks: 100*

Subject: ADVANCED SEMICONDUCTOR DEVICES

Note: (1) Attempt ANY FIVE questions.
(2) All questions are equal marks.
(3) Notations used have usual meaning.
(4) Assume any relevant data, if missing.

3 Q1. (a) What is **Hall** effect? Derive Expression of mobility in terms of Hall's coefficient and resistivity.

(b) A sample of Si is doped with 10^{17} phosphorus atoms/cm^3. What would you expect to measure for its reactivity? What Hall voltage would you expect in sample 100mm thick if I_x = 1mA and $B_z \doteq 1$ KG = 10^{-5} Wb/cm^2.

6 Q2. (a) What do you understand by "Optical Absorption"? Derive the relationship between Intensity of transmitted light I_t and Intensity of Incident light I_o. Consider the length of sample to be 'l'.

9 (b) A 0.46 mm thick sample of GaAs is illuminated with monochromatic light of
hr = 2ev. The absorption coefficient 'α' is 5x10^4 cm-1. The lower incident on the sample is 10 mW.

(i) Find the total energy absorbed by the sample per second (J/s).

(ii) Find the rate of excess thermal energy given up by the electrons to lattice before recombination.

(iii) Find the number of photons per second given off from recombination events, assuming perfect quantum efficiency.

Q3. (a) What is "Eiustein Relation"? Show that $D/\mu = kT/q$ where 'D' is Diffusion coefficient, M is mobility, k is Boltzman constant T is absolute temperature in Kelvin and q is change carrier. 5

(b) What is "CONTACT POTENTIAL" in pn junction? Derive the expression of contact potential in terms of Acceptor impurity Concentration and Intrinsic Carrier Concentration. 6

Q4. (a) An abrupt Si p-n junction has $Na = 10^{17}\ cm^{-3}$ on the 'p' side and $N_d = 10^{16}\ cm^{-3}$ on the 'n' side. At 300^0 k,

(i) Calculate the Fermi levels and draw Equilibrium Level Diagram. 9

(ii) Find 'V_0' (the contact potential).

(b). Derive the expression of Diode Current Equation in terms of D_n, L_n, D_p, L_p, P_n, n_p and other parameters.

Q5. (a) What is impact ionization in Avalanche Breakdown at pn junction? Show that, the electron multiplication 'M_n' is given by $M_n = n_{out}/n_{in} = 1/(1-p)$ where p is probability of impact ionization.

(b) What are different types of capacitances present at p-n junction? Explain their dependence on applied bias voltage. Derive relationship between them.

Q6. (a) What is "pinch off phenomena" in a JFET? Derive the expression of "Pinch off Voltage Vp" of N Channel JFET in terms of half channel width 'a', donor carrier concentration 'N_d' and other constants.

(b) Explain "surface Field Effect" in ideal MOS capacitor with help of energy band diagram. Also derive the expression for threshold voltage at strong inversion.

Q7. (a) Explain the physical structure of energy brand diagram and operation of IMPATT diode. Also compare it with QWITT diode. 12

(b) Write short notes on (i) The Gunn Diode (ii) PIN photo detector (iii) LASERS.