Minor-1 Test

ELL211- Physical Electronics

Total 15 marks

Answer all questions in one hour.

Objective Questions (1 mark for right answer, which may include more than one choice, -1 for wrong or incomplete answer)

Q1. Compared to forward bias condition, reverse biasing a p-n junction diode

(A) depletion layer width increases and depletion capacitance decreases
(B) depletion layer width increases and depletion capacitance increases
(C) depletion layer width decreases and depletion capacitance decreases
(D) depletion layer width decreases and depletion capacitance increases

Q2. The built-in potential in a p-n junction

(A) is equal to the difference in Fermi-levels of the two sides expressed in Volts
(B) increases with increase in doping concentrations of the two sides
(C) increases with increase in temperature
(D) is equal to the average of Fermi levels of the two sides

Q3. Reverse saturation current in a Silicon PN junction diode nearly doubles for a rise in temperature by every

(A) 2^0
(B) 5^0
(C) 6^0
(D) 10^0

***Subjective Questions* (with partial marking for correct steps even if the final answer is incorrect)**

Q4. Draw band-diagrams of a p-n junction for 0 applied bias, forward bias and reverse bias. Clearly mark and show vacuum level, electron affinity, E_C, E_V, E_i, E_F and E_g.

3 marks

Q5. Design a p-n junction such that J_n=10 A/cm^2 and J_p=2.5 A/cm^2 at a forward voltage of 0.6V. Following are given: n_i=1.5X10^{10} cm^{-3}, D_n=25 cm^2/s, D_p=10 cm^2/s, ε_{Si}=11.7, τ_{n0}= τ_{p0}=5X10^{-7} s.

$N_D = ?$, $N_A = ?$

3 marks

Q6. A p-n junction diode has n-type doping of $3X10^{20}$ cm^{-3} and p-type doping of $5X10^{17}$ cm^{-3}. First a bias1 of 0.1V is applied across this diode and its junction capacitance is calculated at room temperature of 300K. Then the bias is changed to bias2 of -1.2V and junction capacitance is again calculated. Assuming sufficient time is given after either bias is applied, such that the diode was in equilibrium when capacitances were measured, what is the percentage change in junction capacitance for bias2 w.r.t. bias1.

3 marks

Q7. In the circuit diagram shown below, the diode has ideality factor of 1.6. Assume R=20 Ohm, I_S=0.1nA and V_S=5V. Calculate the value of V_D at room temperature of 300K. (Hint: use calculator to iterate)

3 marks