BITS, PILANI - DUBAI CAMPUS

Knowledge Village, DUBAI

III - Year - SEMESTER - I (2004-05)

Electronic Devices and Integrated Circuits (EEE UC381)

(Closed-Book)

Time: 50 Minutes

Date: October 17, 2004

Max. Marks: 40

Note: Solve all the four questions.

Q.1. What are the effects of temperature and doping on mobility? Illustrate with graphs.

(10)

Q. 2. For a $2cm$ long bar of Si doped with $N_d = 10^{16}/cm^3$, with a cross sectional area of 0.05 cm^2. What is the current if the applied voltage is $20V$. If $10^{20} EHP/sec/cm^3$ is generated uniformly in the bar and the $\tau_n = \tau_p = 10^{-4}S$ what is the new current? Assume that the low level α_r does not change for high level injection. $\mu_p = 500\ cm^2/V-s$, $\mu_n = 1350 cm^2/V-s$.

(12)

Q. 3.A semiconductor has $E_g = 1.1eV$ and $N_c = N_v$. It is doped with $10^{15}/cm^3$ donors where the donor level is 0.2 eV below E_c. Given that E_F is 0.25 eV below E_c, calculate n_i and the concentration of electrons and holes in the semiconductor at $300^o K$.

(12)

Q.4 (a) The hole concentration in a semiconductor at equilibrium is $10^{15}/cm^3$. At $x = 0$, excess holes of $10^{14}/cm^3$ are injected. At a distance $10\mu m$, the hole density is $1.06 x 10^{15}/cm^3$. If diffusion length of holes is $12.5cm^2/S$, calculate the diffusion current density at $x = 10\mu m$.

(6)

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TEST-II

Open- Book

EEE UC 381 Electronic Devices and Integrated Circuits

Date:5. 12. 2004 Duration: 50 min Max. Marks:40

1. A 900nm oxide is grown on (100) Si in wet oxygen at 1100C. How long does it take to grow the first 200nm, the next 300nm and the final 400nm? 3

2. An abrupt Si p-n junction has acceptor concentration of $10^{18}/cm^3$ on one sideand donor concentration of $5x10^{15}/cm^3$ on the other. Junction area is 0.01Sq cm.
   (a) Calculate the Fermi level positions at 320K and 350K in the p and n regions.
   (b) Calculate the reverse saturation current at room temperature . Assume carrier recombination times for holes and electrons to be 10ns.
   (c) Assuming the reverse saturation current to be constant, calculate the forward current for a forward bias voltage of 0.7V at 300K and 350K. 15

3. In question no. 2, if temperature varies from 300K to 350K, calculate the reverse saturation current at both temperatures and also the forward current. Explain the effect of temperature. 8

4. Sketch the effects of storage delay time on switching voltage and current for storage delay time of 100ns, -E / R of 0.1A and forward current of 500mA, assuming that the time taken to reach reverse saturation current from -0.1A to be 500ns. Switching voltage has a frequency of 500KHz with equal positive and negative periods. Mark all current levels and time intervals. What is the effect of reverse recovery, if the frequency is increased to 1MHz? 14

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First Semester 2004-2005
Comprehensive Examination
EEE UC381 Electronic Devices and Integrated Circuits

Date:13.01. 2005 Duration: 3 Hrs. Max. Marks:80

1. Explain why holes are found at the top of the valence band, whereas electrons are found at the bottom of the conduction band. 5
2. What is drift resistance? Derive the expression for the semiconductor of a bar in terms of mobility and charge concentration. 5
3. Derive an expression relating the intrinsic level to the centre of the band gap. Calculate the displacement of the intrinsic level from the band gap centre at 300K, assuming the effective mass values of electrons and holes are $1.1m_o$ and $0.56m_o$ respectively. 12
4. A Si sample is doped with $6x10^{15}/cm^3$ donors and $2x10^{15}/cm^3$ acceptors. Find the position of the Fermi level with respect to intrinsic level at 300K. What is the value and sign of Hall coefficient? 12
5. For GaAs doped with $2x10^{15}$donors/cm^3 and having 4x 10^{14} EHP/cm^3 created uniformly at t=0, find n(t), p(t) at t=50ns, at t=100ns. At what time n(t) is constant? Assume carrier life time for holes and electrons to be 50ns. 12
6. Explain physically why the charge storage capacitance is unimportant for reverse biased p^+– n junction and the graph showing the variation of depletion region of a p^+– n junction and the graphs showing the variation of edge on n- side with reverse bias. Neglect x_{po} in the heavily doped p material. 6
7. Give the band diagrams for the ideal MOS structure under (a) equilibrium, (b) –ve voltage, (c) positive voltage (d) larger positive voltages. 8
8. Explain the switching mechanism in BJT (cut-off, saturation and switching cycle) for a common emitter transistor circuit with relevant diagrams and graphs. 9
9. A solar cell has a open circuit voltage of 0.8V and short circuit current of 0.2A. The fill factor is 0.7. Indicate an arrangement for obtaining a peak power of 112W. 5
10. Draw suitable band diagrams showing variation of inversion region width with forward bias (lesser and more bias) for a semiconductor laser and diagrams showing the light and intensity versus photon energy under (a) below threshold (b) at threshold (c) above threshold. 6