C7114

Total Pages: 2

Reg No.:

Name:

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: EC203

Course Name: SOLID STATE DEVICES (EC, AE)

Max. Marks: 100

PART A

Answer any two full questions, each carries 15 marks.

- a) Derive the expression for electron, hole and intrinsic concentrations at equilibrium 1 (8) in terms of effective density of states. Formulate the relation between these concentrations at equilibrium.
 - b) A Silicon sample is doped with 10^{17} boron atoms/cm³. What is the equilibrium (7)electron and hole concentrations at 300K? Where is E_F relative to E_i. Draw the energy band diagram. Intrinsic carrier concentration of Silicon is 1.5×10^{10} at 300K.
- A Silicon bar of 100 cm long and 1 cm^2 cross sectional area is doped with 2 a) (7)10¹⁷Arsenic atoms/cm³. Calculate electron and hole concentrations at 300K. Also find the conductivity and the current with 10V applied. Electron mobility at this doping is 700 $\text{cm}^2/\text{V-sec}$.
 - b) What is Hall effect? Derive the expression for carrier concentration and mobility (8) in terms of Hall voltage.
- a) Describe diffusion process. Derive the expression for diffusion current density. 3 (7)
 - b) Prove that under steady state carrier injection, the injected excess carrier (8) concentration is an exponentially decreasing function of distance.

PART B

Answer any two full questions, each carries 15 marks.

- a) Draw the energy band diagram of a PN junction 4 i) at equilibrium, ii) under forward bias and iii) under reverse bias.
 - b) A Silicon sample having circular cross section with diameter 10µm is doped with (9) 10^{18} cm⁻³ acceptor impurities on one side and 5×10^{15} cm⁻³ donor impurities on the other side. If the sample is at equilibrium, calculate contact potential, width of depletion region, penetration of depletion region on both N side and P side, and total charge on both N side and P side at 300K.
- An abrupt Silicon PN junction has the following parameters at 300K. 5 a) (10)P side:- Na= 10^{17} cm⁻³, τ_n =0.145, μ_n = 700 cm²/V-sec. N side:-N_d= 10^{15} cm⁻³, τ_p =1045, μ_p =450 cm²/V-sec. The junction is forward biased by 0.5V. What is the forward current. What is the current at reverse bias of (-0.5V).
 - b) Differentiate between ohmic and rectifying contacts.
- a) Derive the expression for depletion and diffusion capacitance of a PN junction. 6 (7)
 - b) With the help of necessary diagrams, explain the working of a tunnel diode. (8)

Marks

Duration: 3 Hours

(6)

(5)

C7114

PART C

Answer any two full questions, each carries 20 marks.

7	a)	Derive the expression for minority carrier distribution and terminal currents in a	(12)
		transistor.	
	b)	Describe early effect in a transistor.	(5)
	c)	What are the factors which cause base current in a transistor?	(3)
8	a)	With the help of necessary band diagrams, explain equilibrium, accumulation,	(12)
		depletion and inversion stages of a MOS capacitor.	
	b)	What are the effect of real surfaces of a MOS capacitor.	(4)
	c)	Draw and explain the structure of FINFET.	(4)
9	a)	Derive the expression for drain current of a MOSFET.	(10)
	b)	Draw and explain the transfer characteristics of an n-channel MOSFET.	(5)
	c)	A Silicon n-channel MOSFET has $\mu_n = 600 \text{ cm}^2/\text{V-sec}$, $C_{ox} = 1.2 \times 10^{17} \text{ F/cm}^2$, z=50	(5)
		μ m, L=10 μ m and V _{TH} = 0.8V. Find he drain current when	
		i) $V_{GS}=2V$ and $V_{DS}=1V$ ii) $V_{GS}=3V$ and $V_{DS}=5V$	
