C7114

Reg No.:

Name:

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

Course Code: EC203

Course Name: SOLID STATE DEVICES (EC, AE)

Max. Marks: 100

Duration: 3 Hours

Total Pages: 2

PART A

Answer any two full questions, each carries 15 marks.

- a) Derive the expression for electron, hole and intrinsic concentrations at equilibrium (8) 1 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 x 10¹⁰ at 300K.
- A Silicon bar of 100 cm long and 1 cm² cross sectional area is doped with (7)2 a) 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 cm²/V-sec.
 - b) What is Hall effect? Derive the expression for carrier concentration and mobility (8)in terms of Hall voltage.
- 3 a) Describe diffusion process. Derive the expression for diffusion current density. (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 $5x10^{15}$ 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. (10)5 a) P side:- Na= 10^{17} cm⁻³, τ_n =0.145, μ_n = 700 cm²/V-sec. N side:-N_d=10¹⁵ 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). (5)

- b) Differentiate between ohmic and rectifying contacts.
- a) Derive the expression for depletion and diffusion capacitance of a PN junction. (7)
- b) With the help of necessary diagrams, explain the working of a tunnel diode. (8)

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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 transistor.	(12)
and and	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, depletion and inversion stages of a MOS capacitor. 	(12)
	b) What are the effect of real surfaces of a MOS capacitor.	(4)
Marks.	c) Draw and explain the structure of FINFET.	(4)
9	a) Derive the expression for drain current of a MOSFET.	(10)
с	 b) Draw and explain the transfer characteristics of an n-channel MOSFET. c) A Silicon n-channel MOSFET has μ_n= 600 cm²/V-sec, C_{ox}= 1.2x10¹⁷ F/cm², z=50 μm, L=10 μm and V_{TH}= 0.8V. Find he drain current when 	(5) (5)
	i) $V_{GS}=2V$ and $V_{DS}=1V$ ****	
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	r is provided as ferrorised by 0.5 V. What is the forward current. What is the	
	 Defense are between ofmic and realitying contacts. 	
	 Detrive the expression for application and difference capacitance of a PPv junction. 	
689	b) We buy of necessary disprains, explain the working of a normal disfact.	

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