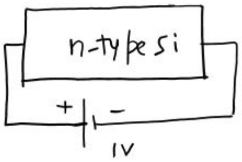
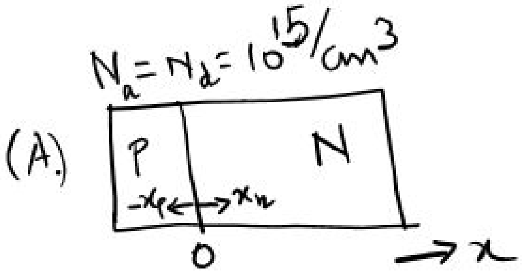
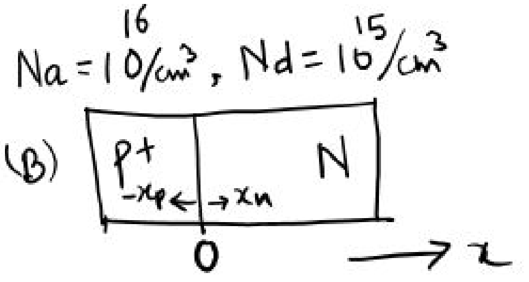
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B.TECH. **SEMESTER : III**
BRANCH: ECE **SESSION : MO/2022**

SUBJECT: EC201 ELECTRONIC DEVICES
TIME: 3:00 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q1 (a)	What is difference between doping and alloying?	[2]	1	2
Q1 (b)	Find the concentration of holes in a p type silicon (p_p) at 300 K assuming its resistivity in a p type silicon as 0.02 Ω-cm, $\mu_p = 475$ cm^2/V-sec, $n_i = 10^{10}$ per cm3.	[3]	1	3
Q1 (c)	c1. Explain Hall Effect with a suitable diagram. [2] c2. Write the relation between Hall Voltage and Hall coefficient. [1] c3. How you differentiate a n-type semiconductor and a metal using Hall Voltage? [2]	[5]	1	4
Q2 (a)	Calculate the diffusion length of excess carriers generated in a n-type silicon sample when it is exposed to light of energy > 1.1 eV, if the carrier lifetime of holes is 1 picosecond and diffusion coefficient of holes is 4 cm^2/s.	[2]	2	2
Q2 (b)	 b1. What do you understand by a diffusion and a drift transport? [1] b2. Show the energy band picture of the diagram shown above assuming given n-type silicon is uniformly doped. [2]	[3]	2	3
Q2 (c)	c1. Show the variation of extrinsic carrier concentration with temperature. [2] c2. What is thermal generation and how it is different than impurity ionization. [2] c3. A Silicon sample is doped by 10^{16}/cm3 boron atoms. What will be the electrons and holes concentration after complete ionization? [1]	[5]	2	4
Q3 (a)	Plot the profile for built-in-potential and electric field for case A of the above figure when the device is at thermal equilibrium. [2]	[2]	3	2
Q3 (b)	  b1. In figure given below, junction is shown at x = 0. Show the relative variation of depletion region edges $-x_p$ and x_n in both the cases as per the given doping levels. [1+1] b2. How the widths will change in case A for a small forward bias and reverse bias [1/2+1/2]	[3]	3	3
Q3 (c)	c1. Calculate the built-in-potential, and maximum electric field for the case B at 300 K if depletion layer width is 1 μm. Take ni = 1.5 X 10^{10} cm^{-3}, dielectric constant for silicon as 11.7. [2] c2. Write two possible mechanisms for breakdown in a PN Junction. Which takes place at lower reverse bias? [1/2+1/2] c3. Does the drop across the diode or more precisely the drop across the depletion region of a forward biased PN junction needs to be larger than the built-in potential for current to flow? Justify your YES or NO. [2]	[5]	3	3
Q4 (a)	What happens in BJT if (a) base region is fully depleted (b) base region is too long. [1+1]	[2]	4	2
Q4 (b)	What are the four regions of operation for BJT? Explain the biasing conditions for cut-off and saturation region. [2+1/2+1/2]	[3]	4	2
Q4 (c)	c1. Explain the phenomena of Early Effect in BJT with suitable diagrams. What are the biasing conditions of E-B and C-B junctions resulting in early effect [2+1] c2. What is the other term used for Early Effect in BJTs. What do you understand by Punch Through in a BJT [1+1]	[5]	4	4

PTO

Q5 (a)	What is threshold voltage is a MOSFET? Describe the sub threshold current and its effect in MOSFET operation? [1+1]	[2]	5	3
Q5 (b)	Show the variation of space-charge density, Qs, as a function of surface potential, φ_s in p-type silicon.	[3]		
Q5 (c)	c1. Draw the device structure of n-channel MOSFET (NMOS) showing approximate thickness of oxide, type and dimensions for the substrate. [2] c2. Draw the input-output and transfer curves for n-channel MOSFET. [1] c3. What are the voltage conditions at pinch-off point in I_{ds}-V_{ds} plots of a NMOS. What is the reason the current is maintained constant even after pinch-off region? [2]	[5]	5	3

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