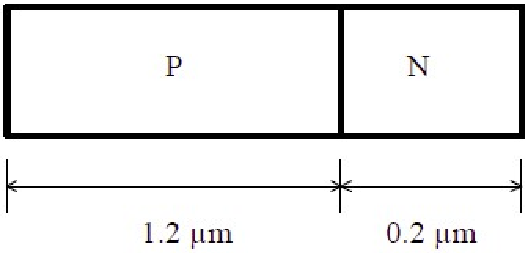
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B.TECH. **SEMESTER : III/ADD**
BRANCH: ECE **SESSION : MO/2024**

SUBJECT: EC201 ELECTRONIC DEVICES

TIME: 3 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**
Q.1(a)	Explain transferred electron mechanism with appropriate E-K diagram as a principle of GUNN Diode. Also, draw neat and properly labelled I-V characteristics of GUNN Diode with applications.	[5]	1 & 3	1, 2
Q.1(b)	i) Explain the formation of energy bands in solids with suitable diagram. ii) 'Silicon is not suitable for fabricating LEDs', Illustrate using appropriate energy band diagram.	[5]	1	1, 3
Q.2(a)	Describe four processes (Drift, Diffusion, Generation, recombination) in a charge carrier lifecycle with appropriate energy band diagram and equations involved in each process.	[5]	2	2
Q.2(b)	i) Sketch variation of excess carrier concentration with time. ii) An n-type silicon sample is uniformly illuminated with light which generates 10^{20} electron hole pairs per cm^3 per second. The minority carrier lifetime in the sample is 1 µs. In the steady state, the hole concentration in the sample is approximately $\mathbf{10^x}$, where **x** is an integer. Determine the value of **x**.	[5]	2	1, 5
Q.3(a)	Describe the construction and working of IMPATT Diode with appropriate diagrams explaining the phenomenon of impact ionization and avalanche. Also mention few disadvantages and applications of IMPATT Diode.	[5]	3	2
Q.3(b)	i) Draw the charge density and Electric field profile of a P+ N junction diode. ii) The doping in the P and N regions of a PN junction diode are $5\times10^{16}\ cm^{-3}$ and $10\times10^{16}\ cm^{-3}$ respectively. The parameters given are built-in potential (V_{bi}) is 0.8 V. Evaluate the magnitude of reverse bias voltage that would completely deplete one of the two regions (P or N) prior to the other. (Take electron charge (q) $=1.6\times10^{-19}$ C, vacuum permittivity (ε_0) = 8.85×10^{-12} F/m and Relative permittivity of silicon (ε_{Si}) = 12) 	[5]	3	3, 5
Q.4(a)	i) Sketch the minority carrier distribution profile in n-p-n transistor under forward bias. ii) Consider a uniformly doped n-p-n BJT at 300K having a base doping level of 5×10^{16} cm^{-3} and a collector doping level of 2×10^{15} cm^{-3}. The metallurgical base width is 0.70µm. Calculate the neutral base width as the C-B voltage changes from 2 V to 10 V.	[5]	4	1, 5

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Q.4(b)	i) Illustrate the base width narrowing and Kirk Effects with appropriate diagrams/graphs. ii) Explain any two frequency limitations of bipolar junction transistor in brief.	[5]	4	2
Q.5(a)	Derive the expression for the threshold voltage of an ideal MOS capacitor and the expression for the flat-band voltage of a non-ideal MOS capacitor.	[5]	5	1, 4
Q.5(b)	Draw and explain the Capacitance-Voltage (C-V) curve for a two-terminal MOS structure with P-type substrate (high and low frequency) showing all regions of operation with proper equation of equivalent capacitance. Draw separate C-V curve to show the effect of fixed and interface charges. **OR** Let us assume the inversion carrier density (number of carriers per unit area) for $V_G = 0.8\,V$ is $2 \times 10^{11} cm^{-2}$ and for $V_G = 1.3\,V$ it is $4 \times 10^{11} cm^{-2}$. Calculate the threshold voltage, the oxide capacitance per unit area C_0, and inversion carrier density for $V_G = 1.8\,V$.	[5]	5	2, 3

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