

2063

M.Tech. (Material Science and Technology)
Second Semester

MT-202: Semiconductor Devices and Technology

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section.

x-x-x

Q 1. Attempt all questions.

(2x5=10)

- Explain the ion channeling process.
- Write the names of the next generation lithography techniques.
- Explain the basic principle of the molecular beam epitaxy method.
- What are direct and indirect semiconductors?
- Draw the frequency response of a bipolar transistor.

Section-A

Q 2 (a) Explain why the carrier mobility in group II-VI semiconductor is lower than that in group III-V and IV semiconductors?

(b) For a semiconductor with indirect recombination characterized by a single trap level at E_t and $\tau_{po} = \tau_{no}$, show that under low level injection the maximum possible lifetime occurs when E_F lies at E_t and that this maximum is given by $\tau_p = \tau_{po} [1 + \text{Cosh} (E_t - E_i)/kT]$ (5,5)

Q.3 (a) In a p-n junction under thermal equilibrium, both the electron and hole currents are zero separately. Prove that this is possible when $(D_p/\mu_p) = (D_n/\mu_n) = (kT/q)$

(b) A p-n-p transistor with uniformly doped base, emitter and collector regions has $I_E = 1.5$ mA. Sketch the minority carrier distribution in the base when (i) the collector is shorted to the base (ii) the collector is shorted to the emitter (iii) the collector terminal is kept open. (6,4)

Q 4 (a) What are the MOS memory structures? Discuss it briefly.

(b) A MOSFET has a threshold voltage of $V_T = 0.5$ V, a subthreshold swing of 100 mV/decade, and a drain current of 0.1 μ A at V_T . What is the subthreshold current at $V_G = 0$? (7,3)

Section-B

Q 5. How will you grow the single crystal of silicon using the Czochralsky method? Describe this technique in detail. (10)

Q 6. Write short notes on the following: (5,5)

- Wet chemical etching process
- Impurity doping by diffusion process

Q 7. How will you deposit the Silicon nitride film using the CVD technique? Describe this technique in detail. What are the applications of this film? (10)

x-x-x