[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1766 **L**

Unique Paper Code : 2512013603

Name of the Paper : Semiconductor Device Technology

Name of the Course : **B.Sc. (H) Electronics (Core)**

Semester : VIII (Under NEP UGCF Mode)

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are **seven** questions in all, out of which you have to attempt any **five** questions.
3. **All** questions carry equal marks.
4. Use of non-programmable Scientific Calculator is allowed.
5. Question No. **1** is Compulsory.

1.	a.	How will you get EGS from MGS?	3
	b.	What is dry etching and wet etching? Differentiate them.	3
	c.	Define contact and proximity printing with digram?	3
	d.	What do you mean by a positive and negative resist? Explain.	3
	e.	Describe the typical material composition of a photo-mask used in UV lithography.	3
	f.	Briefly describe the "Buried Layer" (n+) used in BJT fabrication and its role in reducing collector resistance.	3
2.	a.	Derive an expression for the effective segregation coefficient for single crystal growth using CZ technique.	6
	b.	Explain the Float Zone (FZ) crystal growth technique for producing high-purity silicon with advantages.	6
	c.	At 300 K, the molecular diameter of oxygen is 3.64 Å, and the number of molecules per unit area N_s is 7.54×10^{14} cm^{-2}. Find the time required to form a monolayer of oxygen at pressure of 1, 10^{-4} and 10^{-8} Pa.	6
3.	a.	Discuss the kinetics of thermal oxidation of silicon and obtain expressions for parabolic rate constant and linear rate constant.	6
	b.	Describe the Chemical Vapour Deposition (CVD) process for silicon oxide. Explain its advantages and applications in semiconductor fabrication.	6
	c.	Assume 100-keV boron implants on a 200-nm silicon wafer at a dose of 5×10^{14} ions/cm^2. Calculate the peak concentration and the required ion beam current for 1 minute of implantation.	6

P.T.O.

4.	a.	Discuss the important properties of silicon oxide (SiO_2) and explain why it is widely used in semiconductor device technology.	6
	b.	Explain wafer cleaning technology in semiconductor fabrication. Briefly describe wet cleaning and dry cleaning techniques.	6
	c.	Explain oxide quality, step coverage and P-glass (phosphosilicate glass) flow in semiconductor fabrication.	6
5.	a.	Explain the process of thermal diffusion in semiconductors. Derive the diffusion expression for a constant surface concentration and plot the resulting diffusion profile.	6
	b.	Provide a detailed step-by-step account of the photolithographic process, starting from wafer cleaning to the final stripping of the photoresist.	6
	c.	Why is a "Clean Room" environment essential for lithography? Explain the classification system (e.g., Class 10 vs. Class 100) and the specific types of contaminants that must be filtered out.	6
6.	a.	Describe the mechanism of Sputtering for metal deposition. Discuss the role of inert gas (like Argon) and the advantages of sputtering in terms of "step coverage."	6
	b.	What is BiCMOS technology? Explain the rationale behind integrating both Bipolar and CMOS devices on a single chip and the trade-offs involved in terms of fabrication cost.	6
	c.	Outline the major process steps involved in fabricating a NMOS structure. Use a neat cross-sectional diagram to show the sequence.	6
7.	a.	How are passive components like resisters and capacitors are fabricated in monolithic IC's?	6
	b.	Explain the process of Ion Implantation for dopin a semiconductor material. Describe the steps and discuss parameters such as implantation range and channelling effects.	6
	c.	Compare the structural fabrication complexities of Bipolar Junction Transistors (BJT) and MOSFETs. Why is CMOS technology currently more dominant in digital logic than Bipolar technology?	6