Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

FIRST SEMESTER M.Tech. DEGREE END SEMESTER EXAMINATION
NOV/DEC 2017
SUBJECT: VLSI PROCESS TECHNOLOGY (ECE - 5124)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. At what temperature the As and Ga vacancies in GaAs will become equal given that the activation energy of Ga and As are 0.4 eV and 0.7 eV respectively.

1B. A mixture of 30 % Si and 70 % Ge is heated to 1100^{o} C. If the material is in thermal equilibrium, what is the concentration of Si in the melt? At what temperature, will the entire charge melts? The sample temperature is raised to 1300^{o} C, then slowly cooled back down to 1100^{o} C. What is the concentration of Si in the solid.

1C. Explain limitations of CV technique in determining the diffusion profiles of dopants.

(2+3+5)

2A. A pre-deposition process is carried-out in an n-type Si wafer with bulk doping concentration of 10^{17} / cm ^{3} at 950 ^{o}C using diborane gas. Determine p-n junction depth given surface solubility of boron at 950 ^{o}C is 3.8 x10 ^{20}/cm ^{3} and intrinsic diffusivity (D_o) = 0.76 cm ^{2}/sec. and Arrhenous activation energy (E_a) = 3.46 eV. A drive-in process is performed subsequently. In order to produce the p-n junction 1.28 µm below the wafer surface, estimate required Dt.

2B. How the diffusion constant is to be modified to understand the diffusion behaviour of dopant atoms at high concentrations. Discuss diffusion of phosphorus in Si in the high concentration limits.

(5+5)

3A. It is necessary to grow 1 µm field oxide to isolate transistors in a certain bipolar technology. Due to concerns with dopant diffusion and stalking faults formation, the oxidation must be carried out at 1050 ^{o}C. If the process is carryout in wet ambient at atmospheric pressure conditions, calculate required oxidation time. Compare the results with those of the experiment performed in dry oxidation conditions. Given that: For dry oxidation – B/A = 3.00 µm/hour and B= 0.49 µm ^{2} /hour. And for dry oxidation: B/A = 0.150 µm/hour and B= 0.0159 µm ^{2} /hour.

3B. Assume that 1 µm diameter Si sphere is completely oxidised. Calculate the diameter of of resultant SiO_2 sphere.

3C. Describe how different charges in the SiO/Si interface be understood by CV technique.

(4+2+4)

4A. i) What are advantages of CVD techniques over PVD techniques?

ii) Write all the chemical reactions that are involved in Si CVD processes.

iii) Distinguish between the kinetically controlled and equilibrium controlled reactions in CVD process. How can they be realised?

iv) Discuss the factors to be considered to decide substrate positioning in CVD reactors.

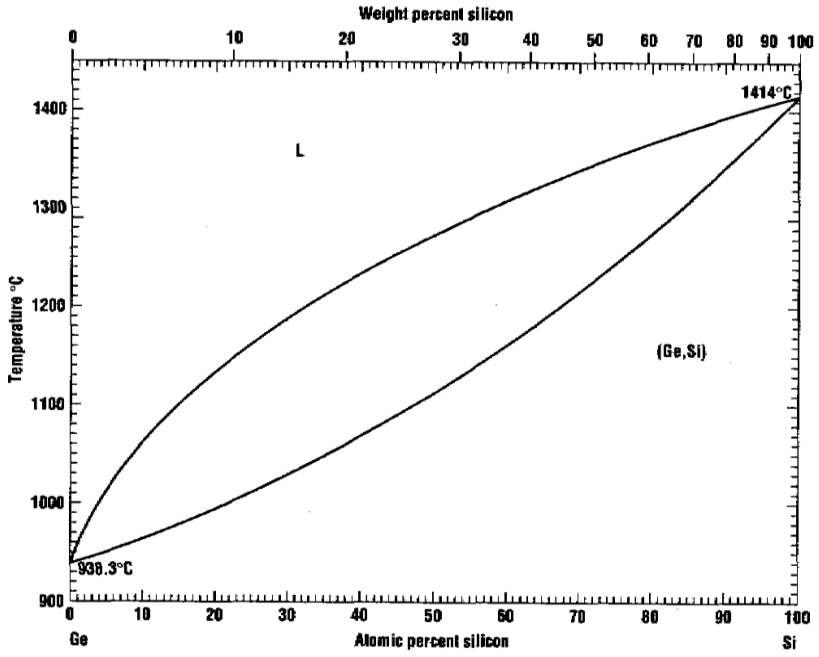
v) What are different reactor configurations of CVD reactor in PECVD technique.

(1+3+2+2+2)

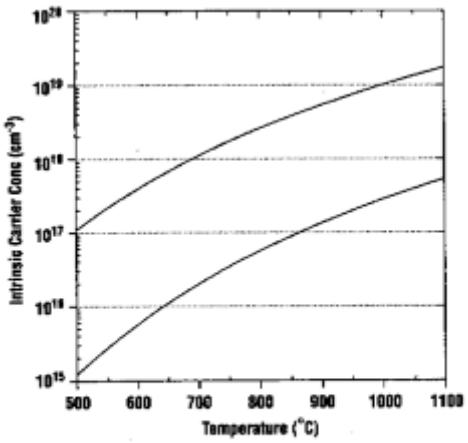
5A. What is heteroepitaxy? Discuss the differenttypes of heteroepitaxy processes.

5B. How Si epitaxial growth process differ from that of poly Si deposition?

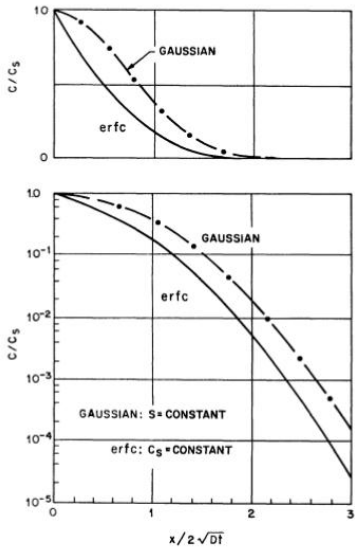
(5+5)



Q. No:1B: Phase diagram of Si-Ge



Intrinsic carrier concentration of silicon and GaAs as a function of temperature.



gure 8.5: Normalized concentration versus normalized distance for the *erfc* and Gaussian functions.