Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

FIRST SEMESTER M.Tech. (ME) DEGREE END SEMESTER EXAMINATION
NOV 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. A pre-deposition process is carried out for 15 minutes on n-type silicon wafer with phosphorous dopant concentration of 10^{17} /Cm ^{3} at 950^0C by using diborane gas. Assuming intrinsic diffusion, determine junction depth. At 950^0C, the boron saturation concentration is 3.8 x 10^{20} / cm^3 and boron diffusion constant is 1.5 x 10^{-15} cm^2 / sec.
After initial pre-deposition process, the sample undergoes drive-in diffusion process for one hour at 1250^o C. What is final junction depth? At 1250^o C, the boron diffusion constant is 1.2 x 10^{-12} cm ^{2}/ sec.

1B. What is extrinsic diffusion? How the diffusion of the dopants will be modified in this case? Explain the diffusion of high concentration of phosphorus dopants in Si.

(5+5)

2A. In capacitance-voltage(CV) measurement, if the bias voltage is ramped from negative set point to positive value, how the values of capacitance is effected in comparison to performing the experiment in reverse direction. Explain.

2B. A 1000 Ågate oxide is required for some technology. It has been decided that the oxidation will be carried-out at 1000 ^{o} C, in dry oxygen. If there is no initial oxide, how long the oxidation has to be performed. Compare the result for, if the oxidation is performed in wet oxidation. Given: 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.

2C. i) What is effect of inert anneal after oxidation? Explain.
ii) Explain the limitation of Deal-Grove model of oxidation and attempts to solve.

(3+4+3)

3A. At what temperature the Ga and As vacancy densities become equal in GaAs. Given that activation energy of Ga vacancy is 0.4 eV and that for As is 0.7 eV.

3B. A silicon wafer that has 2 x 10^{19} /cm ^{3} of Arsenic is found to have a neutral vacancy concentration of 2 x 10^{10} /cm ^{3} at some processing temperature and a singly ionised vacancy concentration of 10^{19} /cm^3 at the same temperature. Find the temperature and the activation energy of the charge vacancy with respect to intrinsic energy.

3C. What are the limitations of CV technique in determining the diffusion profiles of dopants.

(3+4+3)

4A. Write the chemical equations in the formation of silicon film in CVD technique.

4B. What are the factors to be considered for positioning of the substrates in CVD chamber?

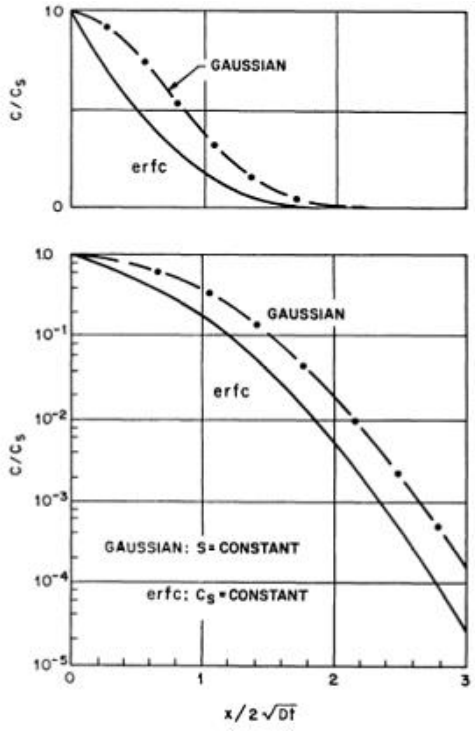
4C. Define heteroepitaxy and explain with two examples.

(3+3+4)

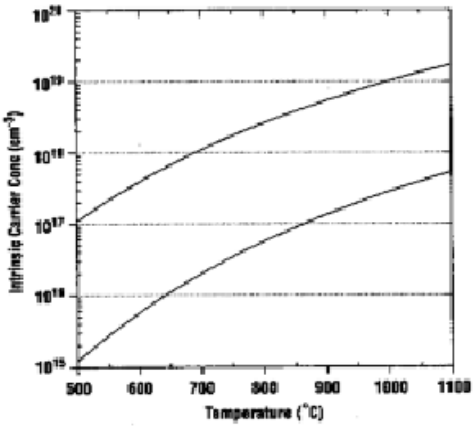
5A. What is requirement of Si wafer cleaning to obtain epitaxial growth. Describe a technique to purify hydrogen gas to inlet into the vapour phase epitaxial reactor.

5B. Compare and contrast the CVD mechanisms for epitaxial and poly Si deposition mechanisms.

(4+6)



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



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