Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FIRST SEMESTER M.TECH (ME) DEGREE END SEMESTER EXAMINATION
NOV/DEC 2015
SUBJECT: VLSI PROCESS TECHNOLOGY (ECE - 523)

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

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. A constant- source boron diffusion is performed into a n-type silicon wafer at 1050 ^oC for an hour. Assume that surface concentration is limited by solid solubility limit. Given that surface solubility is 2.4 x10 ^{20} /cm^3. If n-type background doping of silicon is 5 x 10 ^{16} /cm^3 find the junction depth. Given that D_o = 1.0 x Cm ^{2}/sec., and activation energy is 3.5 eV.

1B. Predict the concentration of oxygen in the crystal at a fraction solidified of 0.4. Given the segregation co-efficient of oxygen is 0.25. Given that the fraction of oxygen atoms solidified at the top is 1.3 x 10 ^{18} / Cm ^{3}. And comment on the result

1C. 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.

(5+2+3)

2A. A 1000-Å gate oxide is required for some technology. It has been decided that the oxidation will be carried-out in wet oxygen. If there is no initial oxide, for how long the oxidation be done? If the oxidation be in linear or parabolic regime or between two? Given that: A = 0.50 µm and B= 0.203 µm ^{2} / hour

2B. Explain significance of the parameter τ in the contest of ultra-thin oxides.

2C. Calculate the diffusivity of arsenic in Silicon at 1000 ^oC if the concentration of Arsenic is much less than intrinsic carrier concentration and again if the arsenic concentration is 1 x 10 ^{19} cm $^{-3}$. Intrinsic carrier concentration for Si at 1000 ^oC is 1 x 10 ^{19}. Given that: D_o = 0.066 and E_a = 3.44, D_o^- (diffusivity for negatively ionised vacancy) = 12.0 and corresponding E_a = 4.05 eV.

(4+3+3)

3A. Phosphorus is added to a silicon wafer from a gaseous source at 975 ^oC for 30 minutes. Determine the junction depth for i) 0.3Ω Cm p-type substrate (N_A = 6.3 x 10 ^{16} cm $^{-3}$) and ii) 20 Ω-cm p-type substrate (N_A = 6.8 x 10 ^{18} Cm $^{-3}$). Diffusion co-efficient of Phosphorous is 10 $^{-13}$ cm ^{2} S $^{-1}$ and that its solid solubility is 10 ^{21} cm $^{-3}$ at 975 ^oC.

3B. Write short note on: i) Extrinsic -diffusion of dopant atoms. ii) Emitter push effect in silicon n-p-n transistors.

(5+5)

4A. Compare and contrast optics of contact, proximity and projection printers and areal image formation

4B. A proximity printer operates with a 10 µm mask-wafer gap and a wavelength of 430 nm. Another printer uses 40 µm gap and wavelength 250nm. Which offers higher resolution?

4C. . Why must the mask used in a wafer stepper be completely be free from defects while some defects be tolerated in systems exposing entire wafer at once?

(5+3+2)

5A. State the chemical reactions that are relevant for the Silicon growth by chemical vapour deposition technique?

5B. Explain different methods of wafer cleaning and native oxide removal before initiating thin film growth process.

5C. Explain limitations of CV technique for impurity profile determinations

(3+3+4)

6 Answer the following with proper explanation.

i) Low-pressure CVD is ---- controlled reaction whereas atmospheric CVD is -------- controlled reaction.

ii) If a process relies on ion-bombardment of the wafers, would you want to put the wafers on the electrode with --- surface area electrode in the plasma-chamber.

iii) How CVD techniques score over PVD techniques?

iv) State two accurate optical techniques to measure the thickness of oxide.

v) Explain a method to purify hydrogen to be used in pre-clean methods of VPE.

(2*5)

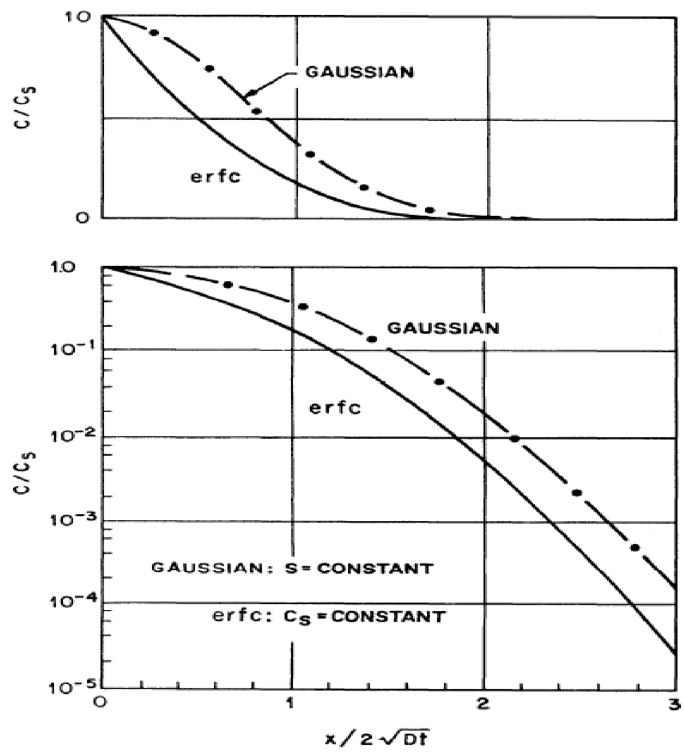

Figure : Normalised concentration verses normalised distance for erfc and Gaussian functions.