Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FIFTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION NOV/DEC 2015

SUBJECT: VLSI PROCESS TECHNOLOGY (ECE - 323)

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

Instructions to candidates

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

1A. Identify the type of etching done for silicon in each case in Fig 1A. Explain the basic processes involved in Plasma etching of silicon.

1B. Explain the fabrication of polysilicon film resistor with neat diagram.

(6+4)

2A. Derive the equation for doping distribution function of fraction solidified in CZ process. Suppose your company was in the business of producing silicon wafers for the semiconductor industry by the CZ growth process. Suppose you had to produce the maximum number of wafers per boule that met a fairly tight resistivity specification. Would you prefer to grow N type or P type crystals? Why?

2B. Explain the basic set-up of ion implanter system.

(6+4)

3A. Determine the final SiO2 thickness for the following wafer (Assume initial oxide thickness is 0). Repeat the same for <100> crystal. Use Table 3A.
Wafer A: <111> oriented Si substrate
1st step: dry oxidation
temperature = 1050 ^oC; pressure = 1 atmosphere; time = 30 minutes.
2nd step: wet oxidation
temperature = 1100 ^oC; pressure = 1 atmosphere; time = 30 minutes.

3B. Explain the e-beam evaporation process with neat diagram

(6+4)

4A. Explain the constant-Total dopant diffusions. A constant-source boron diffusion is performed into an n-type silicon wafer. The diffusion temperature is 1050°C and the diffusion time is 1 hour. Assume that the surface concentration is limited by the solid solubility limit. If the n-type background doping of the silicon is $5x10^{16}$ cm^{-3}, find the junction depth. Given Do= 1 cm^2/s, Ea=3.5eV, $Ns \approx 2.4x10^{20}$ cm^{-3}, k_B=8.617x10^{-5} eV/K, erf(2.63)=0.9998

4B. Plot resolution and depth of field as a function of exposure wavelength for a projection aligner with 100nm < λ < 500nm in step of 100 nm. Assume NA = 0.26. Discuss the implication of these plots for the technologist that must manufacture transistors with 0.5μ*m* features. Given ArF DUV= 193 nm.

(6+4)

5A. Arsenic is implanted into a lightly doped p-type Si substrate at an energy of 75keV. The dose is $1\times10^{14}/cm^2$. The Si substrate is tilted 7° with respect to the ion beam to make it appear amorphous. The implanted region is assumed to be rapidly annealed so that complete electrical activation is achieved. What is the peak electron concentration produced? Given $R_P = 0.05\mu m$ $\Delta R_P = 0.02\mu m$. List three advantages of ion implantation over diffusion.

5B. Explain the fabrication of MOS capacitor with neat diagram.

(6+4)

6A. Sketch following (i) (3-1-2) (ii) [12-2] (iii) (11-3) (iv) [-2-21]

6B. Explain homoepitaxy and heteroepitaxy with an example.

(6+4)

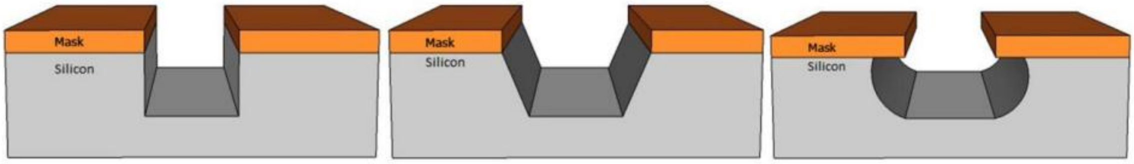

Figure 1A. (a) (b) (c)

Table 1. Wet and dry oxidation of Silicon

Oxidation temperature (°C)	Wet oxidation A (µm)	Wet oxidation B (µm²/hr)	Dry oxidation A (µm)	Dry oxidation B (µm²/hr)
1200	0.05	0.720	0.04	0.045
1100	0.11	0.510	0.09	0.027
1000	0.226	0.287	0.165	0.0117
920	0.50	0.203	0.235	0.0049
800			0.37	0.0011