M.TECH/VLSI/1ST SEM/VLSI 5132/2019

VLSI IC FABRICATION
(VLSI 5132)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Class 1000 clean room means number of particle size up to 0.1 μm
(a) 1 no (b) 1×10^3 nos
(c) 1×10^2 nos (d) none of these.

(ii) Pure Silicon extraction process is
(a) Bridgman technique (b) Czochralski technique
(c) Float zone technique (d) none of these.

(iii) Optical masking is used for
(a) pattern transfer (b) oxidation
(c) protection (d) cleaning.

(iv) Localized defects in an atomic dimension is called
(a) point defect (b) lattice defect
(c) atomic defect (d) none of these.

(v) In IC fabrication the photoresist layer is exposed to
(a) ultraviolet light (b) infra red light
(c) fluorescent light (d) visible light.

(vi) In nmos fabrication etching is done using
(a) plasma (b) hydrochloric acid
(c) sulphuric acid (d) oxalic acid.

(vii) Heavily doped polysilicon is deposited using
(a) chemical vapour decomposition
(b) chemical vapour deposition
(c) chemical decomposition
(d) dry deposition.

(viii) When the oxide growth time is large, the oxide rate curve is
(a) parabolic (b) linear
(c) hyperbolic (d) none of these.

(ix) Plasma etching process is a
(a) dry etching (b) wet etching
(c) chemical etching (d) none of these.

(x) Sputtering is a ___________ process.
(a) physical (b) chemical
(c) mechanical (d) electrical

Group – B

2. (a) Describe the process for growth of Silicon using Czochralski method.

(b) Prove that if a SiO_2 layer is grown by thermal oxidation, the thickness of Si consumed is 0.44 times the thickness of SiO_2. Given, the molecular weight of Si is 28.9 g/mol and the density of Si is 2.33 g/cm^3. The corresponding values for SiO_2 are 60.08 g/mol and 2.21 g/cm^3.

6 + 6 = 12

3. (a) What are the different types of charges that exist at or near the Si/SiO_2 interface of a MOSFET? How can these charges affect the performance of the transistor?

(b) Differentiate between LOCOS and STI techniques of oxidation.

(4 + 2) + 6 = 12

Group – C

4. (a) What are Fick's 1st law and 2nd law of diffusion? What are the influential parameters to control the diffusion rate of impurities into semiconductor lattice?

(b) In thermal oxidation, mathematically find out the concentration of oxidizing species in inner surface and outer surface of oxide layer.

(3 + 3) + 6 = 12

5. (a) Discuss the advantages of doping using ion implantation method over the diffusion method.

(b) Explain the basic principle of operation of an ion-implantation system with a suitable diagram.

4 + 8 = 12

Group – D

6. (a) What is wet chemical etching? What are the characteristics of an ideal etchant used for wet chemical etching?

   (b) Describe about dry and plasma etching. What are the differences between diffusion and ion implantation? Describe the ion implantation system in IC fabrication technology.

(2 + 3) + (2 + 2 + 3) = 12

7. (a) What is a positive photoresist?

   (b) Explain with suitable diagrams the steps of pattern transfer using a negative photoresist.

2 + 10 = 12

Group – E

8. (a) What do you mean by Thin Film? Give some application of Thin Film Technology. What do you mean by Ion Sputtering Technique?

   (b) Describe the n-well fabrication process.

(1 + 2 + 3) + 6 = 12

9. (a) Draw the cross-sectional structure of a CMOS inverter.

   (b) Discuss the fabrication steps of GaAs MESFET. Mention some salient features of GaAs MESFET.

6 + 6 = 12