

2020

ELECTRONICS — GENERAL

Paper : DSE-A-1

(Semiconductor Devices Fabrication)

Full Marks : 50

The figures in the margin indicate full marks.

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

Day 3

Answer **question no. 1** and **any four** questions from the rest.

1. Answer **any ten** questions :

1×10

- (a) Singlecrystalline material has
- (i) long range atomic order
 - (ii) short range atomic order
 - (iii) no atomic order
 - (iv) none of the above.
- (b) In normal thermal evaporation system, source heating is done by
- (i) resistive heating
 - (ii) inductive heating
 - (iii) e-beam
 - (iv) laser ray.
- (c) In epitaxial growth
- (i) single crystal layer is grown on single crystal substrate
 - (ii) polycrystalline layer is grown on single crystal substrate
 - (iii) amorphous layer is grown on polycrystalline substrate
 - (iv) none of the above.
- (d) Lithography is primarily used to / for
- (i) grow new crystalline layer
 - (ii) imaging the sample
 - (iii) transfer geometric patterns to a film or substrate
 - (iv) None of the above.
- (e) A positive photoresist is a type of photoresist in which the portion of the photoresist that is exposed to light becomes _____ to the photoresist developer.
- (i) insoluble
 - (ii) soluble
 - (iii) semi-soluble
 - (iv) None of these.

Please Turn Over

- (f) Etching refers to a technique
- (i) that will enhance the crystallinity of a thin film
 - (ii) that will grow a thin film on a substrate
 - (iii) that will remove material from a thin film on a substrate
 - (iv) none of the above.
- (g) Schottky barrier is formed in
- (i) semiconductor-semiconductor junction
 - (ii) metal-semiconductor junction
 - (iii) metal-metal junction
 - (iv) None of the above.
- (h) Penning gauge is a
- (i) thermal conductivity gauge
 - (ii) cold cathode type ionization gauge
 - (iii) hot anode type gauge
 - (iv) none of these.
- (i) One atmospheric pressure equal to
- (i) 1 torr
 - (ii) 76 torr
 - (iii) 760 torr
 - (iv) 1000 torr.
- (j) Czochralski Technique is used to grow
- (i) Amorphous Si
 - (ii) Polycrystalline Si
 - (iii) Single crystal Si
 - (iv) None of the above.
- (k) MEMS stand for
- (i) Micro Electro Mechanical System
 - (ii) Macro Electro Mechanical System
 - (iii) Micro Electrical Mechanical System
 - (iv) Micro Electro Material System.
- (l) RIE is a process name related to
- (i) Effusion
 - (ii) Electromigration
 - (iii) Etching
 - (iv) Electroluminacense.
2. (a) What is semiconductor?
- (b) Compare metal, semiconductor and insulator in term of their band gap.
- (c) What are point and line defects in crystals? Explain with diagram. 2+3+5
3. (a) What is polycrystalline material?
- (b) What is grain boundary?
- (c) Compare single crystalline, polycrystalline and amorphous materials.
- (d) What is epitaxy? Write down the name of two epitaxial film growth techniques. 2+2+3+3

4. (a) What are thin and thick films?
(b) Why vacuum system is required in thin film deposition process?
(c) Explain the working principal of an oil diffusion pump. 3+2+5
5. (a) What are the advantages of RF sputtering over DC sputtering technique?
(b) Explain with schematic diagram the working principle of a thermal evaporation system.
(c) How does a Pirani gauge work? 2+4+4
6. (a) Why Si is usually preferred for the fabrication of ICs?
(b) Explain briefly the growth process of Si ingots by Czochralski technique.
(c) Can you use depletion type MOSFETs in enhancement modes? 2+5+3
7. (a) Why MOSFET is called unipolar device?
(b) In what condition a metal-n-type semiconductor junction is rectifying? Explain with band diagram.
(c) What is negative photoresist?
(d) Compare photolithography and e-beam lithography techniques. 2+4+2+2
8. (a) What is the use of ion-implantation in device fabrication?
(b) Compare isotropic and anisotropic etching.
(c) What are the advantages and disadvantages of reactive ion etching over wet chemical etching?
(d) Explain briefly the fabrication process of a PNP transistor. 2+2+2+4
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