

**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 1**

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

**1.** Answer **any ten** questions :

1×10

- (a) The common *n*-type dopant in *Si* is
- |                |               |
|----------------|---------------|
| (i) Phosphorus | (ii) Aluminum |
| (iii) Boron    | (iv) Gallium. |
- (b) Schottky defects are
- |                               |                    |
|-------------------------------|--------------------|
| (i) point defects             | (ii) line defects  |
| (iii) non-equilibrium defects | (iv) all of these. |
- (c) Czochralski technique produces
- |  |                                |
|--|--------------------------------|
| (i) single crystalline <i>Si</i> wafer | (ii) amorphous <i>Si</i> wafer |
| (iii) polycrystalline <i>Si</i> wafer  | (iv) none of these.            |
- (d) One atmospheric pressure equal to
- |                |                 |
|----------------|-----------------|
| (i) 1 torr     | (ii) 76 torr    |
| (iii) 760 torr | (iv) 1000 torr. |
- (e) Penning gauge is a
- |                                |   |
|--------------------------------|---|
| (i) thermal conductivity gauge | (ii) cold cathode type ionization gauge |
| (iii) electron beam gauge      | (iv) none of these.                     |
- (f) RF sputtering is useful for thin film deposition of
- |  |
|--|
| (i) conducting materials only                          |
| (ii) non-conducting materials only                     |
| (iii) both the conducting and non-conducting materials |
| (iv) none of these.                                    |

**Please Turn Over**

- (g) For the deposition of epitaxial thin film which deposition technique would you prefer?
- (i) Thermal evaporation
  - (ii) Sputtering
  - (iii) Chemical vapor deposition
  - (iv) None of these.
- (h) Molecular beam epitaxy (MBE) is a
- (i) inexpensive thin film deposition technique
  - (ii) physical-vapor deposition technique
  - (iii) chemical-vapor deposition technique
  - (iv) none of these.
- (i) Assuming constant diffusivity, the doping profile for an infinite source diffusion process can be approximated as
- (i) Gaussian
  - (ii) Exponential
  - (iii) Erfc
  - (iv) Pearson IV.
- (j) Which of the following is/are microwave device(s)?
- (i) LED
  - (ii) Gunn diode
  - (iii) Tunnel diode
  - (iv) Solar cells.
- (k) RAM is a memory device of \_\_\_\_\_ type.
- (i) volatile
  - (ii) non-volatile
  - (iii) magnetic
  - (iv) optical
- (l) Which of the following statement(s) is/are true?
- (i) Positive photoresist softens on exposure to UV light
  - (ii) Positive photoresist hardens on exposure to UV light
  - (iii) Negative photoresist softens on exposure to UV light
  - (iv) Negative photoresist hardens on exposure to UV light.

2. (a) What is semiconductor?

(b) Compare metal, semiconductor and insulator in term of their band gap.

(c) How many types of point defects are there in ionic crystals? Explain briefly with diagram.

2+3+5

3. (a) What is crystal?

(b) Compare single crystalline, polycrystalline and amorphous materials.

(c) Explain briefly the growth process of Si ingots by Czochralski technique.

2+3+5

4. (a) Why vacuum system is required in thin film deposition system?  
(b) Explain the working principal of a rotary vacuum pump.  
(c) What is the function of cold trap in diffusion pumps? 2+5+3
5. (a) What are the advantages and disadvantages of electron beam evaporation over thermal evaporation technique?  
(b) Explain with schematic diagram the working principle of DC sputtering system.  
(c) How does a Pirani gauge work? 2+4+4
6. (a) Why does oxidation important in device fabrication?  
(b) In what conditions metal-semiconductor (both  $n$  and  $p$  type) junctions are rectifying? Explain with band diagram.  
(c) Compare depletion and enhancement mode MOSFETs. 3+5+2
7. (a) What is Electron Beam Lithography? Why it is required? How it is different from photolithography?  
(b) Explain briefly the operation of a CMOS inverter circuit.  
(c) Write down the names of commonly used optical memory devices. (2+1+2)+3+2
8. (a) How materials are selected for MEMS devices?  
(b) Compare isotropic and anisotropic etching.  
(c) What are the advantages and disadvantages of Reactive Ion Etching (RIE) over wet chemical etching?  
(d) Explain briefly the fabrication process of a PN junction diode. 2+2+2+4
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