[This question paper contains 4 printed pages.]

**1019** *Your Roll No.* .....

**B.Sc. (Hons.) / III** **C**

ELECTRONIC SCIENCE – Paper 3.5 (XIX)

(Material Science and I.C. Technology)

*Time : 3 Hours* *Maximum Marks : 38*

*(Write your Roll No. on the top immediately on receipt of this question paper.)*

*Attempt* **five** *questions in all, including Question No.* **1** *which is compulsory. Non-programmable scientific calculator is allowed.*

1. (a) Draw a flowchart outlining how EGS can be obtained.

(b) In VPE, the growth temperature must be kept high to obtain high quality epitaxial film. Why ?

(c) If the time a wafer is oxidized is doubled does the oxide thickness double ? If not, then how it varies.

P.T.O.

(d) Why is $Si_3N_4$ required in the LOCOS technique ?

(e) Distinguish between positive and negative resist and give one example for each. (2×5)

2. (a) Explain the CZ technique for growing single crystal of silicon. What changes are necessary if we need to grow GaAs using this method ? (4)

(b) A Si ingot which should contain $10^{16}$ boron atoms/ $cm^3$ is to be grown by CZ method. What concentration of boron atoms must be there in the melt to give the required concentration in the ingot ? If the initial load of Si in the crucible is 60 kg. how many grams boron (atomic weight 10.8 g mole) should be added. Given that $k_0 = 0.8$. Density of molten Si = 2.53g/$cm^3$. (3)

3. (a) What is the need for Epitaxy and how is the epitaxial process different from melt growth process ? (3)

(b) Explain the kinetics of growth of VPE. Show that if the surface reaction rate constant (ks) is much larger than vapor phase mass transfer coefficient (hg). the growth rate is referred to as mass transfer controlled. (4)

4. (a) Explain the kinetics of growth during thermal oxidation with suitable equations showing that during early stages of oxidation, the oxide thickness varies linearly with time while for larger times it results in parabolic growth rates. (3)

(b) Which metal is used extensively for metallization in integrated circuits and why ? What are its shortcomings as a metallization material and how can they be overcome ? (4)

5. (a) What is predeposition diffusion ? Show that the diffusion profile obtained during predeposition step is an erfc profile. (4)

(b) Discuss the advantages and disadvantages of using ion implantation process as an alternative to diffusion process. (3)

6. (a) What is electron beam lithography. Give its schematic diagram. What are its advantages and disadvantages ? (4)

(b) Discuss the principle of X-ray diffraction (XRD) technique and explain its use for material characterization. (3)

P.T.O.

7. (a) Explain the various steps involved in the fabrication of npn transistor. What is the significance of buried layer in BJT fabrication. (4)

(b) Why is it preferable to start with an n-substrate and form p-well in CMOS fabrication? Why is <100> orientation preferred in NMOS fabrication? (3)