Ex/ET/T/315/2018

BETCE Examination, 2018 (UG)
(3rd year, 1st semester)
Subject: IC TECHNOLOGY

Full Marks: 100 Time: Three hours

Answer any **five questions** (twenty marks each)
All the sub-questions should be answered in one place
The answers should be exact and precise
The figures in the margin indicate full marks

Q1 (a) Calculate the atomic packing factor for face centered cubic structure 5

(b) Calculate the c/a ratio for a hexagonal closed packed structure 5

(c) Classify solid solutions with examples 4

(d) What is Gibb's free energy? How does it modify with temperature explain with example 6

Q2 (a) What are the different types of defects in a crystal? Explain with appropriate diagrams. 2+10

(b) Draw the Burger Vector for edge dislocations 3

(c) Compute the line energy of dislocations in BCC iron (a= 2.87Å). The Burgers vector of iron is of ½<111> type. The shear modulus of iron is $80.2 GNm^{-2}$. 5

Q3 (a) Prove that "Reciprocal lattice of BCC is FCC and vice versa" 8

(b) Explain the generation of characteristic x-ray with schematic diagram of the x-ray tube 6

(c) Describe the Czochralski method for converting polycrystalline EGS into single crystal ingot 6

Q4 (a) Find out the number of atoms per cubic centimetre of Silicon (a=5.431Å)? 2

(b) What is the purity of bulk silicon necessary for integrated circuits? 1

(c) A boron doped crystal is required to have a resistivity of 25.0 ohm-cm when 50% of the crystal is grown, *i.e.*, halfway down the ingot from the top or seed end. Assuming that a 100 kg charge of pure silicon is used and neglecting any silicon added to the melt by the seed,

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what is the required initial concentration of boron in the melt? Ignore density differences between the solid and the melt, assume that the melt is well stirred, the distribution coefficient for boron is 0.72, all resistivities are measured at 300K, and that at 300K the hole mobility is 480 cm^2/volt-sec and the electron mobility is 1250 cm^2/V sec. 6

(d) What are the problems associated with CZ growth techniques? How are the problems overcome using float-zone technique? 3+4

(e) Briefly describe the doping distribution of float zone technique? 4

Q5 (a) State the two Fick's Laws of Diffusion. 3

(b) Cite examples for (i) solid source (ii) liquid source and (iii) gas source diffusion system 3

(c) Explain graphically the diffusion from an (i) infinite source and (ii) limited source on surface. Show the two distribution profiles at a constant temperature, for increasing time. 8

(d) How can a simple NPN BJT be formed using diffusion? Show the doping profiles. 4

(e) Derive the activation energy for intrinsic diffusion 2

Q6 (a) Describe with an appropriate diagram an ion implanter system. 6

(b) What are the different types of stopping mechanisms? Explain with the energy loss profiles. 2+3

(c) What are lateral and longitudinal straggles? 4

(d) How are the damages from ion implantation process mitigated? 5

Q7 (a) What are the different susceptor configurations used in CVD technique? 6

(b) Describe the criteria for the deposition of epitaxial Silicon on to a Silicon substrate 4

(c) What is sputtering? Classify sputtering processes. What are the advantages of magnetron sputtering over the conventional sputtering processes? 2+2+2

(d) Describe the reactant-transport steps of atmospheric CVD for film deposition. 4

Q8. (a) What is non-conformal step coverage? What does it depend on? 4

(b) Explain the role of PECVD in ensuring conformal step coverage of SiO_2 Film 3

(c) What is photolithography? What are the different exposure systems? 2+3

(d) Define the Mask set for 2-input NAND gate for process integration 6

(e) Enlist the steps of photolithography 2