Question Paper

Exam Date & Time: 02-May-2024 (10:00 AM - 01:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

Manipal School of Information Sciences (MSIS), Manipal
Second Semester Master of Engineering - ME (Microelectronics and VLSI Technology) Degree Examination - April / May 2024

Process and Device Characterization [MVT 5201]

Marks: 100 **Duration: 180 mins.**

Thursday, May 02, 2024

Answer all the questions.

1) With examples of clean room compatible materials, illustrate the differences between body centric cubic (BCC) structure and face center cubic (FCC) structure w.r.t number of atoms/unit cell, atomic radius, coordinate number and atomic packing factor (APF). (10)

2) With graphs and mathematical models, illustrate the dependence of equilibrium concentration on temperature. Further, compute the equilibrium number of vacancies in 1 m^3 of Cu at 1000°C. Given: ρ=8.4 g/cm^3, A_{Cu}= 63.5g/mol, Q_V= 0.9eV/atom, N_A= 6.02 x10^{23} atoms/mol. (10)

3) Write the limitations of two-probe measurement technique for resistivity. Further, with neat figures and mathematical models, illustrate the method of four probe resistivity measurement. (10)

4) Compare the various combinations of metal, semiconductor and oxide typically encountered in VLSI semiconductor devices with energy band diagrams. Further, depict the impact of variation in doping concentration and temperature on any one of the combinations with the energy band diagrams. (10)

5) With energy band diagrams, analyze the concept of metal-semiconductor barrier under accumulation, neutral and depletion modes of operation. (10)

6) Analyze the impact of defects on Gate integrity of a typical MOSFET device. Further, examine the impact of defect on the device parameters of MOSFETs and thereby on digital CMOS inverter performance. (10)

7) Compare the phenomenon of electron diffraction and ion backscattering. (10)

8) Analyze the various possible characterization techniques in which the incident particle is an electron. Further, cite at-least 5 specifications of a characterization technique along with its physical significance in sample characterization. (10)

9) Examine Auger Electron Spectroscopy (AES) characterization technique (10)

w.r.t physics of operation, experimental set up, limitations and applications in VLSI.

10) Analyze atomic force microscopy (AFM) technique w.r.t the physics of operation, experimental set up and applications for reliability analysis of VLSI ICs. (10)

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