



MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics & Communication Engineering (SEEC)

Department of Electronics & Communication Engineering
Course Hand-out

VLSI/ULSI Process Technology | EC 1551 | 4 Credits | 4 0 0 4

Session: Jul 14 – Dec 14 | Faculty: Nitin Gupta |

A. Course Outcomes: At the end of the course, students will be able to

- [1551.1] Illustrate the manufacturing methods and their underlying scientific principles in the context of technologies used in VLSI fabrication.
- [1551.2] Apply knowledge of VLSI Fabrication principles in real time problems and enable to develop employability skills.
- [1551.3] Explain fabrication processes such as crystal growth, epitaxy, oxidation, lithography, etching, diffusion and metallization.
- [1551.4] Contrast characteristics of various semiconductor materials used for fabrication.
- [1551.5] Explain different crystals and their characteristic parameters.

B. SYLLABUS

Material properties: Physical properties, Crystal structure, Miller indices, Packing Density, Defects, Dislocation;

Crystal growth: Silicon Crystal Growth - Czochralski and Float Zone Technique, Distribution of dopants, Segregation/Distribution coefficient;

Silicon oxidation: Thermal Oxidation process- Kinetics of Growth, Deal-Grove Model, Impurity Distribution, Masking properties, Oxide thickness characterization, LOCOS, SWAMI;

Photolithography: Photo resists, Lift Off technique, Optical Lithography, masks, photo resists, Pattern transfer, Resolution enhancement techniques, Next generation lithography- electron beam lithography, X-ray lithography, Ion beam lithography;

Diffusion: Basic diffusion process, Fick's law, Pre-deposition and drive-in diffusion, Diffusion profile for various dopants, Lateral Diffusion; **Ion implantation:** Range of Implanted Ions, straggle, ion stopping, ion Channeling, Annealing, Rapid Thermal Annealing, Measuring sheet resistance and doping profile;

Etching: Wet chemical etching of Silicon, Silicon dioxide, Silicon Nitride and Aluminum. Dry etching, Plasma fundamentals and etch mechanism;

Epitaxy: Epitaxial growth technique, Molecular beam epitaxy;

Metallization: evaporation and sputtering, Realizing resistor, capacitor, BJT, MOSFET, electromigration; **Single and double damascene process.**

C. TEXT BOOKS

1. S. M. Sze, *VLSI Technology, Second Edition, McGraw Hill, 1988.*
2. S.K. Gandhi, *VLSI Fabrication Principles, Second Edition, John Wiley & Sons, 1983.*

D. REFERENCE BOOKS

1. S. A. Campbell, *The Science & Engineering of Microelectronic Fabrication, Second Edition, Oxford University Press, 2005.*
2. G.S. May & S. M. Sze, *Fundamentals of Semiconductor Fabrication, Wiley, 2004.*

