Nano Electronics & MEMS (404212)

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Assessment:
Phase I : 30
End Semester Examination:
Phase II: 70

Course Objectives:

- To understand the Nano-CMOS Devices.
- To learn the applications of nanotechnology in electronics.
- To understand the various MEMS controls.
- To learn different types of MEMS transducers.

Course Outcomes:

After successfully completing the course students will be able to

- Explain the properties of Nano particles and Nanotube with their applications in electronics.
- Identify the suitable MEMS transducer for a given electronic system

Unit I : **Introduction to Nano-CMOS Devices** 6L

Introduction to Nanotechnology: Fundamental science behind nanotechnology, tools for measuring nanostructures, tools to make nanostructures and imagine nano-behaviours Silicon Nanocrystal non volatile memories, Novel dielectric materials for future transistors, Nano-CMOS devices and applications. Tools for measuring nanostructures, scanning probe instrument, nanoscale lithography.

Unit II : **Nano particles and Nanotubes** 6L

Properties of Nano particles: Metal nanostructures and semiconducting nanoparticles, Carbon nanostructures: carbon molecules, clusters, nanotubes, properties of nanotubes-strength and elasticity, applications of carbon nanotubes.

Unit III : **Nanotechnology in Electronics** 6L

Use of Nanotechnology in Electronics: Application of nano structures in electronics, sensors, optics, energy capture, transformation and storage. Application of nanotechnology in biomedical electronics.

Unit IV : **Introduction to MEMS** 6L

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes.

Unit V : **Control and Materials of MEMS** 6L

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon piezoresisters, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

Unit VI : **Transducers** 6L

Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.
Chemical and Biological Transducers: basic concepts of cellular biology, chemical sensors, molecule-based biosensors, cell-based biosensors, chemical actuators, biological transducers.

Text Books

1. Nanotechnology: A Gentle Introduction to the Next Big Idea, Mark ratner,Daniel Rattner, ISBN-10:0-13-101400-5.
2. Kovacs, Gregory T. A. "Micromachined Transducers Sourcebook" McGraw-Hill
3. Charles P. Poole Jr., Frank J. Owens, "Introduction to Nanotechnology", John Wiley & Sons.
4. Jan G Korvinik and Oliver Paul, "MEMS Practical Guide to Design, analysis and Applications" William Andrew, Inc Springer

Reference Books

1. Springer Handbook of Nanotechnology ISBN: 978-3-540-35172-6
2. Nanotechnology :Principals &practices, Sulbha K.Kulkarni,Capital publishing company, ISBN:-81-85589-29-1