PEI202: MICRO-SENSORS AND ACTUATORS

L	T	P	Cr
3	1	0	3.5

Course Objectives: To understand the concepts of working of Micro-sensors and actuators, to enable selection, design and configuration of Micro-sensors and actuators

Over View of Mems and Microsystems: Definition – historical development, fundamental properties, micro fluidics, design and fabrication micro-system, microelectronics, working principle and applications of micro system.

Materials, Fabrication Processes and Micro System Packaging: Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds silicon piezo resistors, Gallium arsenide, quartz, polymers for MEMS, conductive polymers. Photolithography, photo resist applications, light sources in implantation, diffusion process oxidation – thermal oxidation, silicon diode, chemical vapour deposition, sputtering - deposition by epitoxy–etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level.

Micro-Sensors and Micro-Actuators: Electrostatic sensors, Parallel plate capacitors,, Applications, Inter-digitated Finger capacitor, Comb drive devices . Thermal Sensing and Actuation, Thermal expansion, Thermal resistors Applications, Magnetic Actuators, Micromagnetic components.

Case studies of MEMS in magnetic actuators: Piezoresistive sensors – Piezoresistive sensor materials, Stress analysis of mechanical elements, Applications to Inertia, Pressure, Tactile and Flow sensors. Piezoelectric sensors and actuators piezoelectric materials, Applications to Inertia, Acoustic, Tactile and Flow sensors. Microactuator examples, microvalves, micropumps, micromotors Microactuator systems: Ink-Jet printer heads, Micro-mirror TV Projector.

Bio-MEMS: Introduction to Bio MEMS, Cell Electrophysiology, Silicon Micro-fabrication, Micro-fluidics and Bio-MEMS applications, MEMS for Drug delivery.

Communication standard: IEEE P1451 standard WG

Course learning outcome (CLO): After the completion of the course the students will be able to

1. Design MEMS system.
2. Handle Magnetic MEMS for process applications.
3. Use Bio-MEMS for process measurements.

Recommended Books:

1. *Gardner, J. W., Microsensors, Principles and Applications, John Wiley (2008).*
2. *Gregory T. Korvacs, Micromachined Transducer sourcebook, McGraw Hill (1998).*
3. *Turner, A.P.F., and Wilson, G.S., Biosensors□Fundamentals and applications, Oxford University Press (2005).*
4. *William T., Micromechanics and MEMS, IEEE Press (1997).*
5. *Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.*

Evaluation Scheme:

Evaluation Elements	Weightage (%)
MST	30
EST	45
Sessionals (May include Assignments/ Projects/ Tutorials/ Quizes/ Lab Evaluations)	25