Course Type	Course Code	Name of Course	L	T	P	Credit
DE	ECD412	MEMS and its applications	3	0	0	9

Course Objective
The objective of the course is to present an introductory idea on Micro Electro Mechanical Systems, with an emphasis on various types of sensors and actuators and systems – and their characteristics.
Learning Outcomes
Upon successful completion of this course, students will: • have a broad understanding of Micro Electro Mechanical Systems. • have a high-level understanding of major types of sensors and actuators and systems • be able to analyze measuring and sensing techniques effectively

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	INTRODUCTION: MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, Mechanical Sensors And Actuators: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.	11	Overview of MEMS systems, operating principles, and mechanisms. Understanding of sensing and actuation of different measurement systems and new technologies.
2	THERMAL SENSORS AND ACTUATORS: Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever	11	Basic understanding of heat transfer processes and components that employ them along with other electric techniques. Broad understanding of actuators and cantilevers.
3	MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.	10	Pinciples of MOEMS technology and different modulators and devices and detectors for tuning and measurement.
4	CHEMICAL AND BIO MEDICAL MICRO SYSTEMS: Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.	10	Concepts of sensing and chemical and mio medical micro systems for detection and spectroscopy.

Text Books:

1. Foundation of MEMS, Chang Liu, Pearson Education (2011).

Reference Books:

1. MEMS, Nitaigour Premchand Mahalik, TMH (2007).
2. MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.