ECE3092: INTRODUCTION TO MICRO-ELECTRO-MECHANICAL-SYSTEMS

Programme: B.Tech. Year: 3rd Semester: Even
Course: Other Elective Credits: 3 Hours: 40

Course Context and Overview (100 words):

In today's interconnected world, entire systems are designed using miniaturized sensors and connecting them to a network. Microfabricated sensors are found everywhere, from the smartphone inside your pocket to rocket launchers. What is the whole process of microfabrication? What makes it so special? What kind of sensors and devices can be made using microfabrication? This course will attempt to answer these questions.

This course will begin with a history and salient features of MEMS technology. Then the microfabrication processes will be discussed in depth. We will then discuss how to design a process flow to microfabricate a sensor (eg. Cantilever). Finally, two or three sensors/applications will be discussed as case studies.

This is an inter-disciplinary course which should cater to students seeking information regarding microfabrication of sensors using MEMS technology.

Prerequisites Courses: Basic calculus.

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: Understand the benefits of MEMS technology.
CO2: Become aware of general microfabrication technologies.
CO3: Understand bulk and surface micromachining .
CO4: Be able to design a basic process-flow for a simple mechanical device (eg. Cantilever).
CO5: Be able to perform literature survey of a particular MEMS application and prepare report.

Course Topics:

Topics	Lecture Hours
UNIT – I (Introduction to MEMS)	**6**
Course information, History of MEMS, salient features and some applications	
Clean-room fundamentals	
Introduction to MEMS applications	
Introduction to MEMS fabrication	
UNIT – II (MEMS elements and devices)	**12**
Micromachined passive elements: capacitors, tunable capacitors	
MEMS physical sensors, thermal, electrical, mechanical	
Microactuators	
Chemical and biosensors, BioMEMS	
Optical MEMS	

UNIT – III (Microfabrication)	**14**
Dry and wet oxidation	
Various CVD and PVD techniques	
Bulk and surface micromachining	
Photolithography	
Dry and wet etching	
UNIT – IV (Advanced MEMS techniques)	**2**
LIGA, molecular beam epitaxy, novel techniques	
UNIT-V (Process flow development and Packaging)	**2**
Process flow basics	
Packaging of MEMS - Introduction	
Process flow development of a microcantilever	
UNIT-VI (Case studies – research papers)	**4**
Sensor 1 (optical or mechanical or chemical)	
Project – Case study (1 sensor will be given to each group – presentation).	

Textbook references (IEEE format):
Text Book:

1. *Fundamentals of microfabrication and nanotechnology*, Madou, Marc J., 2012. Boca Raton, FL: CRC Press.
2. *Foundations of MEMS (2nd edition),* Chang Liu, 2011, Prentice Hall.

Reference book:
Microsystem Design, Senturia, Stephen D., Kluwer Academic Publishers
Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

1. https://nptel.ac.in/courses/108108113/1
2. http://www.nptelvideos.in/2012/12/mems-microsystems.html

Evaluation Methods:

Item	Units	Weightage (%)
Quiz 1	1 and 2	10
Midterm	1, 2 part of 3	20
Quiz 2	3 and 4	10
Term paper (case study)	6	10
Case study ppt and viva		10
Final examination	Complete	40

Please note, as per the notice circulated in the ECE department on 5th March 2018 students having attendance less than 60% will not be allowed to sit in the final examination.

Updated By: Dr. Gaurav Chatterjee