Course Number and Name

BEC008 - MEMS AND NEMS

Credits and Contact Hours

3 and 45

Course Coordinator's Name

Dr E.Kanniga

Text Books and References

TEXT BOOKS:

1. Marc Madou, "Fundamentals of Micro fabrication", CRC press 1997.
2. Stephen D. Senturia," Micro system Design", Kluwer Academic Publishers,2001

REFERENCES:

1. Tai Ran Hsu ,"MEMS and Microsystems Design and Manufacture" ,Tata Mcraw Hill, 2002.
2. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006
3. www.tutorials point.com

Course Description

- Have a concept on the scope and recent development of the science and technology of micro- and nano-systems;
- Gain the physical knowledge underlying the operation principles and design of micro- and nano- systems;
- Learn some typical or potentially applicable micro- and nano-systems at the frontier of the development of the field

Prerequisites	Co-requisites
Engineering Physics- I & II , Engineering Chemistry - I & II	Nil

required, elective, or selected elective (as per Table 5-1)

Selected Elective

Course Outcomes (COs)

CO1: Ability to understand the operation of micro devices, micro systems and their applications
CO2 : Ability to design the micro devices, micro systems using the MEMS fabrication process.
CO3 : Gain a knowledge of basic approaches for various sensor design
CO4 : Gain a knowledge of basic approaches for various actuator design
CO5: Develop experience on micro/nano systems for photonics .
CO6 : Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.

Student Outcomes (SOs) from Criterion 3 covered by this Course

COs/SOs	a	b	c	d	e	f	g	h	i	j	k
CO1	H				M	M		H	M	H	
CO2	M	M	M		M		H				
CO3	M	H		M		M					H
CO4	M	H	M				M	M		M	
CO5		M	M		H	M		M	M		M
CO6				M	H	H			M		

List of Topics Covered

UNIT I OVERVIEW AND INTRODUCTION 9

New trends in Engineering and Science: Micro and Nano scale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electro mechanical systems, Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation.Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

UNIT III MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor

UNIT IV MICRO ACTUATORS 9

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS 9

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Shrodinger Equation and Wavefunction Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.