PVP 19

MEMS AND NANOSENSORS

Course Code	19EC4801F	**Year**	IV	**Semester**	II
Course Category	Program Elective VI	**Branch**	**ECE**	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Explain the role of MEMS for various applications (L2)
CO2	Classify micro sensors& actuators used in MEMS and characterize them (L4)
CO3	Choose the suitable micro fabrication technology for given MEMS (L3)
CO4	Select suitable material and technology for MEMs Packaging (L3)
CO5	Categorize nano sensors and describe their characteristics (L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2			2	2		2			2		2
CO2	2		3			3	3		3			2		3
CO3	2		3			3	3		3			2		3
CO4	2		3			3	3		3			2		3
CO5	2		3			3	3		3			2		3
Average* (Rounded to nearest integer)	2		3			3	3		3			2		3

Syllabus

Unit No.	Contents	Mapped CO
I	**Introduction:** Need for miniaturization, Microsystems versus MEMS, micro fabrication, smart materials, structures and systems, integrated microsystems: micromechanical structures, microsensors, microactuators, applications of smart materials and microsystems. Applications of MEMS in the automotive, health care, aerospace, industrial products, consumer products and telecommunications.	CO1

II	**Microsensors and actuators:** Silicon capacitive accelerometer, piezo resistive pressure sensor, conductometric gas sensor, electrostatic comb drive, a magnetic micro relay, portable blood analyzer, piezoelectric inkjet print head, micromirror array for video projection, micro-PCR systems, smart materials and systems.	CO2
III	**Micro fabrication technologies:** Silicon as a material for micromachining, Thin-film deposition, lithography, doping, etching, silicon micromachining: bulk and surface, specialized materials for microsystems: polymers and ceramic materials, advanced processes for micro fabrication: wafer bonding techniques, dissolved wafer processes, LIGA process, HexSil process.	CO3
IV	**MEMs Packaging:** Overview of Mechanical Packaging of Microelectronics, Micro-system Packaging, Interfaces in Micro-system Packaging, Essential Packaging Technologies, Three-Dimensional Packaging, Assembly of MEMS, Selection of Packaging Materials, Signal Mapping and Transduction, Design Case: Pressure Sensor Packaging.	CO4
V	**Nano Sensors:** Introduction to nano sensors, mechanical nano sensors, thermal nano sensors, magnetic nano sensors, optical nano sensors, chemical nano sensors and nano biosensors.	CO5

Learning Resources

Text Books

1. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre, Micro and Smart Systems, Wiley India, 2010.
2. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture", Wiley, 2008.
3. Vinod Kumar Khanna, Nano sensors: Physical, Chemical and Biological, Series in Sensors, CRC press Taylor and Francis Group, 2012.

Reference Books

1. Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, John Wiley, 2006.
2. Mohamed GadelHak , The MEMS Handbook, University of Notre Dame,
3. M.-H. Bao, "Micromechanical Transducers: Pressure sensors, accelrometers, and gyroscopes", Elsevier, New York, 2000
4. M.J. Madou, "Fundamentals of Microfabrication",3rd Ed, CRC, 2011

e- Resources & other digital material

1. https://nptel.ac.in/courses/117/105/117105082/
2. https://www.edx.org/course/micro-and-nanofabrication-mems
