MEMS
(Professional Elective - IV)

B.Tech. IV Year I Sem.	L	T/P/D	C
Course Code: ME743PE	3	0/0/0	3

Pre-requisites: None

Course Objectives: At the end of this course the student will be able to

- Integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- Understand the rudiments of Micro fabrication techniques.
- identify and understand the various sensors and actuators'
- different materials used for MEMS
- applications of MEMS to disciplines beyond Electrical and Mechanical engineering

Course Outcomes:

- Students will be able to understand working principles of currently available micro sensors, actuators, and motors, valves, pumps, and fluidics used in Microsystems.
- Students will be able to apply scaling laws that are used extensively in the conceptual design of micro devices and systems. Students will be able to differentiate between the positive and negative consequences of scaling down certain physical quantities that are pertinent to Microsystems.
- Students will be able to use materials for common micro components and devices.
- Students will be able to choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process.
- Students will be able to understand the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching.
- Students will be able to consider recent advancements in the field of MEMS and devices.
- Students will be able communicate their results and findings orally via formal presentations and in writing through reports.

UNIT – I

Introduction to MEMS and Micro fabrication: MEMS Roadmap MEMS markets-MEMS foundries-Benefits of Miniaturization -Benefits of Scaling. Micro fabrication: Basic Fabrication Processes–oxidation -film deposition lithography–etching-ion implantation–diffusion.

UNIT - II

Surface Micromachining and Bulk Micromachining: Surface Micromachining: Basic process flow–release–stiction-material choices-residual stress-Electroplating. Bulk

Micromachining: wet etch-based-dissolved wafer process- SOI MEMS–Scream–MEMS–RIE–DRIE.

UNIT - III

Mechanics of MEMS Materials: Stress–strain-material properties-measurement & characterization of mechanical parameters. Microstructural Elements: bending moment and strain-flexural rigidity-residual stress boundary conditions-spring combinations.

UNIT - IV

MEMS Devices: Pressure sensors-Accelerometers-Gyroscopes-RF MEMS Switch-Temperature sensors Humidity sensors. Microactuators: Electrostatic–piezoelectric–SMA–Thermoelectric-electromagnetic.

UNIT - V

Fluid Dynamics and Micro pumps: Viscosity–density-surface tension-continuity equation-Newton's second law-Navier-Stokes equation and its interpretation-flow types. Micro fluidics: Electro kinetics electro osmosis–electrophoresis-fabrication methods-Lab ona Chip–micropumps-microvalves.

TEXT BOOKS:

1. Microelectromechanical Systems / Bhattacharyya / Cengage
2. Microsystems Design/ Stephen D. Senturia /Springer

REFERENCES BOOKS:

1. Foundations of MEMS /Chang Liu / Pearson
2. MEMS/ Mahalik/ Mc Graw Hill