

| Course Code     | Course Name                                    | Credits   |
|-----------------|--|-----------|
| <b>MEDO8053</b> | <b>Micro Electro Mechanical Systems (MEMS)</b> | <b>03</b> |

**Objectives:**

1. To realize the benefits and effects of scaling.
2. To understand properties and crystallography of Silicon
3. To learn the microfabrication techniques
4. To understand the principles and uses of micro systems

**Outcomes:**

After taking this course, learner should be able to:

1. Apply laws of scaling for development of a MEMS device
2. Understand the materials and their processing to make MEMS
3. Select and use microfabrication techniques for microsystems
4. Understand the development of micro sensors and actuators
5. Analyze microsystems technology for technical feasibility as well as practicality
6. Develop useful applications of MEMS.

| Module   | Contents   | Hours     |
|----------|--|-----------|
| <b>1</b> | <b>Introduction to MEMS</b><br>Unique characteristics of MEMS,<br>Microsystems Technology- An Overview, typical MEMS and<br>Microsystem Products, Scaling effects - scaling laws in<br>miniaturization- Application of MEMS  | <b>05</b> |
| <b>2</b> | <b>Material for MEMS and manufacturing</b><br>Structure of silicon and other materials - Silicon wafer processing - Bulk<br>micromachining and Surface micromachining, Wafer-bonding. Thin-film<br>deposition, Lithography, wet etching and dry etching.   | <b>07</b> |
| <b>3</b> | <b>Micro-fabrication methods</b><br>LIGA and other moulding techniques- Soft lithography and polymer<br>processing- Thick-film processing; Low temperature co-fired ceramic<br>processing.   | <b>06</b> |
| <b>4</b> | <b>MEMS components-micro sensors</b><br>Micro sensors - Basic principles and working of micro sensors- Acoustic<br>wave micro sensors- Bio-medical micro sensors- Bio-sensors- Chemical<br>microsensors – Optical Sensors – Pressure micro sensors- Thermal micro<br>sensors-acceleration micro sensors; | <b>08</b> |
| <b>5</b> | <b>Micro-actuators</b><br>Basic principles and working of micro actuators- Electrostatic micro<br>actuators- Piezoelectric micro actuators- Thermal micro actuators- SMA<br>micro actuators- Electromagnetic micro actuators, micro valves, micro<br>pumps.  | <b>06</b> |
| <b>6</b> | Case studies /research based on MEMS applications-impact of materials,<br>processes and design, Actuation using Shape Memory Alloys, Medical<br>device, micropumps   | <b>04</b> |

**Text books:**

1. MEMS and Microsystems Design and Manufacture by Tai-Ran Hsu, Tata McGraw-Hill Publishing Company Ltd.
2. Foundation of MEMS by Chang Liu, Pearson Education

**References:**

1. Fundamentals of Microfabrication and Nanotechnology, by Marc J. Madou, CRC Press, 2011, ISBN: 9780849331800
2. Micromachined Transducers Sourcebook, by Gregory Kovacs, WCB McGraw-Hill, Boston, 1998, ISBN: 9780071164627
3. Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes, by M.H. Bao, Elsevier, New York, 2000, ISBN: 978-0444505583
4. Microsystem Design, by Stephen D Senturia, Springer Publication, 2000, ISBN: 9780792372462.
5. Micro sensors - Principles and Applications, by Julian W. Gardner, John Wiley & Sons, Inc.1994, ISBN: 9780471941361.