**III B. Tech – II Semester**

**(20ME6762) MICRO ELECTRO MECHANICAL SYSTEMS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | 1 | - | 4 |

**Pre-Requisites:** Basic electrical and electronics engineering, Instrumentation, Machine tools

**UNIT-I:**

**Introduction:** Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA. MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

**UNIT-II:**

**Thermal Sensors and Actuators:** Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

**UNIT-III:**

**Micro-Opto-Electro Mechanical Systems:** Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

**UNIT-IV:**

**Magnetic Sensors and Actuators:** Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

**UNIT-V:**

**Micro Fluidic Systems:** Applications, considerations on micro scale fluid, fluid actuation methods, dielectrophoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS: RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

**Chemical and Bio Medical Micro Systems:** Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

**Course Outcomes:**

A student who successfully fulfills this course requirement will be able to:

| S. No | Course Outcome | BTL |
|---|---|---|
| 1. | Explain the fundamental principles of MEMS. | L2 |
| 2. | Illustrate use of thermal sensors and actuators. | L2 |
| 3. | Outline micro-opto-electro mechanical systems. | L2 |
| 4. | Classify magnetic sensors and actuators. | L2 |
| 5. | Summarize micro fluidic systems, . frequency (rf) mems and chemical and bio medical micro systems. | L2 |

**Correlation of Cos with POs & PSOs:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 0 | 3 | 2 | 1 | 1 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 1 | 1 | 3 | 1 | 2 | 1 | 0 | 1 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 2 | 3 | 2 | 0 | 3 | 2 |
| CO5 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 0 | 3 | 1 | 1 | 1 | 3 | 2 |

**Text Books:**

1. MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.

**Reference Books:**

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.