| COURSE CODE | MEMS AND NANO TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| 1153ME102 | | 3 | 0 | 0 | 3 |

**1. Course Content**

**UNIT I INTRODUCTION TO MEMS** **9**

Overview - Definition, scaling laws, multi disciplinary nature of MEMS; working principle - actuation techniques, types of microactuators; fabrication - substrates, lithography, CVD, PVD, ion implantation, diffusion; application of MEMS in various industries.

**UNIT II INTRODUCTION TO NANOMATERIALS** **9**

Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials- historical development of nanomaterials – Nanomaterials classification (Gleiter's Classification) – properly changes done to size effects, Hall – petch, inverse Hall- petch effects - polymeric nanostructures.

**UNIT III ZERO DIMENSIONAL NANOMATERIALS** **9**

Nanoparticles – Properties – Processing – Liquid state processing - Sol-gel process, wet chemical synthesis – Vapour state processing , Aerosol processing, solid state processing – mechanical, mechanochemical synthesis – Application of nanoparticle. Quantum Dots – Quantum confinement – Pauli's Exclusion Principle – Processing – Optical lithography – MOCVD – Droplet epitaxy - Applications.

**UNIT IV ONE DIMENSIONAL NANOMATERIALS** **9**

Carbon nanotubes – Old and new forms of carbon – Structure of CNT and classification – Processing – Solid carbon based production techniques – Gaseous carbon based production technique - growth mechanisms – Applications. Nanowire – processing – Laser ablation – Oxide assisted growth – carbo thermal reactions – Thermal evaporation – Temperature based synthesis – Electro spinning – Vapour–Solid growth (VS growth) - vapour – liquid – solid growth (VLS technique) – Applications.

**UNIT V CHARACTERIZATION OF NANOMATERIALS** **9**

Nano indentation – Types of nanoindenter – Force actuation-Displacement measurement- factors affectingnanoindentation- Atomic Force Microscope (AFM) – Scanning Tunneling Microscope (STM) – Electrostatic Force Mode (EFM) – Magnetic Force Mode (MFM) – Scanning Electron Microscope (SEM) – Transmission Electron Microscope (TEM).

**TOTAL: 45 periods**

**2.TEXT BOOKS:**

1. Carl C. Koch (ed.), "Nanostructured Materials", Processing, Properties and Potential Applications, Noyes Publications, Norwich, New York, U.S.A.
2. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd Edition, 2007.

**3.REFERENCES:**

1. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, New Delhi, 2003.
2. Charles P. Poole Jr., Frank J. Ownes, 'Introduction to Nanotechnology", Wiley Interscience, 2003.
3. G. Wilde, "Nanostructured Materials', Elsevier, 2008.
4. Bamberg, D., Grundman, M. and Ledentsov, N.N., "Quantum Dot Heterostructures", Wiley, 1999.

5. G Timp (ed), "Nanotechnology", AIP press/Springer, 1999.
6. K.A. Padmanabhan and S. BalasivanandhaPrabu, 'On the Origins of Conflict in the Experimental Results Concerning the Mechanical Properties of Ultra-Fine Grained and Nanostructured Materials: Effects of Processing Routes and Experimental Conditions', Adv.Mech.Properties and Deform. Mechanism of Bulk Nanostr.Mat, Trans Tech Publication,

**4. Correlation Of COs With Programme Outcomes**

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | H | | | | L | | L | | | | | | M | |
| CO | H | | | | L | | L | | | | | | M | |
| CO | H | | | | L | | L | | | | | | M | |
| CO | H | | | | L | | L | | | | | | M | |
| CO | H | | | | L | | L | | | | | | M | |

**5. Revised Bloom's based Assessment Pattern:**

| Revised Bloom's Category | Internal | | | | University Examination % |
|---|---|---|---|---|---|
| | Unit Test- I % | Mid Term Test I % | Unit Test- II % | Mid Term Test II % | |
| Remember | 40 | 40 | 20 | 20 | 20 |
| Understand | 60 | 40 | 20 | 20 | 50 |
| Apply | | 20 | 40 | 40 | 20 |
| Analyse | | | 20 | 20 | 10 |
| Evaluate | | | | | |
| Create | | | | | |

| Revised Bloom's Category | Assignments | |
|---|---|---|
| | 1 (CO1 &CO2) (Max marks in %) | 2 (CO3&CO4) (Max marks in %) |
| **Remember** | | |
| **Understand** | **10** | |
| **Apply** | **70** | **70** |
| **Analyze** | **20** | **30** |
| **Evaluate** | | |
| **Create** | | |