



Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



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VII SEMESTER B.TECH (MECHATRONICS ENGINEERING) END SEMESTER EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: MICRO ELECTRO MECHANICAL SYSTEM [MME 423]

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ANY FIVE FULL questions.
- Missing data may be suitably assumed.
- 1A. List and explain any four types of interface problems associated with various 4 kinds of microsystems.
- **1B.** Compare silicon and gallium arsenide material used in microsystems. **3**
- **1C.** Explain the plasma enhanced CVD process with diagram.
- 2A. Determine the thickness of the beam spring of a force balanced micro 4 accelerometer as shown in Figure 1. If the maximum allowable deflection of the beam is 16.875µm. The beam which is at neutral equilibrium position, decelerate from its initial velocity of 50km/h to a standstill. Beam is made of silicon and its young's modulus E = 190 GPa, and density is 2.3gm/cm³.
- **2B.** Sketch and explain working of linear electrostatic micro motor. **3**
- 2C. What is the effect of scaling on electromagnetic force? Derive the relation for 3 the same.
- **3A.** Explain any three major technical problems associated with Micro-assembly. **3**
- **3B.** Describe the methods used to convert polymers into electrically conductive **3** materials.
- 3C. Suggest a technique, used to control anisotropic etching. Sketch and explain 4 its working principle in detail.
- 4A. Describe the principles of electrophoresis and electro-osmosis and Indicate 4 these processes used in MEMS and Microsystems?

- 4B. A silicon substrate is doped with boron ions at 100 keV. Assume the maximum concentration after the doping is 3X10¹⁹ /cm³. Find 1) the dose, 2) the dopant concentration at a depth of 0.4µm, and 3) the depth at which the dopant concentration is 0.75 percent of the maximum value. Projected range is 307nm and straggle is 69nm.
- 4C. Use the scaling laws to estimate the variations of the volumetric flow and pressure drop in a circular tube if the radius of the tube is reduced by a factor 10. Make an observation on this scaling practice and provide a reason for pressure drop, when the tube radius is reduced to microscale?
- 5A. With the help of setup diagram, Describe the fabrication process used to extend a single crystal substrate by growing a film of the same single crystal material.
- **5B.** How silicon nitride layer is deposited over silicon substrate? Explain with the **3** help of neat sketch.
- **5C.** Differentiate between Microelectronics and Microsystems. **3**
- **6A.** Describe various mechanical problems associated with surface **3** micromachining.
- **6B.** Suggest a sensor used to detect concentration of glucose in the blood **3** sample? With a sketch explain its working principle?

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6C. Compare the micromachining technique used to produce microsystem.



Figure 1.