B.E. / B.Tech. DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2011

Electrical and Electronics Engineering Branch

Sixth Semester

EE 9040 – Micro Electro Mechanical Systems

(REGULATIONS - 2008)

Duration: 3 Hours **Max. Marks: 100**

Answer All Questions

PART – A (10 x 2 = 20 Marks)

1. Compare microelectronics with MEMS.
2. What is called sputtering?
3. State the use of silicon nitride in MEMS devices.
4. What is the need for sacrificial layer in micromachining process?
5. A parallel plate capacitor remains stable under excited condition at a gap distance equal to 1.0 per unit. Compute the gap distance at which it is likely to go unstable.
6. State any one applications of accelerometer.
7. Enumerate the principle using which ink is ejected out from the chamber of ink jet printers.
8. Write down the Navier-Stokes equation of a moving fluid in three-dimensional space.
9. Explain why the change of the state of stress in a silicon diaphragm in a micro pressure sensor results in a change of its natural or resonant frequency.
10. Name any one Biosensor and state its application

Part – B (5 x 16 = 80 marks)

11.(a). From first principles obtain the expression for the developed electrostatic force in a capacitor being charged at zero gap and then lifted. [8]

11. (b). Calculate the electrostatic forces on the plate electrodes with an applied d.c. Voltage at 70 volts. The two plates have identical dimensions of L=W=1000 μm with a gap distance of d = 2 μm. The plates are initially misaligned by 20 percent in both length and width directions. Pyrex glass is used as the dielectric material so there is no gap change with the applied voltage. (relative permittivity of pyrex glass = 4.7). [8]

12. (a).(i). Explain the pattern transfer using photolithography. [8]

(ii). Describe why silicon is very popular for the manufacture of substrate material [8]

(Or)

12 B). (i). Discuss in detail about the isotropic and anisotropic wet etching process. [8]

(ii). Write short notes on LIGA process. [8]

13. (a). Discuss in detail how a cantilever structure can be fabricated using the surface micromachining method. [16]

(Or)

13. (b). Explain the principle of operation of (i) micro motors and (ii) microgrippers. [16]

14. (a). (i). Water is to flow through a circular conduit 20 μm in diameter over a length of 1000 μm. Using appropriate expression determine the drop in pressure in the flow and also estimate the additional pressure drop due to the surface tension in the water assuming the structure is a capillary tube. [8]

(ii). Explain the operation of micro pumps. [8]

(Or)

14. (b). Elaborate on (i) Dielectrophoresis (ii) Optoelectro wetting [16]

15 (a). Explain in detail the principle of operation of piezo resistive pressure sensors. [16]

(Or)

15 (b). Explain in detail any one field applications of MEMS devices. [16]