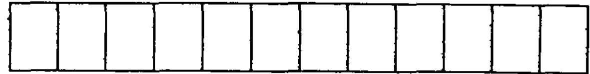

B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2013

ELECTRICAL AND ELECTRONICS ENGINEERING BRANCH

Sixth Semester

EE 9040 - MICRO ELECTRO MECHANICAL SYSTEMS

(Regulation 2008)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Distinguish between the MEMS technology and microelectronics.
2. Compare Gallium Arsenide's property with Silicon?
3. Where the Plasma enhanced CVD process in used in MEMS fabrication process?
4. Name any one technique that is used for doping silicon.
5. A RF MEMS switch should be designed with either low or high value of stiffness coefficient k. Justify your answer.
6. In a comb drive if the supply voltage > pull-in voltage, what will be the outcome?
7. A thermal bimorph is initially flat where metal 1 is on the top and metal 2 is at the bottom. If its coefficient of thermal expansion is such that $\alpha_1 < \alpha_2$, then in what direction should it bend?
8. Show the picture of any one electro thermal sensor.
9. On what principle does the fluid is made to move in electro wetting?
10. A piezoelectric crystal with piezo electric coefficient 500 X10^{-12} m/V undergoes a mechanical strain equal to 125 X 10^{-5} m/m. Calculate the induced voltage per meter in the crystal.

PART – B (5 x 16 = 80 Marks)

11 a) Show that a parallel plate capacitor can act as a switch if the gap distance (g) between the plates reduces to two thirds of distance between the plates (g_o) upon application of electric potential across it, where g_o is the initial and uniform distance between the parallel plates. [8]

11 b) Pictorially show and distinguish the transverse and the longitudinal comb drives. [8]

12 a) i). Describe the scaling advantage of electrostatic application over electromagnetic application of MEMS devices. [8]

12 a) (ii) Suggest atleast one of the properties and applications of the following MEMS materials: Silicon, Silicon nitride, Polysilicon, Quartz, Nickel, P-type silicon, Gold, Conductive polymers. [8]

OR

12 b) (i). Explain the working principle of sputtering. [8]

12 b (ii). With an example show where and how Deep Reactive Ion Etching (DRIE) is done. [8]

13 a). Write short notes on (i) isotropic and (ii) anisotropic etching process. [16]

OR

13 b). With necessary figures discuss the fabrication steps involved in Silicon on Insulator (SOI) based cantilever type pressure sensor. [16]

14 a) (i). For a thermal bimorph actuator derive the expression for the radius of curvature of the arc, r. [8]

14 a) (ii). Design a sensor that could help to measure temperature. [8]

OR

14 b) (i). Design an accelerometer based on electro thermal principle. [10]

14 b) (ii). Elaborate on the working principle of an ink jet printer based on electro thermal principle. [6]

15 a) (i). Define the piezoresistive property and then explain the operation of a piezoresistive pressure sensor. [10]

15 a) (ii). A bicycle of mass **M** is moving in x-direction at a velocity of **V** m/sec suddenly turns in the y-direction at an angle α degrees at a speed Ω m/sec. Quantify the developed coriolis force on the bicycle and explain how it acts to bring stability to the bicycle. [6]

OR

15 b). With necessary diagram, governing equation discuss the working principle of any two MEMS applications. [16]