Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(EIE)/SEM-2/EIEM-202/2012

2012

SENSORS SCIENCE AND TECHNOLOGY

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. 5 × 14 = 70

1. What are the basic differences between micro-electronics and micro-system ? Define 'transducer' in electronic sensor system. What do you mean by 'Intelligent Micro System' ? Specify commonly used communication links for electronic sensor network. 4 + 3 + 3 + 4

2. Give a brief description of IC technology used in micro-sensor fabrication system. State the process flow in IC/MEMS fabrication with a suitable block diagram. What are the issues associated with the deposition process in IC technology ? How do you define anisotropic etching ?

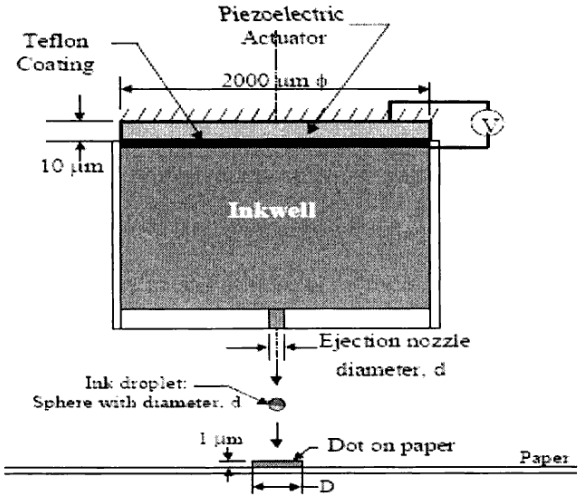
   5 + 4 + 3 + 2

3. State the major applications of diffusion in micro-fabrication process. Why do we prefer PLASMA in micro-fabrication ? How do you produce plasma ? 4 + 5 + 5

4. State the reasons of choosing single silicon crystal structure for micro-sensor fabrication. What do you mean by Polysilicon ? How does the silicon piezoresistor work ?

   Determine the required electric voltage for ejecting a droplet of ink from an inject printer head using PZT piezoelectric crystal as a pumping mechanism. The ejected ink will have a resolution of 300 dpi (dots per inch). The ink droplet is assumed to produce a dot with a film thickness of 1 μm on the paper. The geometry and dimension of the printer head is shown below. Assume that the ink droplet takes a shape of a sphere and the inkwell is always re-filled after ejection.

   3 + 3 + 2 + 6



5. What is the signal transduction phenomenon in chemical sensors ? Classify chemical sensors according to the transduction effect. What are the applications of Bio-MEMS based sensors ? State the working principle of thermopile.

   2 + 6 + 3 + 3

6. Why do we prefer polymers as sensor material ? What do you mean by LB films and what are the applications ? State few examples of natural and synthesized piezoelectric crystals.

   A fixed free cantilever is made of single-crystal silicon. The longitudinal axis of the cantilever points in the [100] crystal orientation. The resistor is made by diffusion doping, with a longitudinal gauge factor of 50. The length (l), width (w), and thickness (t) of the cantilever are 200 μm, 20 μm and 5 μm respectively. If a force F = 100 μm is applied at the end of the cantilever in the longitudinal direction, what would be the percentage change in resistance ? Assume that the Young's modulus of silicon along the longitudinal direction of the resistor is 130 GPa. 3 + 4 + 3 + 4

7. Write short notes on any *four* of the following : 4 × 3½

   a) Smart Sensor

   b) Lithography

   c) Thermal oxidation

   d) Quartz crystal

   e) Reliability models of sensors

   f) Comparative study on different shapes of diaphragm type pressure sensor

   g) Low pressure chemical vapour deposition *vs* physical vapour deposition.

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