(vi) The main advantage of a MEMS capacitance type pressure sensor is
(a) suitable for high temperature applications
(b) its simplicity
(c) its low cost of production
(d) very strong temperature dependence

(vii) CVD is effective in depositing foreign materials over silicon substrates because it is a process that
(a) is thermally activated.
(b) combines mechanical and chemical diffusion.
(c) combines thermal diffusion and chemical reactions.
(d) combines mechanical and electrical diffusion.

(viii) For higher rate of deposition, the process engineer would choose:
(a) APCVD (b) LPCVD
(c) PECVD (d) All of the above

(ix) Stiction free micro-structures is made by
(a) bulk micromachining. (b) surface micromachining.
(c) LIGA. (d) LASER microfabrication.

(x) The LB process is used to produce
(a) thin films
(b) thick films
(c) piezoelectric polymers in MEMS and microsystems
(d) all of the above.

**Group - B**

2. (a) Give a brief description of physical vapour Deposition techniques used in micro-sensor fabrication process.

(b) Define the application area of isotropic and an-isotropic etching. What do you mean by 'sputtering technique'? State the difference between dry and wet etching.

**6 + (2+2+2) = 12**

3. (a) Classify MEMS fabrication techniques from conventional IC fabrication technology. Define MEMS fabrication technique with a suitable block diagram.





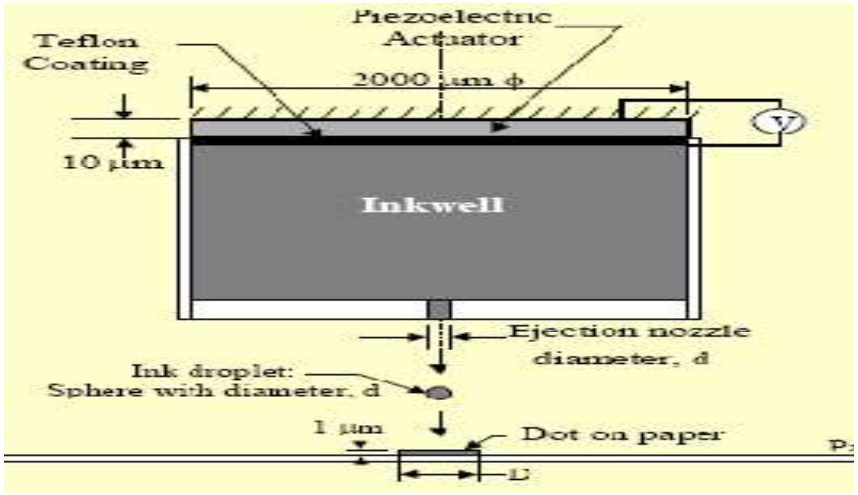
(b) Why is oxidation being considered as a very important proc both microelectronic and microsystem fabrication? Explai process of diffusion in semiconductor manufacturing process.

**(4+3) + (2+3**

**Group - C**

4. (a) What is Polysilicon? How does the silicon piezoresistor work? Polysilicon work as a piezoresistor?

(b) Determine the required electric voltage for ejecting a droplet from an inkjet printer head using PZT piezoelectric crystal pumping mechanism. The ejected ink will have a resolution c dpi (dots per inch). The ink droplet is assumed to produce a do a film thickness of 1 μm on the paper. The geometry and dimens the printer head is shown below. Assume that the ink droplet t shape of a sphere and the inkwell is always re-filled after ejectio




**(3+2+2) + (5**

5. (a) State the different types of micro-pressure sensors. Provide at one major advantage and one disadvantage of each type.

(b) Why is electroplating necessary in a LIGA process? List the pri advantages and disadvantages of LIGA process.

**(2+4) + (3+3**

**Group - D**

6. (a) Explain the working principle of bio-sensor with a suitable block diagram. How does it differ from chemical sensor?
   (b) List down at least four applications of MEMS in bio-medical industry.

**(4+4) + 4 = 12**

7. (a) What are the advantages of positive photo resist over negative photo resist in photolithography? Which type of light source is used in photolithography?
   (b) How do you produce PLASMA? How is it related to micro-sensor fabrication technique?

**(3+3) + (3+3) = 12**

**Group – E**

8. (a) Explain the working principle of micro pumping action with a suitable schematic diagram.
   (b) Why are electrostatic forces used to run micro motors rather than conventional electromagnetic forces?

**6 + 6 = 12**

9. (a) Write short notes on Polymers as Packaging materials in MEMS. Why are LB films so popular in micro sensors?
   (b) Write short note on any two: (i) Epitaxy, (ii) Sputtering, (iii) Quartz

**(3+3) + (2×3) = 12**





**2016**

# MICRO SENSOR SCIENCE AND TECHNOLOGY
## (AEIE 5202)

**Time Allotted : 3 hrs** **Full Marks : 70**

***Figures out of the right margin indicate full marks.***

***Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.***

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

**Group – A**
**(Multiple Choice Type Questions)**

1. Choose the correct alternatives for the following: **10 × 1=10**

   (i) Metal oxide gas sensors fall in categories of
   (a) bio-sensors. (b) chemical sensors.
   (c) bio-medical Sensors. (d) none of the above.

   (ii) The (100) plane in silicon crystal consists of
   (a) 5 atoms. (b) 8 atoms.
   (c) 6 atoms. (d) 4 atoms.

   (iii) Micro-Pressure sensors work on the principle of
   (a) deflecting a thin diaphragm.
   (b) heating a thin diaphragm.
   (c) magnetising a thin diaphragm.
   (d) both (b) & (c).

   (iv) The toughest plane for processing in a single silicon crystal is
   (a) The (100) plane. (b) the (110) plane.
   (c) The (111) plane. (d) the (101) plane.

   (v) Diffusion analysis is based on
   (a) Fourier's Law. (b) Fick's law.
   (c) Hooke's Law. (d) Coulomb's Law.