

**MICRO SENSOR SCIENCE AND TECHNOLOGY  
(AEIE 5231)**

**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 alternative for the following: **10 × 1 = 10**
- (i) The sensors used in mobile telephones and base stations as “band filters” are of
    - (a) Piezoelectric type
    - (b) Piezoresistive type
    - (c) Surface acoustic wave type
    - (d) Chemiresistor type
  - (ii) Metal oxide gas sensors fall in categories of
    - (a) Bio-sensors
    - (b) chemical sensors
    - (c) Bio-medical Sensors
    - (d) none of the above
  - (iii) In micro-sensor fabrication, the preferable polymer material as photo resist is
    - (a) LB films
    - (b) SiC
    - (c) Glass
    - (d) Su-8
  - (iv) The weakest plane for easier to work in a single silicon crystal is:
    - (a) the (100) plane
    - (b) the (110) plane
    - (c) the (111) plane
    - (d) the (101) plane
  - (v) The silicon compound preferred as pizeo-resister in MEMS pressure sensor is
    - (a) Silicon dioxide (SiO<sub>2</sub>)
    - (b) Silicon carbide (SiC)
    - (c) Silicon nitride (Si<sub>3</sub>N<sub>4</sub>)
    - (d) Polysilicon
  - (vi) The wet etching process is
    - (a) Isotropic
    - (b) Anisotropic
    - (c) Conformal
    - (d) Planarization
  - (vii) In micro/robotic surgery, linear actuation is initiated by the principle of
    - (a) electrostatic effect
    - (b) electromagnetic effect
    - (c) electro-mechanical effect
    - (d) electro-pneumatic effect

- (viii) The etching process having highest aspect ratio is  
(a) reactive ion etching (b) deep reactive ion etching  
(c) plasma etching (d) wet etching
- (ix) In sputtering, the carrier gas for metal vapour is  
(a) hydrogen gas (b) helium gas  
(c) air (d) argon gas
- (x) The concept used in “air bag” deployment system in automobile is:  
(a) microgyroscope  
(b) balanced force micro accelerometer  
(c) cantilever based micro accelerometer  
(d) magnetometer

**Group – B**

2. (a) Describe the steps involved in microfabrication technique with a suitable block diagram. How do you differentiate MEMS fabrication techniques from conventional IC fabrication technology?  
(b) Why is oxidation being considered as a very important process in both microelectronic and microsystem fabrication?  
**(5 + 5) + 2 = 12**
3. (a) Explain the working principle of bio-sensors with proper diagram. How does it differ from chemical sensor?  
(b) List down the major technical issues related to application of Bio-MEMS products.  
**(4 + 4) + 4 = 12**

**Group – C**

4. (a) Why is “Quartz” the ideal material for micro-sensor? Name two natural and two synthetic piezoelectric crystals.  
(b) Which material is deposited to the substrate surfaces to produce localized “resistors” and “gates for transistors during micro fabrication techniques? How does it prepare from silicon and why is it as popular as piezo resistive material?  
**(3 + 2 + 2) + (1 + 2 + 2) = 12**
5. (a) Which mechanical aspects one should consider for designing a diaphragm based micro-pressure sensor? Specify the reasons of selecting LB films as good conducting material.  
(b) Write short note on any two of the following: -  
(i) Ion implantation vs. diffusion  
(ii) Low pressure chemical vapour deposition vs. Oxidation  
(iii) Optical sensor vs. Thermal sensor  
**(2 + 4) + (3 + 3) = 12**

**Group – D**

6. (a) What do you mean by photolithography? Write the importance of photo resist material and state the reasons of frequent using of positive photo resist over negative in photolithography.
- (b) What are the different types of Chemical vapour Deposition (CVD) techniques? State a few points of difference among them.
- (2 + 2 + 3) + (3 + 2) = 12**
7. (a) What are the issues associated with deposition techniques? Explain with suitable diagram.
- (b) Why are Polymers so popular in micro-sensors? Name a few different types of polymers and their applications as sensors.
- (3 + 3) + (3 + 3) = 12**

**Group – E**

8. (a) Explain the working principle of micro valve action technique with a suitable schematic diagram.
- (b) Describe in brief what you understand by micro-sensing element and transduction unit in a Biomedical sensor.
- 6 + (3 + 3) = 12**
9. (a) State the drawbacks of surface micro machining over bulk micro machining. Why is LIGA more advantageous over the conventional micro machining technologies?
- (b) Which type of micromachining technique will you opt for fabrication of a micro cantilever? Describe the entire cantilever micro fabrication process with a suitable diagram by using the said micromachining technique.
- (2 + 4) + (1 + 5) = 12**

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