

**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) Why are Polymers so popular in MEMS industry? What do you mean by LB films? State the attributes of LB films.
- (b) Write at least four distinction points between CMOS based microelectronic system form MEMS based microsystem.

**(4 + 2 + 3) + 3 = 12**

**M.TECH/AEIE/2<sup>ND</sup> SEM/AEIE 5202/2017**  
**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 alternative for the following: **10 × 1 = 10**
- (i) Photolithography is used in microfabrication  
 (a) to take photograph of micro-device.  
 (b) to create patterns in micro-scale on substrate.  
 (c) to develop pictures on micro scale.  
 (d) to create pictures on micro-device.
- (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) The theory of thin films in diaphragm based micro pressure sensors can be used to assess  
 (a) the deflection only (b) the stress only  
 (c) both deflection and stress (d) metal fatigue.
- (iv) In Micro-fabrication, the diffusion analysis is based on  
 (a) Fourier's law (b) Fick's law  
 (c) Hooke's law (d) Coulomb's law.
- (v) The main advantage of a MEMS capacitance type pressure sensor is  
 (a) suitable for high temperature applications  
 (b) its simplicity  
 (c) its low cost in production  
 (d) no temperature dependency .
- (vi) The well accepted structural material in bulk micromachining is  
 (a) silicon (b) polysilicon  
 (c) silicon dioxide (d) PSG.

- (vii) 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 .
- (viii) Ion implantation in implanting foreign substances is done by  
 (a) melting (b) insertion by force  
 (c) slow diffusion (d) none of the above.
- (ix) For higher rate of deposition, the process engineer would choose  
 (a) APCVD (b) LPCVD (c) PECVD (d) all of the above.
- (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) What are the different techniques used in physical vapour deposition in micro-sensor fabrication process? Describe any one of such techniques with suitable diagram.
- (b) Why is photolithography technique required in IC/MEMS fabrication? What is the importance of photo resist in photolithography? Define the application area of positive and negative photo-resist.

$$(2 + 3) + (2 + 2 + 3) = 12$$

- 3.(a) How will you distinguish MEMS fabrication techniques from conventional IC fabrication technology? State MEMS fabrication technique with a suitable block diagram.
- (b) Why is oxidation being considered as a very important process in both microelectronic and microsystem fabrication? Explain the process of diffusion in semiconductor manufacturing process.

$$(4 + 3) + (2 + 3) = 12$$

**Group - C**

- 4.(a) State the attributes of single silicon crystal for best suitable structure material in micro-sensor fabrication. Explain any three widely used actuation techniques in micro-devices.
- (b) How do Acoustic Wave sensors work as "Band Pass Filters" in mobile sets? List down other application areas of Acoustic Wave sensors.

$$(3 + 3) + (4 + 2) = 12$$

- 5.(a) What are the different types of micro-pressure sensors? Which one is most advantageous and why?
- (b) "Electroplating is necessary in LIGA process" - why? List the principal advantages and disadvantages of LIGA process over other micromachining processes.

$$(2 + 3) + (3 + 4) = 12$$

**Group - D**

- 6.(a) Explain the working principle of chemical sensors with a suitable block diagram. State the different types of chemical sensor.
- (b) How will you distinguish bio-medical sensors from biosensors?

$$(4 + 4) + 4 = 12$$

- 7.(a) A MEMS based parallel capacitor is made of two square plates with the dimensions  $L = W = 100\mu\text{m}$ , as shown in Fig.1. Determine the normal electrostatic force if the gap between these two plates ( $d$ ) is  $2\mu\text{m}$ . The plates are separated by static air with  $\epsilon_0 = 8.85 \times 10^{-2}\text{F / m}$ .

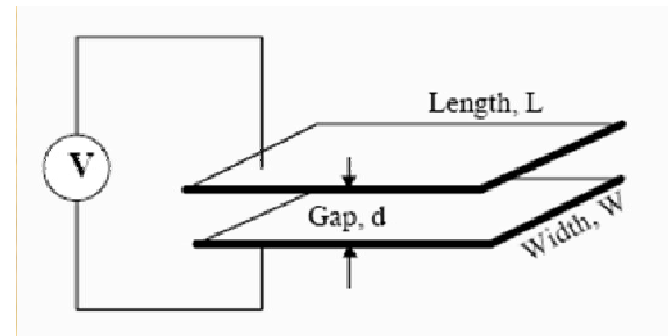


Fig. 1

- (b) How do you produce PLASMA? How is it related to micro-sensor fabrication technique?

$$6 + (3 + 3) = 12$$