



Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech (EIE)/SEM-2/EIEM-202/2013

2013

SENSORS SCIENCE AND TECHNOLOGY

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

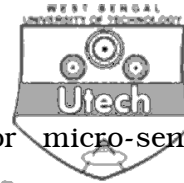
*Candidates are required to give their answers in their own words
as far as practicable.*

Answer any *five* questions.

5 × 14 = 70

1. Define "Smart Sensor" in electronic measurement system.
How does micro electronics differ from micro-system ? What
do you mean by "intelligent micro system" ? Specify
commonly used communication links to connect smart
sensor to PC/network. 4 + 3 + 3 + 4

2. Give a brief description of different types of deposition
techniques used in micro-sensor fabrication process. What
are the issues associated with deposition ? State the
photolithography technique in IC/MEMS fabrication with a
suitable diagram. Define the application area of isotropic and
an-isotropic etching ? 5 + 4 + 3 + 2

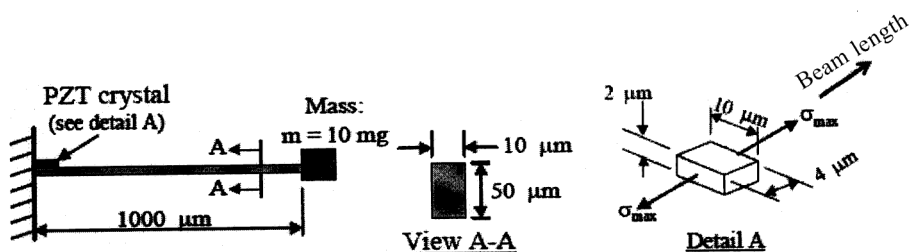


3. “Silicon – an ideal substrate material for micro-sensor fabrication” — why ? Name three principal silicon compounds used in MEMS and microsystems. Why do polymers preferred as industrial material ?

A thin piezoelectric crystal film, PZT is used to transduce the signal in a micro accelerometer involving a cantilever beam made of silicon. The accelerometer is designed for a maximum acceleration/ deceleration of 10 g. The PZT transducer is located at the support of the cantilever beam where the maximum strain exists (near the support) during the bending of the beam as illustrated in the following figure.

Determine the electrical voltage output from the PZT film at a maximum acceleration/deceleration of 10 g. Assume that the Young’s modulus of the beam is 19×10^{-10} Pa.

3 + 2 + 3 + 6





4. What is the signal transduction unit in Bio-medical sensors ? State the working principle of Bio-MEMS based sensor. Classify chemical sensors according to the transduction effect. What are the applications of micro-grippers ? State four types of optical sensors are commonly available in market.
- 2 + 2 + 4 + 2 + 4

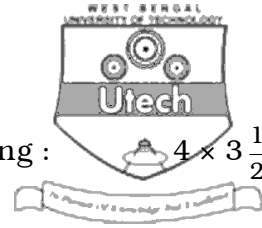
5. What are the mechanical aspects one should consider for designing a diaphragm based micro-pressure sensor ? How do you choose the shape of the diaphragm for such design ? Specify the reasons of selecting LB films as good conducting material.

Determine the maximum stress and deflection in a square shaped diaphragm types MEMS pressure sensor made of Si when subjected to a pressure of 20 MPa. The diaphragm has edge length of 532 μm and thickness of 13.887 μm . Assume that Young's modulus of Si is 19×10^4 MPa.

3 + 4 + 3 + 4

6. State the different types of Chemical vapor deposition techniques in micro-fabrication process. What are the advantages of positive photo resist over negative photo resist in photolithography ? What is PLASMA and how do you produce it ?
- 5 + 4 + 5

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

- a) Ion implantation *vs* diffusion
 - b) Chemical vapor deposition *vs* physical vapour deposition
 - c) Dry *vs* wet etching
 - d) Piezoelectric *vs* piezo-resistive crystals
 - e) Circular *vs* square shaped diaphragm
 - f) Epitaxy *vs* sputtering
 - g) Low pressure chemical vapor deposition *vs* oxidation
 - h) Optical sensor *vs* thermal sensor.
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