

AS-74.3136 Introduction to microsystems

Examination 10.5.2007

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No books are allowed in the exam! All questions are of equal value.

- What is a microsystem (explain)
 - What is meant by microfluidics
- Name four benefits of microsystem technology and justify them briefly.
- What are the forces that need to be considered in microworld?
Explain with few words what causes them (physical reasons).
- Explain what is meant by memory alloys.
 - Explain the principle behind an actuator based on memory alloy.
- Pressure sensors are mechanical sensors. Explain at least 3 principles how to measure pressure.
- Name at least 3 challenges associated with use of microfluidics and explain them briefly
- Connect a sensor and its property by writing the number of the property in front of the corresponding sensor.

___ Capacitive accelerometer

___ Tunneling accelerometer

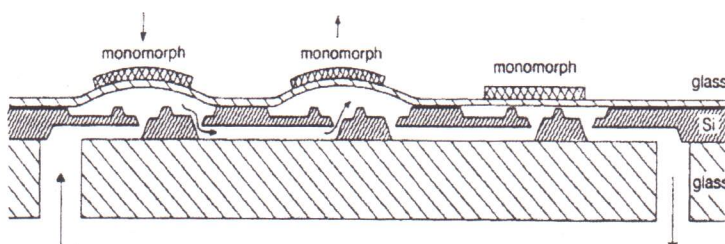
___ Pressure sensor

___ Piezoresistive accelerometer

___ Gyroscope

- Performance varies over temperature.
- Vibration frequency of a membrane or separate resonator (on the membrane) is affected by the measurand.
- Sensor consists of a proof (seismic) mass supported by a suspension frame (no hysteresis)
- The displacement of a proof mass causes a change of current which is compensated by the read-out circuit by adjusting the bottom detection voltage (to keep the current constant).
- Measurand causes transfer of energy between two vibration modes.

- Consider the pump in the Figure.



- What type of pump is it?
- On what is the pumping based on?

c) Describe briefly the working principle.

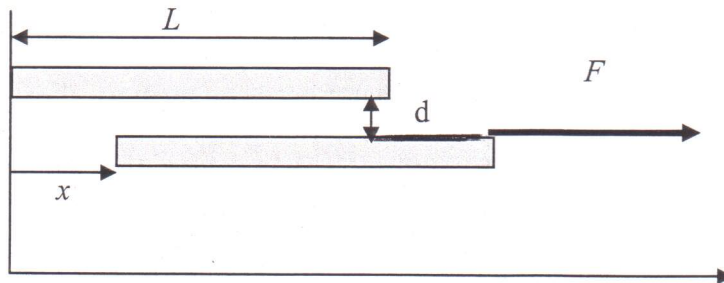
9. List at least 5 performance measures used for describing actuator performance.

10. Consider the plate capacitor in the Figure below: length = L , cross-sectional area = A , gap = d . Apply voltage V across the capacitor. These are all constant.

a) Write down the expression for the capacitance C , when the lower plate has moved horizontally distance x .

b) Derive the equation for force F , when the lower plate has moved horizontally distance x . Recall that the energy stored in the capacitor is

$$W = \frac{1}{2} CV^2.$$



a)