

FYS E430 "Microsensors"  
Exam on 28.05.2010  
Lecturer: K. Arutyunov

Problem 1 (5 points)

- 1.1 (1 point) What is the difference between metals and semiconductors?
- 1.2 (1 point) What is the difference between semiconductors and insulators?
- 1.3 (2 points) Derive Ohm's law using Drude model of conductivity in metals.
- 1.4 (1 point) What experimental facts indicate limiting applicability of Drude model?

Problem 2 (4 points)

- 2.1 (2 points) Explain how mass of a deposited material can be measured by a quartz resonator.
- 2.2 (2 points) What other properties can be measured using piezoelectric materials?

Problem 3 (4 points)

- 3.1 (3 points) What is metal – oxide – semiconductor field effect?
- 3.2 (1 point) Give an example of devices using this effect.

Problem 4 (6 points)

Explain principle of operation, plot the schematics of the following sensors:

- 4.1 (1 point) smoke sensor;
- 4.2 (1 point) humidity sensor;
- 4.3 (1 point) compressed powder (Taguchi) sensor;
- 4.4 (2 points) ion-sensitive field effect transistor (ISFET) pH-sensor.
- 4.5 (1 point) What is the principle of operation of a molecular membranes in gas sensor applications?

Problem 5 (6 points)

- 5.1 (2 point) Explain what is Josephson effect?
- 5.2 (3 points) Draw schematic of a SQUID. Explain what are the input and output signals, and how they are related to the measured parameter.
- 5.3 (1 point) What other physical parameters can be measured using a SQUID?