FYS E430 Microsensors
Exam on 17.05.2013
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 (1 point) What is the principal of operation of an optical waveguide?
2.2 (1 point) What are the spontaneous and stimulated optical emissions?
2.3 (2 points) Explain principle of operation and construction of a semiconductor laser?

Problem 3 (6 points)
Explain principle of operation of the following charged particle detectors:
3.1 (2 points) silicon strip detector;
3.2 (2 points) silicon drift chamber;
3.3 (2 points) charge coupled device.

Problem 4 (5 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 (1 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 (5 points)
5.1 (2 point) Explain what is Josephson effect?
5.2 (2 points) Draw schematic of a SQUID. How the critical current of a SQUID depends on the flux through the SQUID area?
5.3 (1 point) What physical parameters can be measured using a SQUID? Draw schematic of the device(s) and explain what are the input and output signals