LTT-1126 Measurements of Physiological Systems
Final exam 16.5.2008

Consider different factors and functional components that must be taken into account or must be included in designing of measurement system of physiological signals. Draw a functional flow chart of the measurement system. Consider the problem first in general and then from the point of view of recording of electrical activity of the brain.

2. Explain a method to record

a) minute ventilation
b) residual lung volume
c) flow velocity in air ways
d) oxygen concentration of breathing air
e) carbon dioxide concentration of breathing air
f) oxygen saturation of blood
g) blood flow velocity in vessel
h) flow profile or flow distribution in vessel

Answer briefly with few sentences to **three** questions below:

Describe (draw) a functional flow chart of a typical BMI-system (Brain-machine interface)
List typical physiological or environmental quantities that should be recorded from firefighters to control their condition. Justify why these quantities must be recorded.
Explain methods needed to diagnose different types of cardiac arrhythmias. (describe the method and diagnostic information obtained)
d) Describe different alternative methods to measure glucose concentration of blood.
e) How bio-impedance method is applied in plethysmography?
f) What is the purpose of clinical exercise-ECG test and what kind of clinical information is obtained with it?
g) Explain the Fick method and its variations to measure cardiac output.
h) Explain the measurements needed in cell culture and cell differentiation.
i) Explain, what is heart rate variability and what kind of information it gives about the physiological control of the body.
What is the importance of EEG in the analysis of the depth of anesthesia?
The monitoring of physiological system during anesthesia: what and how is monitored?

4. In the recording of the ECG there might exist in worst case a 100-mV common mode voltage in the patient.

a) Explain, what is this common mode voltage and how it is originated or coupled to the patient and how it can be minimized.
b) If there is a poor electrode connection to patient the common mode voltage can induce up to 0.2-mV differential voltage to the input of the ECG amplifies. We measure the ECG with an amplifier of the CMRR of 80 dB and differential gain of 1000. How big is the noise voltage caused by the common mode voltage in the output of the amplifier?
c) If the amplitude of the ECG in the input of the amplifier is 2 mV, what is the signal-to-noise ratio in the output?