

BME-2106 Measurement and analysis of physiological systems

Exam 16.12.2011

No calculators allowed.

Answer all questions. To pass the exam, you must get at least 40% of the maximum points in ALL problems AND at least 25 points in total. Use clear handwriting. Aim at analytical and well structured answers. Compact answers are preferred instead of long non-stop text answers. Use graphics to illustrate your answers if possible.

1. Optical measurements are common also in medical applications. (max. 10 point)
 - a) **Justify** what benefits are obtained with optical measurements compared to more conventional measurements in clinical applications.
 - b) **Describe** the physical *absorption* processes of light with different tissues.
 - c) **Describe** a medical instrumentation system for the light *absorption* measurements.
 - d) **Apply** above mentioned processes and instrumentation to measure *oxygen saturation of blood*. **What** is the clinical importance of that measurement?

2. ECG is a basic physiological measurement that is most commonly measured from a resting patient using the standard 12-lead system. (max. 15 points)
 - a) **Explain** the concept of the standard 12-lead ECG system to measure the ECG. (What and how is measured in practice and in theory?)
 - b) Arrhythmia (problems in the cardiac rhythm) is a quite common cardiac problem. **Briefly explain** the *main categories* of different cardiac arrhythmia and how they are manifested in the ECG signal.
 - c) Standard resting ECG recording has some limitations to diagnose different cardiac arrhythmia. **Explain what** kind of limitations? These limitations can be overcome by other ECG recording methods. **Explain and compare briefly two** other clinically important alternative ECG methods with respect to the standard resting ECG to diagnose patients with a supposed arrhythmia. (method, technology, data analysis)

3. Cardiac output is a very important clinical cardiovascular measurement quantity. (max. 10 points)
 - a) **Explain** principles of *thermodilution* method to measure the CO.
 - b) **Explain** principles of *impedance cardiography* method to measure the CO.
 - c) **Compare** the *benefits and drawbacks* of the two above-mentioned CO measurement methods.

4. **Explain briefly** in few sentences the following measurement methods (what, why and how is measured) (max. 15 points)
 - a) Measurement of the depth of anaesthesia.
 - b) Measurement of evoked potentials of the brain.
 - c) Measurement in dynamic spirometry tests.
 - d) Measurement of electrooculogram (EOG).
 - e) Oscillometric non-invasive measurement of blood pressure.