Measurements of Physiological Systems

Exam 10.4.2019 (Juha Nousiainen)

No materials or calculators.

Answer all questions. 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. In biopotential and bioimpedance measurements of the body, it is important to consider the interface between the bioelectrode and the skin (electrode-skin interface) (max. 20 points)
   a) Draw and explain an equivalent electrical circuit model for the electrode-skin interface.
   b) Explain, what is a motion artifact being found especially in the ECG recording, how is it originated from the electrode-skin interface and how it can be best avoided or minimized in the ECG recording.
   c) Bioimpedance measurements are usually done by using so called 4-electrode (tetrapol) system. Explain that 4-electrode measurement principle of bioimpedance and argue why it is preferred to 2-electrode measurement system. Apply the tetrapolar measurement method to impedance cardiology measurement.

2. Explain the concept of the standard 12-lead ECG system. (max 10 p.)

3. Characterize the EEG signal and give some common problems related to the EEG recording. (max. 10 p.)

4. Give with a brief description alternative methods for continuous non-invasive blood pressure recording. (max. 10 p.)

5. The cardiac output (CO) of the heart can be measured by means of two main principles: a) by beat-to-beat basis from the stroke volume (SV) or b) by dilution method. Briefly describe the following two methods (max. 5+5 p.):
   a) measurement of the CO through the SV with ultrasound
   b) measurement of the CO with the thermodilution method.

6. Briefly explain how you can measure the following (max. 20 p.)
   a) oxygen gas concentration of inhaled air
   b) oxygen saturation level of blood
   c) flow velocity of inhaled/exhaled air
   d) functioning of the neuro-muscular junction in anesthesia