ELT-61216 Biomedical Engineering: Signals and Systems
Exam 16.10.2014/ Juha Nousiainen

No calculators allowed.
Give brief and compact answers in each question.

1.a) Explain what are the open-loop and closed-loop control systems. Describe an example of a closed-loop control system in the body and an example where it is used medical devices controlling some physiological function.

b) Explain why you should be as a biomedical engineer aware of noise and variability in physiological measurements? Explain how the noise and signal variability can be originated in the measurements, use ECG as an example?

2. Related to physiological measurement systems:
   a) Explain the principles of strain gage sensor and give applications how it is used in medical measurements.
   b) Explain what kind of sensor is used in physiological ultrasound measurements. Give applications of these ultrasound measurements.
   c) The cardiac output of the heart is usually measured by an indirect method. Explain, what does is mean. Describe an example of one indirect method to measure the cardiac output of the heart.

3. Consider the ECG and answer the following questions.
   a) Describe a typical ECG signal wave form, name its components and argue why this typical wave forms is usually observed.
   b) Explain what is a bipolar and unipolar lead in biopotential recording in general and in the 12-lead ECG system in particular.
   c) Describe how you can model the generation of the ECG.

4. Related to the medical imaging systems:
   a) Explain what is medical tomography imaging? What kinds of tomography imaging modalities are in clinical use?
   b) Explain why ultrasound imaging is so popular in medical practice?
   c) Explain the meaning of the Larmor frequency?