

## BME-1157 Biomedical Engineering: Signals and Systems

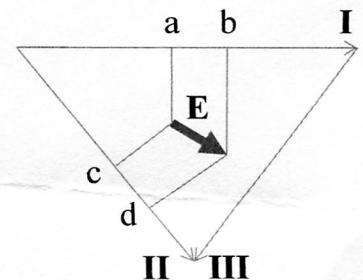
Exam 19.10.2012/ Juha Nousiainen

No calculators allowed.

Each problem yields maximally 6 points. To pass the exam, you must get in total at least 12 points **and** in every question at least 2 points. **Answer briefly** with few sentences in each question.

1. Consider the human cardiovascular system as a transportation system.
  - a) **List** components (organs, tissues, anatomical structures, molecules) of that system that are essential in the transportation.
  - b) You should quantitatively describe the cardiovascular system. **List** physical or chemical quantities that can be measured and that describe the functioning of the cardiovascular system.
  - c) You should draw an analog model for the cardiovascular system. **Briefly explain**, what kind of *system properties* you should include in the model and with what kind of analog you can implement that property in the model.

2. Figure on the right depicts the Einthoven triangle model.



- a) **Explain** what the Einthoven triangle is (what are the arrows I, II, and III?)
- b) **Explain** what the arrow E is in this model.
- c) **Explain** what the lines ab and cd do represent in this model and how they are formed.

3. Related to the physiological measurements, **briefly explain** the following:

- a) Role and application of *stimulators* in physiological measurements systems?
- b) Principle of any sensor that is able to measure *mechanical displacement* in the body?
- c) *Noise and variability* in the ECG signal (types and sources of noise and variability)?

4. **Briefly explain** the following:

- a) What is medical *tomography* imaging? What kinds of tomography imaging modalities are in clinical use?
- b) What are the main *interaction mechanisms* of x ray with tissue that produce the image information?
- c) Why *ultrasound* imaging is so popular in medical practice?