BMT-63306 Modelling of Physiological Systems
Exam 26.11.2020
Examiner: Jari Hyttinen
No calculator needed or allowed in this exam.

Each numbered question is valued 6 points.

1. Answer to following:
   a) What are the general system properties of resistance and compliance, how those can be used to model aorta and blood flow (see picture below)?

![Heart and Elastic arteries diagram]

b) Give one mode example of a physiological system described by these basic system properties?

1. Answer to the following questions:
   a. Describe white box, black box, empirical, and theoretical model – how they link each other?
   b. How the variability of the biological systems make their modeling difficult?
      i. Making the models?
      ii. Using the models?
      iii. Interpreting the results?

2. a) What are the boundary conditions in FEM modelling and why we need them?
     b) Describe the boundary condition needed for a FEM model of impedance measurement of breathing?

3. a) Describe "agent", "individual" or "cellular automata" based computational modeling principle.
     b) Describe how using such modelling principle how you can model the growth of cancer?
        i) Cellular automata model with simple rule-based propagation?
        ii) Agent or individual based model with cell cycle modelling?