

BME-2506 Physics and engineering in medical therapy

Exam 7.3.2013 / Juha Nousiainen

Calculators are not allowed.

Answer all questions. To pass the exam, you must get at least 40% of the maximum points all problems AND at least 30 points in total. Use clear handwriting. Draw a margin to each page. Aim at analytical and well structured answers. Compact answers are preferred instead of long answers. **Use graphics to illustrate your answers.**

1. VDD type cardiac pacemaker (20 p.)
 - a) **Explain** the main indications for implanting a cardiac pacemaker.
 - b) **Explain in general** how the cardiac pacemaker is functioning (the functional and structural block diagram).
 - c) **Explain in specific** what is the VDD type pacemaker: how is it working (operation modes), what is the meaning of codes V, D, and D?
 - d) **Explain**, what is the meaning of letter code "R" in pacemaker code VDDR. Explain principles of how this "R"-function can be implemented?

2. Consider implantable functional electrical nerve stimulation. (15 p.)
 - a) **List and briefly explain** different factors that affect the simulation of nerves. (how optimal and appropriate an electrical neurostimulation and the interface of the electrode with the tissue is in implanted neurostimulators).
 - b) **Explain** the operation, structures and clinical applications of **two** illustrative examples of functional electrical nerve stimulator.

3. Consider the concept of mass transfer through a semipermeable membranes. (15 p.)
 - a) **Explain** physical mechanisms and factors that affect the mass transfer through the membranes. **Give** also some parameters to describe the effectiveness of the transfer.
 - b) **Explain** the operation, structures and clinical applications of **two** illustrative examples of artificial organs of which operation is based the mass transfer through a semipermeable membrane.

4. **Briefly explain** the following therapies (answer the questions: what, how and why) (10 p.)
 - a) CPAP
 - b) LASIK
 - c) catheter rf-ablation
 - d) LVAD
 - e) AICD