

# FYS4239/FYS9239 - Electrical bioimpedance

Textbook: S. Grimnes and Ø.G. Martinsen. Bioimpedance and Bioelectricity Basics. 3<sup>rd</sup> edition. Academic Press. 2015. Chapters 1 – 10 (approx. 500 pages).

*These typical questions or topics will be posed during the oral exam. Other topics may also be brought up and there will probably be follow-up-questions as well. It is not necessary to remember complicated equations or tabulated values. It is important that you read and understand all the ten chapters, since many topics are explained in different ways several places in the text and the description is always based on understanding gained in earlier parts of the book. Page numbers given are approximate.*

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## CHAPTER 1

Page 001: Difference bioimpedance / bioelectricity?

Page 003: Is DC simply AC with  $f \rightarrow 0$  ?

## CHAPTER 2

Page 009: Mention some differences between ionic and electronic conduction.

Page 011: What is electronegativity?

Page 012: Four types of molecular bonds

Page 034: What is electro-osmosis?

Page 035: What is streaming potential?

## CHAPTER 3

Page 038: What is polarization?

Page 041: Three types of polarization

Page 053: What is (Debye) relaxation?

Page 061: What is Maxwell-Wagner effect?

Page 072: Explain Figure 3.14 (dispersions)

## CHAPTER 4

Page 083: Talk about the cell membrane

Page 095: The electrical properties of human skin

Page 098: Explain G in Figure 4.18

Page 109: Explain Figure 4.28

Page 110: What is anisotropy?

## CHAPTER 5

Page 122: What is an action potential?

Page 131: How is the action potential signal propagated on an axon?

## CHAPTER 6

Page 165: What is transfer impedance?

Pages 165 & 223: Explain the four-electrode system

Page 166: What is (negative) sensitivity?

Page 171: Talk about EIT

## Chapter 7

Page 180: Explain (non-)polarized electrode

Page 185: Wet and solid gel

Page 191: Talk about the electric double-layer

Page 215: Explain Figure 7.20

## CHAPTER 8

Page 256: Explain impedance and admittance

Page 258: What is reciprocity?

Page 260: What are Kramers-Kronig transforms?

Page 295: What is a lock-in amplifier and how does it work?

## CHAPTER 9

Page 344: What is a constant phase element?

Page 348: What is the Cole equation?

Page 367: What is a memristor?

Page 397: Talk about Figure 9.34 (ROC graph)

## CHAPTER 10

Having read this chapter you should be able to give a few good examples of applications of bioimpedance methods and describe the basics of how the methods work.