ME-481

Biomechanics of the cardiovascular system

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Cursus	Sem.	Type
Biomedical technologies minor	E	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Mechanical engineering minor	E	Opt.
Mechanical engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This lecture will cover anatomy and physiology of the cardiovascular system, biophysics of the blood, cardiac mechanics, hemodynamics and biomechanics of the arterial system, microcirculation and biomechanics of the venous system.

Content

Introduction
Physics of living matter and biomedical engineering; anatomy and physiology of the cardiovascular system
Biophysics of the blood
Blood rheology; mechanical properties of red blood cells.
Cardiac mechanics
Mechanical activity of the heart; biomechanics of the cardiac muscle; Pressure-volume diagram; Frank-Starling laws of the heart; Varying elastance principle; Pump function graphs; Cardiac energetics; Arterio-ventricular coupling; Windkessel effect.
Hemodynamics and biomechanics of the arterial system
Structure, passive and active mechanical properties of the arterial wall; pulsatile blood flow in a rigid tube, model of Womersley; propagation of pressure and flow waves in an elastic tube; reflection and attenuation of waves in arteries; physical models of the arterial system; blood-vessel wall interactions.
Microcirculation
Hemodynamics in capillaries; exchange of substances and liquids across the capillary wall.
Biomechanics of the venous system
Biomechanics of the venous wall; flow in collapsible tubes; "Waterfall" phenomenon.

Learning Outcomes

By the end of the course, the student must be able to:

- Explain the link between the physiology and the mechanical properties of a tissue, B2
- Identify the mechanical behaviour of tissues and fluids from experimental data, B5

Assessment methods

Written exam.