Course Specifications
Valid as from the academic year 2018-2019
Modelling of Physiological Systems (E092620)

Course size (nominal values; actual values may depend on programme)

<table>
<thead>
<tr>
<th>Credits</th>
<th>Study time</th>
<th>Contact hrs</th>
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<tbody>
<tr>
<td>6.0</td>
<td>180 h</td>
<td>67.5 h</td>
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Course offerings and teaching methods in academic year 2018-2019

A (semester 1) English
group work 15.0 h
practicum 7.5 h
seminar 3.75 h
lecture 45.0 h

B (semester 1) Dutch
guided self-study 45.0 h
seminar 3.75 h
group work 15.0 h
practicum 7.5 h

C (semester 2) English
practicum 7.5 h
group work 15.0 h
lecture 45.0 h
seminar 3.75 h

Lecturers in academic year 2018-2019

Segers, Patrick TW06 lecturer-in-charge
D’Herde, Katharina GE38 co-lecturer
Eloot, Sunny GE35 co-lecturer
Leybaert, Luc GE33 co-lecturer
Vanheel, Bert GE33 co-lecturer

Offered in the following programmes in 2018-2019

<table>
<thead>
<tr>
<th>credits</th>
<th>offering</th>
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<tr>
<td>6</td>
<td>A</td>
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<tr>
<td>Brugprogramma Master of Science in Bioinformatics (main subject Engineering)</td>
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<tr>
<td>Bridging Programme Master of Science in Biomedical Engineering</td>
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<tr>
<td>Bridging Programme Master of Science in Biomedical Engineering</td>
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<tr>
<td>Master of Science in Electrical Engineering (main subject Communication and Information Technology)</td>
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<td>Master of Science in Electromechanical Engineering (main subject Control Engineering and Automation)</td>
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<tr>
<td>Master of Science in Electromechanical Engineering (main subject Electrical Power Engineering)</td>
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<tr>
<td>Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)</td>
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<td>Master of Science in Bioinformatics (main subject Engineering)</td>
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<tr>
<td>Master of Science in Electromechanical Engineering (main subject Maritime Engineering)</td>
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<tr>
<td>Master of Science in Electromechanical Engineering (main subject Mechanical Construction)</td>
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<tr>
<td>Master of Science in Electromechanical Engineering (main subject Mechanical Energy Engineering)</td>
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<tr>
<td>Master of Science in Biomedical Engineering</td>
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<tr>
<td>International Master of Science in Biomedical Engineering</td>
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<tr>
<td>Master of Science in Biomedical Engineering</td>
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<tr>
<td>Master of Science in Chemical Engineering</td>
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<tr>
<td>Master of Science in Civil Engineering</td>
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<tr>
<td>Master of Science in Computer Science Engineering</td>
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(Approved)
Teaching languages
Dutch, English

Keywords
physiology, transport, kinetics, experimental and mathematical model

Position of the course
The aim of the course is to familiarise the student with human physiology in general and physiological systems in particular, with attention to biological control and regulation mechanisms. The organism is studied on cellular and organ level, as well as on an integrated level. There is attention for transport physics and modelling techniques applied to physiological systems.

Contents
• Introduction: The human body on a macroscopic scale
• Homestasis: Homeostasis in the body and glucose homeostasis
• The nervous system: Sympathetic and parasympathetic nervous system, Communication between (nerve)cells, Hodgkin-Huxley model
• Physiology of muscle cells: Anatomy and physiology, Force-Length-Frequency relation
• Arterial system physiology: Anatomy and physiology, Models of the arterial system: windkessel and transmission line
• Cardiac physiology: The heart as a pump
• The cardiovascular system: Heart-arterial coupling, Computer exercise on the cardiovascular system
• The kidney: Anatomy and physiology of the kidney, Modelling aspects
• The lungs and respiration: Anatomy and physiology of the lung
• Digestion, metabolism and temperature control: Basic and physiological aspects
• The brain: Anatomy and physiology, Application: The visual system
• Hot topics in physiological modelling: Hot topic
• Laboratory visits and practical sessions: Lab 1: the brain, Lab 2: the heart, Lab 3: experimental models
• Applications of physiological models: Project work

Initial competences
no specific prior knowledge required

Final competences
1 KNOWLEDGE OF: basic knowledge of physiology; action potentials, ion channels; force-length-frequency relation; pressure-volume relations, contractility, preload and afterload; pressure-diameter relation, visco-elasticity, impedance; lumped parameter models; arterial pressure wave reflection; heart-arterial coupling; kinetic modelling, osmolarity, convection, diffusion; perfusion, gas transport, dissociation curves; wave intensity analysis.

2 ACQUIRED INSIGHTS: propagation of electrical signals and communication between cells; insight in the visual system, processing of visual stimuli in the brain into an image; function of individual muscle cells, experimental models; anatomy and function of the heart; assessment of the heart as a pump; mechanical behaviour of blood vessels and quantification of mechanical properties; generation of arterial blood pressure and flow and contribution of the heart and the arteries herein; anatomy and function of the kidney, control mechanisms; (modelling of) mechanics of and gas exchange in the lung; Insight in the anatomy of the brain

3 Searching of scientific, biomedically oriented information (Pubmed, web of science) through project work, processing of this information into a scientific report and oral communication of these results in a (powerpoint) presentation

4 Analysis and schematizing of physiological processes

5 Practical knowledge on the analysis of hemodynamic data (arterial pressure and flow, ventricular pressure and volume) and quantification of systolic function, system analysis of the arterial system, quantification of the interaction between the heart and

(Approved)
the atrial system (via spreadsheet and Matlab applications)

Conditions for credit contract
Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract
This course unit cannot be taken via an exam contract

Teaching methods
Guided self-study, group work, lecture, practicum, seminar

Learning materials and price

References

Course content-related study coaching

Evaluation methods
end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period
Written examination with open questions, written examination with multiple choice questions

Examination methods in case of periodic evaluation during the second examination period
Written examination with open questions, written examination with multiple choice questions

Examination methods in case of permanent evaluation
Oral examination, participation, peer assessment, report

Possibilities of retake in case of permanent evaluation
examination during the second examination period is not possible

Extra information on the examination methods
During examination period: written closed-book exam with open questions, multiple-choice questions and exercises and applications. During semester: graded project reports; graded oral presentation. Frequency: Once.

Calculation of the examination mark
Special conditions: Non period-bound evaluation counts for 25% of the total score.