Course Package

Biorobotics – 1A + 1B

Name module	Biorobotics - 1A + 1B
Educational programme	MSc Biomedical Engineering
Period	First semester (block 1A + 1B)
Study load	30 ECTS
Coordinator	J. Huttenhuis

Biorobotics			
block 1A	**block 1B**	**block 2A**	**block 2B**
Biostatistics - 201400285 (5 EC)	**Robotics for Medical Applications - 201300004** (5 EC)		
Clinical Research Methods - 201400286 (5 EC)	**Technology for health - 201500222** (5 EC)		
Integrative Design of Bio. Prod. - 191150700 (5 EC)	**Dynamics and Control - 201400040** (5 EC)		

Required preliminary knowledge: Bachelor's degree in Biomedical Engineering, Industrial Design & Engineering, or Mechanical Engineering, Basic knowledge in Mechanics, Multi-body Kinematics and Dynamics, General Physics, General Mathematics, Principles of Signal Processing, Linear Algebra.

201400286 **Clinical Research Methods (1A)**
Clinical research is the systematic process of examining clinical conditions and outcomes, in order to establish relationships among clinical phenomena and to generate evidence for decision making toward improved clinical practice. As a Biomedical Engineer, you will continuously encounter clinical research, either by performing a clinical study yourself or by using the results of clinical research for development or validation of new technologies or medical devices. Furthermore, you will frequently be working with professionals for whom clinical research is a main source of knowledge toward theory building and clinical innovation - c.f., evidence based medicine.

The modules are tentative and subject to change. Please check the website regularly.

This course will provide the foundations of clinical research by addressing key aspects of theory building, concepts of measurements, study design, interpretation of data. Students will assess and interpret clinical methods and results and use clinical results for developing new concepts or for assessment or validation of new technology. The course consists of lectures disclosing the structure of the subject material, explaining approaches and concepts and providing illustrative examples from the clinical research practice. During the course, students will build a portfolio based on assignments for application of the theory on a specific clinical research topic of interest and participate in peer groups for providing mutual feedback and receiving feedback from a tutor. This feedback is processed into the final version of the portfolio, which is graded at the end of the course. The final assignment in the portfolio will be a brief research proposal, to be presented to fellow students.

201400285 **Biostatistics (1A)**
Central concepts of probability theory like (conditional) probability, expectation and variance are treated. Also, the calculation of expectations and variances of linear functions of the observations is a topic of the course and this topic ends with principal components. The principles of statistical testing theory are explained considering the case of one sample (discrete and continuous data). Statistical tests are focused towards: the comparison of two samples, regression, analysis of variances (including repeated measures) and logistic regression. Within analysis of variance we spend some time on multiple comparison / post hoc analysis / simultaneous confidence intervals.

Each week you have to do an assignment. You have to deliver a written report for the first three assignments and the last assignment. You need to use SPSS (or another statistical package if the student prefers that) for the last 5 assignments and these last 5 assignments have to be discussed individually, except for the last one.

191150700 **Integrative Design of Biomedical Products (1A)**
During this course strategies are presented as an addition to the methodical design process. Subjects that will be discussed are project management, teamwork, communication methods for a good co-operation between medical and technical experts, application of selection processes, specific design aspects of implants, test of prototypes, including FMEA-analysis, METC-protocol and CE-certification. During the course an project assignment will be worked out by a multidisciplinary group of students.

201300004 **Robotics for Medical Applications (1B)**
This course provides an introduction to robotics with emphasis on the mathematical tools for describing the kinematics and control of robotic manipulators. In addition, selected topics concerning modeling of soft biological tissues and haptics, are also discussed. During minimally invasive surgery, instruments are often teleoperated by the clinician. Principles from robotics are used to describe this manipulation and navigation of instruments. Clinical insight and applications to medical robotics are also covered in this course. In addition to classroom lecture, there is a weekly lab where experiments are conducted using a haptic device.

201500222 **Technology for Health (1B)**
The aim of Biomedical engineering is to provide technological solutions for health care problems, for example for the support of human functions which are impaired by trauma or disease. As a biomedical engineer, you will be actively involved in technology research for advancing new ideas, concepts or intermediate results on the translation chain towards innovation of clinical practice and commercial exploitation. The overall goal of this course is to provide an overview of key aspects of the process of biomedical engineering and the role of the biomedical engineer.

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201400040 **Dynamics and Control (1B)**
The analysis of nonlinear dynamic mechanical systems, and techniques for controlling such systems, play important roles in nowadays engineering research and applications. Typical examples are helicopter blades, robotic manipulators, and unfolding solar panels for satellites. In this course the theoretical framework is outlined for the kinematic and dynamic description of such multibody systems. The analysis involves both rigid systems as well as systems with elastic components. The relevance of inverse kinematic and dynamic relations is addressed for the realisation of specified motion profiles. The use of feedback and feedforward control is presented for mechatronic systems. In this context issues regarding stability and accuracy are addressed.