

Course Package

Physiological Signals and Systems – 1B

Name module	Physiological Signals and Systems - 1B
Educational programme	MSc Biomedical Engineering
Period	Second block of the first semester (block 1B)
Study load	15 ECTS
Coordinator	J. Huttenhuis

Physiological Signals and Systems			
block 1A	block 1B	block 2A	block 2B
	Technology for Health - 201500222 (5 EC)		
	Mathematical Methods - 191506001 (5 EC)		
	Remote Monitoring and Coaching - 201500132 (5 EC)		

Required preliminary knowledge: Bachelor's degree in Biomedical Engineering, Industrial Design & Engineering, or Mechanical Engineering. Knowledge of Dynamics and Control (Master's level course within Mechanical Engineering) or a comparable course, Basic knowledge of Linear Algebra, Familiarity with MATLAB, Mechanics, Multi-body Kinematics and Dynamics, General Physics, General Mathematics, Principles of Signal Processing.

201500222 **Technology for Health**

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.

The modules are tentative and subject to change. Please check [the website](#) regularly.

191506001 **Mathematical Methods**

The understanding of scientific models and solving complicated engineering problems requires the correct use of programming and mathematical algorithms. Typical problems involve numerical solutions of nonlinear equations, simulations of dynamical systems, stability via eigenvalues, finite-dimensional approximations of spatial systems by discretization or Fourier analysis. The art is not just to be able to solve such problems but also to have an intuition for the accuracy of the solution. Here we use some analytical insights and error analysis.

201500132 **Telemedicine: Remote Monitoring and Coaching**

In Telemedicine we study theories, approaches and systems that focus on treating and assisting people in managing chronic health conditions or lifestyle changes in their own daily environment thereby supported by health care professionals when needed (Remote monitoring and coaching). To understand these systems, analyse them and to design them, we need to understand the health issues and problems that have to be addressed by the telemedicine system and we need to understand what the suitable building blocks and architectures are to design these systems. Furthermore, we need to be able to evaluate the system and understand how they can be implemented in every day care practice. A telemedicine system can be decomposed into four main functional building blocks:

Monitoring – this part of the system takes care of sensing relevant health related parameters and whenever needed environmental parameters. It will often include some data processing so as to remove measurement artifacts or to extract basic features from the sensor data. Monitoring may also include the transfer of data to some local or remote data-store facility, and it may include presentation of the (raw) data. Analysis – this part of the system takes care of analyzing and interpreting the with respect to biomedical or clinical metrics, or to estimate the state (either physical or mental) of the patient.

The two other functional building blocks are Decision Support and Feedback and coaching. In decision support the outcomes of the analysis are used to make decisions on whether or not action should be undertaken and which action. The question here is how we can derive and construct decision models and how should these be used. Once a decision has been made, proper feedback and coaching to the patient is needed in order to effectuate the action and/or move the patient into the desired direction. This course is about the design and development of a remote monitoring and coaching system by addressing these four different building blocks

Especially the rising age of the Dutch citizen as well as an increasing number of people with chronic diseases puts an extra pressure on our society as both elderly and people with chronic diseases are more viable to become victim of all kind of complaints and with the consequence of problems with their balance between work and private life. Supporting these people in deploying a healthier life style is considered important. Employers, communities and the taxpayer all bear the costs of working-age ill-health which is estimated to run to around several billion Euros every year. Since health, work and well-being are closely and powerfully linked, they need to be addressed together. Well-being applications at work and at home are expected to help people to continue contributing to society, the marketplace and the economy. Furthermore, these applications may help suppressing the rising costs of chronic disease and ill-health.

Two aspects related to deploying a healthier lifestyle are physical activity and stress. These two will be studied as cases in this course. Supporting people in becoming more active because a sedentary lifestyle is one of the main risk factors for all kind of health problems such as cardiovascular diseases, diabetes and musculoskeletal problems and because of the existing evidence that being active contributes positively to feeling healthy and quality of life. Although people do recognize the need for a more active lifestyle, they often find it difficult to get started and/or to stay motivated. Chronic stress is related to many diseases and reduces the performance and productivity. Occupational stress is believed to have a large impact on the economy. Chronic stress is associated with several negative health outcomes including cardiovascular risks and depression. This results in economic costs caused by illness absence of employee's. Hence, effective stress management is needed to solve these problems.

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