Course Package

Bioengineering Technologies – 2A + 2B

Name module	BET Biomedical Membranes & Artificial Organs - 2A + 2B
Educational programme	MSc Biomedical Engineering
Period	Second semester (block 2A + 2B)
Study load	30 ECTS
Coordinator	J. Huttenhuis

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Required preliminary knowledge: Fundamental knowledge and concepts from Cell Biology, Biochemistry, Chemistry (both Inorganic and Organic Chemistry, Standard Techniques), Biomaterials and Cell Material Interactions, Basic Anatomy and Physiology, Cell Culture and Molecular Biological, laboratory experience is of eminent importance, Fundamental knowledge and concepts from Molecular Biology, Physical Chemistry especially Thermodynamics, one of the technical bachelor programmes.

Block 2A

201400284 - **Biomedical membranes & (bio) artificial organs**

The course covers biomedical applications where the (bio) artificial membrane plays a crucial role. Main topics are: membrane preparation and characterization, drug delivery, blood purification-dialysis, blood oxygenation, bio-artificial kidney, bio-artificial pancreas, bio-artificial liver and tissue engineering. The course combines theory, assignments as well as experiments.

191210720 - Biomedical Signal Acquisition

The electrochemical detection methods form a beautiful comprehensive part of this course: starting from electrochemical processes at an electrode and the subsequent mass transport phenomena result in the three basic operational principles (potentiometry, amperometry and conductometry). When the relation between the variable to be determined (ionic species and/or its concentration)

and the measured quantity (voltage, current or conductance) is known, the relevant examples follow: the oxygen electrode (Clark electrode), the carbon dioxide sensor (Severinghaus principle) and the pH sensors (glass electrode). Additionally, other chemical biosensors like the glucose sensor, and biosensors based on optical detection principles are treated. The treatment of physical sensor systems is guided by the biomedical application: blood pressure and flow, lung volume and capacity. A bridge to the course Lab-on-a-Chip is formed by some examples of micro Total Analysis Systems, of which the detector is based on one of the mentioned sensor principles.

This course is open for TM, MBE, APH, NANO and EE students. General knowledge from your bachelor programs is required. For TM students, this course bridges the gap between biophysiology and biomedical signal processing and -analysis. This course consists of 12 lectures, where you actively participate in discussions to reach the learning objectives.. You will write your critical review paper in teams of two students to train and improve your knowledge and understanding via the original papers you have to review. Moreover, a 4-hr practical project concerning synchronous sensor data retrieval into a computer is one of the instructional modes of this course.

Block 2B

193400111 - **Bionanotechnology**

Bionanotechnology is a field of research and applications that sits at the interface between nanotechnology on the one hand and life sciences on the other.

This course includes:

- An introduction into the field of bionanotechnology field
- Basics of nanobiology, including structure and function of DNA/RNA, DNA supercoiling, chromatin structure, structure and function of proteins, lipids, membranes, molecular motors, biological cells
- (Biological) nanoparticles, including gene therapy and DNA nanoparticles, inorganica and iron oxide nanoparticles, quantum dots, the unfamiliar world at the nanoscale, molecular interactions, Brownian motion, and diffusion
- Methods and techniques to study biology at the nanoscale, including fluorescence microscopy and other fluorescence-based technoniques, nanoscopy methods, scanning probe microscopy (AFM), single molecule force spectroscopy, elasticity mapping, optical tweezers, magnetic tweezers.
- Writing of a comprehensive essay on the applications of nanobiotechnology, based on a short literature study.

Electives: (1 of the 2)

193640050 - Clinical Chemistry

The course clinical chemistry includes the basics of laboratory medicine in chemistry and pathology. Various concepts of clinical chemistry and laboratory medicine will be discussed such as; different measuring principles, sensitivity and specificity. What qualities are required of a laboratory test when it is used for screening purposes, like the current national screen for colorectal cancer. The aim is to explore the principles, techniques and instrumentation involved in quantitative analysis, with special emphasis on their clinical applications.

The start of this course will involve the basic concepts followed by a lab tour. During the remainder of the course you will address a current problem within the field of clinical chemistry. Together with one or more fellow students you will be challenged to make this problem ‘your own’, by writing a project description and a more extensive paper on your vision and ideas on the problem. During this

time you will be supervised by a clinical chemist. Furthermore you will teach your fellow students about a subject regarding the project, like lab on a chip, diabetes etc.

This course is especially interesting for students interested in the clinical laboratory, involving multidisciplinary fields of biology, science, chemistry and healthcare.

200900040 - Topics in Human Anatomy & Sports Physiology

This course will focus at different topics in the field of human anatomy and physiology with a focus on sport injuries and sport physiology. Lectures and practical courses will be used alternatively. In addition, guest speakers who are experts in the field of sport injuries and rehabilitation will provide one or more lectures. The course will be examined by a written exam and two assignments throughout the course.

Topics that will be addressed are:

- Anatomy
- Anatomy and pathology of the upper extremities with a focus on injuries of the shoulder
- Anatomy and pathology of the lower extremities with a focus on injuries of the knee
- Anatomy in vivo with a focus on the muscular structures involved in sporting activities
- Clinical anatomy and physiology
- Neuro-anatomy and physiology for motor control
- How imaging can help to detect (sports) injuries?

Physiology of sports and exercise:

- Energy systems and muscle fiber typing in relation to sports
- Fick's law and the Wasserman wheels
- Training physiology and adaptation to training
- Testing of physical capacity
- Movement analysis applied to sports
- Fatigue (and its effect on movement patterns)
- Injuries

Block 2A & 2B

201900123 - **Advanced Organic Chemistry**

- Give insight in reaction mechanisms;
- Reacive groups, competing mechanisms;
- Structures of amino acids and proteins;
- Peptides and their chemical synthesis;
- Orthogonal chemistry;
- Protein modification;
- Chemistry on surfaces;
- Cell surface engineering;
- Protein arrays, protein sensors
- Antifouling and bio-activation of biomaterials.