Course Package

BET Advanced Biomanufacturing - 1A

Name module	BET Advanced Biomanufacturing - 1A
Educational programme	MSc Biomedical Engineering
Period	First block of the first semester (block 1A)
Study load	15 ECTS
Coordinator	J. Huttenhuis

BET Advanced Biomanufacturing			
block 1A	**block 1B**	**block 2A**	**block 2B**
In vitro Diagnostics* 201700040 (5 EC)			
Physical Biology 202001414 (5 EC)			
Electives: (1 of the 2)			
Biophysical Techniques & Molecular Imaging - 193640020 (5 EC)			
Technology for Health - 201500222 (5 EC)			

Required preliminary knowledge: Fundamental knowledge and concepts from Cell Biology, Biochemistry, Chemistry, Physics: - Biology/Biochemistry: Cell structure, organelles, DNA, RNA, proteins, enzymes, antibodies; - Chemistry: fundamentals of inorganic and organic chemistry, standard techniques; - Physics: Fundamentals of optics, thermodynamics; - Math: Statistics (basics), Basic knowledge in Biology (high school level) and Thermodynamics (BSc level), A bachelor degree in Applied Physics, Biomedical Technology or Advanced Nanotechnology, Bachelor BMT or equivalent.

* Mandatory preliminary knowledge: Entry requirements for BME.

201700040 - In vitro Molecular Diagnostics

In vitro diagnostics (IVD) is the analysis of bodily fluids and tissue samples for the purpose of medical diagnostics.
Main aims of the course are to understand the requirements an IVD device has to fulfil, to understand the processes and concepts employed in existing IVD devices and to apply this understanding to critically assess recent developments and proposed concepts for targeted biomarkers and/or diseases.

Lecture: After an introduction on the purpose of IVD devices and the requirements they have to fulfil, the lectures will focus on the (bio)-chemical and physical processes and technical concepts employed in these devices:
• Sample preparation techniques

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

- enrichment/purification/separation
- amplification
- labelling

• Detection techniques:
- label free
- fluorescence based
- electrochemical/electrical

• Microfluidics for IVD
• Point-of-care diagnostics

Students will work in groups to prepare a summary a self-chosen topic (challenge) within the context of in-vitro diagnostics in a presentation. They will develop their own concept to address this challenge and present their solution in a poster presentation

202001414 - Physical Biology

The complex behaviour of cells and bio-molecules cannot be fully understood without deep physical insight, triggering an increasing interest in physical biology. Generic physical concepts have given quantitative insight into how muscle cells convert the chemical energy of ATP into movement and into how DNA can replicate itself during cell division. In this course, we will discuss both the biochemistry and basic physical principles that help us understand and quantitatively describe biological phenomena and processes occurring in cells.

After an introduction into cellular and molecular biology, you will learn how the confluence of thermal, mechanical, chemical and entropic forces make the behaviour of cells and biological macromolecules so different from our everyday experience. Topics include: the central dogma in molecular biology, cellular transport mechanisms, different forms of intracellular signalling mechanisms, , diffusion, entropic forces, self-assembly, biopolymer elasticity, and molecular machines. The course consists of lectures, self-study, and 15 min presentation and peer review by students on a self-chosen subject related to the latest developments in one of the course topics.

Electives: (1 of the 2)

193640020 - Biophysical Techniques & Molecular Imaging

Luminscence: Fluorescence, phosphorescence, bioluminescence; advanced luminescence principles: polarization, lifetime; bulk and single molecule approaches; imaging and spectroscopy in a microscope; intrinsic and extrinsic fluorophores; protein fluorescence; genetically encodable fluorescent markers, nanoparticles
Microscopy: wide-field, dark field, confocal, phase contrast, fluorescence microscopy (FRAP, FLIP, FLIM, FRET), micro-spectroscopy, hyperspectral imaging, polarization contrast, lifetime imaging, resonance energy transfer imaging, nano-particle imaging, non-linear microscopy.
Vibrational Spectroscopy and Imaging: label-free contrast methods such as spontaneous Raman micro-spectroscopy, Infrared microscopy, CARS microscopy, non-linear fluorescence microscopy and single molecule micro-spectroscopy.

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. Therefore, this course consists of:

- theoretical lectures on clinical problem analysis, technology research and technology transfer;
- capita selecta lectures in which experts from the field describe a clinical problem and state of the art technical solutions and future developments in technology research;

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- assignments in which students individually prepare a final proposal for a research project for development of a technological solution beyond the present state of the art;
- peer groups in which students present and discuss their progress during the preparation and receive feedback from fellow students and a tutor;
- a grant competition in which final proposals are presented to and evaluated by a student jury.