

Course Package

Imaging & In Vitro Dagnostics – Q1

Name module	Imaging & In Vitro Dagnostics – Q1
Educational programme	MSc Biomedical Engineering
Period	First quartile of the first semester – Q1
Study load	15 ECTS
Coordinator	J. Huttenhuis

Imaging & In Vitro Dagnostics			
Quartile 1	Quartile 2	Quartile 3	Quartile 4
Electives: choose 15 EC			
Biophysical Techniques and Molecular Imaging - 193640020 (5 EC)			
In vitro Diagnostics - 201700040 (5 EC)			
Technology for Health - 201500222 (5 EC)			
Imaging Processing and Computer Vision - 202200103 (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; Linear Algebra; Bachelor BMT or equivalent.

Electives: choose 15 EC

193640020 - Biophysical Techniques and Molecular Imaging

Biophysical Techniques & Molecular Imaging (BT&MI) introduces a selection of advanced micro-spectroscopic techniques for molecular and cellular studies. The course treats imaging techniques based on fluorescence spectroscopy and vibrational spectroscopy. The general concepts of contrast, resolution, localization, sensitivity and signal-to-noise ratio will be presented and related to microscopic properties of molecules. Electro-magnetic properties of the light field, basic to contrast, will be put in the context of microscopic methods. Light distributions in the focus of microscope objectives will be presented to understand the basics of resolution. Micro-spectroscopic techniques are essential to modern biomedical sciences, such as in-vivo imaging, quantitative biology, stem cell research and studies of fundamental cellular processes, for example cell-division, apoptosis, phagocytosis, cell differentiation, carcinogenesis. Concepts will be illustrated with examples from the life and (bio)-material sciences.

201700040 - In Vitro 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:

- To understand the requirements an IVD device has to fulfil
- To understand the processes and concepts employed in existing IVD devices
- To apply this understanding to critically assess recent developments and proposed concepts for targeted biomarkers and/or diseases.

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

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
 - enrichment/purification/separation
 - amplification
 - labelling
- Detection techniques:
 - label free
 - fluorescence based
 - electrochemical/electrical
- Microfluidics for IVD
- Point-of-care diagnostics

201500222 - Technology for Health

This course is offered at the beginning of the Master Biomedical Engineering (BME) and is primarily designed for students of the Master Biomedical Engineering. 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 outline the identity of the biomedical engineering discipline and to generate awareness of key aspects of biomedical engineering by focusing on the key roles of the biomedical engineer in:

- Healthcare Innovation – Biomedical engineers analyze today's healthcare problems to recognize technological limitations and to envision the potential impact of new technology.
- Technology Research – Biomedical engineers develop new concepts, tools and skills for measuring, analysis, modeling or controlling of quantities, or realization of materials.
- Technology Transfer – Biomedical engineers synthesize new technological concepts and stake-holders interests into validated and innovative solutions for health care problems.

In this course you will learn through active engagement in online and face-to-face learning activities aiming at your professional development, especially your competences in meeting societal challenges, ensuring impact of your ideas and work, and communication and collaboration with fellow professionals and stakeholders. You will be challenged to connect insights acquired from several course materials to the practice of research presently performed at the TechMed institute and to reflect on your own professional development.

202200103 - Imaging Processing and Computer Vision

The course familiarizes students with digital image processing and computer vision techniques. It provides the fundamentals for 2-D signal processing applied to digital images. It also discusses techniques for the extraction of 2D, 3D, or 4D information that is represented by a digital image (or image sequence). Examples of computer vision tasks are:

- a. the detection, e.g. checking the presence of an object or event.
- b. The recognition or identification of an object or person.
- c. The measurement of the parameters of an object, e.g. position, size, shape.
- d. Motion analysis of objects.

The topics of the course include image formation and acquisition, 2D Fourier transforms, image operations, image segmentation, regional description, recognition and parameter estimation. The course involves practical work in which the students design a vision system for a simple application. As such, the student acquires programming skills using Matlab and its image processing toolbox. Examples of design tasks that students can select are:

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- a. Virtual advertising: inserting virtual advertising images into recorded movies of sports events
- b. Motion analysis: tracking an object in a cluttered movie.
- c. 3D face reconstruction from 3 images
- d. 3D tracking of facial point features.