

# Course Package

## Bionanotechnology & Advanced Biomanufacturing

Name module	BNT - Advanced Biomanufacturing
Educational programme	MSc Biomedical Engineering
Period	First quartile of the first semester (Quarter 1A)
Study load	15 ECTS

BNT - Advanced Biomanufacturing			
Quarter 1A	Quarter 1B	Quarter 2A	Quarter 2B
<b>In vitro diagnostics</b> (5 EC)			
<b>Controlled Drug and Gene Delivery</b> (5 EC)			
<b>Biophysical Techniques &amp; Molecular Imaging</b> (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, spectroscopy; - Math: Statistics (basics).

### 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 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
  - enrichment/purification/separation
  - amplification
  - labelling

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

- 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

### **193740010 Controlled Drug and Gene Delivery**

This course gives a general overview about basic drug and gene delivery technologies and the recent advances and directions of future developments in controlled release technology. Topics included are: fundamental principles of controlled drug and gene delivery and their pharmaceutical applications in various delivery routes (oral, pulmonary, nasal, ocular, brain, etc.); delivery from biodegradable polymeric systems (nanoparticles, hydrogels, microspheres, dendrimers, etc.), microstents and nanodevices; delivery in tissue engineering. The course is composed of tutorial lectures, guest lectures and self-learning assignments (based on industrial and theoretical applications).

### **193640020 Biophysical Techniques & 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.