Course Package

Imaging & In Vitro Diagnostics – 2B

Name module	Imaging & In Vitro Dagnostics
Educational programme	MSc Biomedical Engineering
Period	Second block of the second semester (block 2B)
Study load	15 ECTS
Coordinator	J. Huttenhuis

Imaging & In Vitro Dagnostics			
block 1A	**block 1B**	**block 2A**	**block 2B**
			Biomedical Optics - 193500000 (5 EC)
			Clinical Chemistry - 193640050 (5 EC)
			Imaging Techniques in Radiology - 201800114 (5 EC)

Required preliminary knowledge: Knowledge of Optics, Wave Optics, Electrodynamics, Fourier Transform, Calculus, Differential and Integral Equations.

193500000 **Biomedical Optics**
Skin and other biological tissues scatter light, making it impossible to look directly inside the body. Still, there are many optical methods that can image structures deep under the skin e. g. by cleverly using interactions between light and tissue, by exploiting the properties of light propagation in scattering materials, or by combining light with ultrasound. In this course, you will get to know the basic theoretical models for light propagation in biological tissue, and you will learn the working principle of a large range of optical imaging methods, ranging from highly experimental approaches to devices widely used in the clinic on a daily basis. Topics include: light scattering on small particles, light diffusion and radiative transport, optical coherence tomography, photoacoustic tomography, speckle-based blood flow monitoring, optical wavefront shaping, and more. In addition to the lectures, you will perform a series of light-scattering experiments.
Written examination (weight factor 0.5). Reports on experiments (weight factor 0.5).

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

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.

201800114 **Imaging Techniques in Radiology**

The goal of this course is that students understand and can apply techniques that are currently used in the clinic to generate medical images from signals. Next to that they can optimize the acquisition and reconstruction of these images for specific purposes such as image quality, acquisition time or dose reduction.

It is expected from the students that they already know how to get a measurable signal from a human body using CT, PET/SPECT and MRI. The requirements on hardware to obtain signals should therefore be known. Using this course the students learn how to make optimal use of this equipment.

The lectures on radiography and fluoroscopic imaging give the student an overview of the radiographic and mammographic systems used in the clinic, as well as on fluoroscopy systems used for interventional procedures. The different clinical applications of these systems, their relation to patient dose, and the relation between image quality and the diagnostic accuracy are discussed.

In the lectures on Computed Tomography students will gain insight in the different configurations of CT systems, the techniques of image formation, image reconstruction and the influence of acquisition and reconstruction parameters on image quality. In addition, the students will learn about radiation dose in CT and the significance of dose saving strategies and radiation dose indices provided on the scanner. The translation of the technical parameters on CT and their influence on the diagnosis of patients will be enlightened by different case studies.

The PET/SPECT lectures will introduce the key aspects of nuclear medicine imaging. Radioactivity as a means of detecting functional processes inside the body and radiation protection issues will be considered. The students will also gain insight into technological basics of PET and SPECT scanners as well as into image reconstruction and quantification techniques. Typical artefacts will be presented in selected case studies.

During the MRI part of the course students will become familiar with signal encoding that makes generating images possible and the parameters that influence the resulting image quality and resolution. Next to that, students will learn how this acquisition can be described and optimized in the frequency domain. Finally, by practical sessions on an MRI scanner students will learn how to use a scanner and optimize it for a specific use.