LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Medicinska bildgivande system
Medical Imaging Systems

EXTG01, 5 credits, G2 (First Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED BME
Date of Decision: 2023-04-13

General Information

Main field: Technology.
Compulsory for: BME3
Language of instruction: The course will be given in Swedish

Aim

Biomedical imaging is central for diagnosis and therapy, as images give the user the possibility to immediately interpret complex and large data sets. In today's imaging systems for biomedical applications, these are processed from information retrieved from ionizing radiation (nuclear medicine, X-rays) or non-ionizing radatopn (ultrasound or magnetic resonance imaging). The current trend is that biomedical images has an ever increasing role not only for diagnosis and therapy, but also to gain an understanding of the functions of the human body as sick or healthy all the way down to a molecular level. It is therefore important that the engineer in medicine and technology acquire an understanding of the basic principles behind these systems in terms of image generation, constraints and opportunities, applications and any related health risks..

Learning outcomes

Knowledge and understanding
For a passing grade the student must

• Have knowledge of most common imaging modalities for biomedical applications
• Understand how images from each modality are created
• Have an understanding of how a clinical examination is performed for each of the imaging systems
• Have an understanding of what application areas each system typically is used for.

• Have an understanding for the limitations of the systems to avoid misinterpretations of measurement results
• Have a basic knowledge of radiation protection and related health risks

Competences and skills
For a passing grade the student must

• have experience in image interpretation that are typical of the most common imaging systems
• To communicate acquired results of laboratory experiments in writing

Judgement and approach
For a passing grade the student must

• be able to make a discussion about which imaging system that should be used for a given problem

Contents

Nuclear medicine: The principles behind nuclear medicine. The Scintillation camera, PET / SPECT - Basic principles of data collection for tomographic image reconstruction. Radiopharmaceuticals and internal dosimetry. Quality control.

Radiology: Generation of bremsstrahlung, X-rays, X-ray spectrum and filtering, the X-ray image. Radiation field, Radiation quality parameters (HVL, spectra). Primary and secondary radiation, contrast agents. Detectors (emulsion, intensifying screens, image plates). Image intensifiers. Direct digital detectors. Computed tomography, reconstruction algorithms, the CT number. Clinical applications of X-rays. Image quality versus the absorbed dose to the patient. DICOM image archiving in radiology. Quality control.

Magnetic resonance imaging: Brief history. NMR-related nuclear physics introduction including the concepts of magnetic resonance, spin population and signal generation. Basal contrast parameters: proton density, T1, T2 and T2 * relaxation. The signal detection and image reconstruction by Fourier transform. Basal pulse sequences, i.e., spin echo, gradient echo, inversion recovery, and their typical contrast properties at various machine settings. MR safety and practical risks.

Ultrasound: Physics, transducer technology, ultrasound scanner architecture, Doppler, safety and artifacts.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: For a grade 3 the following parts must be passed: practical laborations with reports, as well as a written exam.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts

Code: 0117. **Name:** Written Examination.
Credits: 4. **Grading scale:** TH. **Assessment:** Passed exam

Code: 0217. **Name:** Laboratory Work.
Credits: 1. **Grading scale:** UG. **Assessment:** Passed laboratory works and reports

Admission

Assumed prior knowledge: EITA01 Introduction to Biomedical Engineering
The number of participants is limited to: No

Reading list

- Magdy M. Khalil: Basic Sciences of Nuclear Medicine (e-bok). Samt föreläsningsanteckningar.
- Hendee, W R and Russell, R E: Medical Imaging Physics (e-bok). Samt föreläsningsanteckningar.

Contact and other information

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