SH2310 Radiation Detectors and Medical Imaging Systems 7.5 credits

Strålningsdetektorer och medicinska bildgivande system

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for SH2310 valid from Spring 2010

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Physics

Specific prerequisites

Recommended prerequisites: Subatomic physics (SH2101) or equivalent.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completion of the course, the student should be able to:

- Explain the physical and technological principles behind various types of radiation detectors and imaging modalities.
- List the various components that build up imaging systems of different types and describe their respective functions.
- Give examples of radionuclides and radiopharmaceuticals used for nuclear imaging, explain how they are produced, as well as motivate their use in their respective applications in terms of their physical, chemical and biological properties.
- Describe the various contrast mechanisms employed by the different medical imaging modalities.
- Categorize imaging modalities with respect to parameters such as emission/transmission imaging; anatomical/functional imaging; ionizing/non-ionizing radiation imaging, projection/tomographic imaging, etc.
- Solve basic numerical problems involving e.g. count rate and image acquisition time, radiation dosimetry, administration of activity and radiographic contrast, Rose model.

To qualify for the highest grades, the student should also demonstrate the ability to:

- Evaluate detectors and medical imaging systems in terms of quantitative parameters such as contrast, signal-to-noise ratio, modulation transfer function, etc.
- Identify physical and current technological limitations of medical imaging systems.

Course contents

The course treats the physical, mathematical and technological aspects of medical imaging systems. Modalities (imaging types) covered include x-ray imaging, computed tomography (CT), gamma camera imaging and single photon emission computed tomography (SPECT), positron emission tomography (PET), ultrasound imaging and magnetic resonance imaging (MRI). Other topics include radiation biology, dosimetry and production of radioisotopes.

Special emphasis is given to the principles of radiation detection and the associated instrumentation, which in many cases were developed within sub-atomic physics. Recently introduced digital detectors, current development and technology trends are an important part of the course.

Numerical methods to quantify the performance of medical imaging systems are presented. The design of medical imaging systems usually involves a number of tradeoffs involving parameters such as contrast, spatial resolution, noise, image acquisition time, size and cost. It is a major goal of the course to provide an understanding of these relations.

Course literature

J. Bushberg (Editor), “The essential physics of medical imaging”, 2nd edition, 2001.

Examination

- LAB1 - Laboratory Work, 3.0 credits, grading scale: P, F
- TEN1 - Examination, 4.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

One written exam (or project work) (TEN1; 4,5 university credits) and laboratory work including compulsory participation in visits (LAB1; 3 university credits).

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.