Medical Radiation Physics

Programme course

8 credits

Medicinsk strålningsfysik

TVFA02

Valid from: 2018 Spring semester

Determined by
Board of Studies for Electrical
Engineering, Physics and Mathematics

Date determined

Main field of study
Biomedical Engineering

Course level
First cycle

Advancement level
G2X

Course offered for
- Biomedical Engineering, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Wave motion, Electromagnetism - Theory and Application, Modern physic.

Intended learning outcomes

The course will provide the student with basic knowledge of how ionizing and non-ionizing radiation interacts with matter, the basics of dosimetry of ionizing radiation with emphasis on diagnostic and therapeutic applications in health care. The course also introduces radiation biology and radiological protection of patient and staff so that the student are made aware of the radiation hazards for humans and how to protect him/herself and patient from unnecessary irradiation. The course gives an overview of regulations that are formed around the use of ionizing radiation in health care and how different staff (i.e. physicist, engineers, nurses and doctors) collaborates on quality assurance on equipments that produce radiation.
After the course the student should be able to:

- Describe how the human body is affected by ionizing radiation (Solo2)
- Describe quantities used for radiation dosimetry, report on how these are measured or computed and to do simple dose estimations (Solo2)
- Describe fundamental knowledge of radiological protection so that the student can protect him/herself and assist others to manage their own safety (Solo2)
- Explain how ionizing radiation interact with matter and use this knowledge to select a suitable method to measure radiation (Solo3)
- Explain radioactive decay, give example of how it is used in the hospital and reflect on how radiological waste is managed from an environmental perspective (Solo3)
- Describe how different radiation detectors operate and make an argument why some radiation detectors are suitable for measuring a particular type of ionizing radiation (Solo3)
- Apply different radiation detectors working principles and use this knowledge in different radiation environments to assess the reasonableness in the measured data (Solo4)
- To briefly describe the regulations and requirement from government and authorities (i.e. Swedish Radiation Protection Agency) that surrounds the use of ionizing radiation in society, specifically in the health care system with focus on the responsibility of the medical engineer (Solo2)
- Describe and give examples of systematic quality assurance in the health care system with emphasis on radiological equipment (Solo2)
- Describe the basic physics of nuclear magnetic resonance as a basis for the course TBMT02 (Solo2)
- Describe the basic physics of ultra sound as a basis for the course TBMT02 (Solo2)

Course content

The course focuses on the basic physics of ionizing radiation behind the many diagnostic and therapeutic applications in health care and, as a central part, include interaction of ionizing radiation and matter In radiation dosimetry we study how ionizing radiations impart energy to for example human tissue and how the energy-impartation per unit mass (absorbed dose) is quantified by measurements or calculations. Radiation detectors are used for patient and staff dosimetry, for creating diagnostic images, for surveillance and for quality assurance of the environment in health care and industry. The subject of radiation biology describes how radiation affects living organisms and what risk are associated with ionizing and non-ionizing radiation, in the short and long run. Radiological protection is a subject that includes how to protect staff and patients from unnecessary irradiation or damages due to radiation. The course includes the basic physics of nuclear magnetic resonance and ultra sound – techniques that are used in health care for imaging and for quantitative analysis.

Teaching and working methods

The course is divided into lectures, seminars, study group sessions, tutorials, laboratory work and a field study exercises. The course is scheduled for student-centred learning with sessions of problem-based learning that are compulsory (1 ECTS). The course is to a large extent based on laboratory work and all lab sessions are compulsory and are completed by submitting a written lab report (3 ECTS).

Examination

UPG1	Home Assignments	4 credits	U, 3, 4, 5
MOM1	Laboratory work and field study exercise	1 credits	U, G
LAB1	Laboratory work and field study exercise	3 credits	U, G

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Medical Imaging

Department

Institutionen för medicin och hälsa

Director of Studies or equivalent

Alexandr Malusek

Examiner

Alexandr Malusek

Course website and other links

http://www.imh.liu.se/utbildning_vid_IMH/medicinsk-stralningsfysik?l=sv

Education components

Preliminary scheduled hours: 64 h
Recommended self-study hours: 149 h

Course literature

Grundläggande strålningsfysik av Mats Isaksson (Studentlitteratur) Ytterligare kursmaterial finns på kursens webbsida, se nedan.

Common rules

Course syllabus

A syllabus has been established for each course. The syllabus specifies the aim and contents of the course, and the prior knowledge that a student must have in order to be able to benefit from the course.

Timetabling

Courses are timetabled after a decision has been made for this course concerning its assignment to a timetable module. A central timetable is not drawn up for courses with fewer than five participants. Most project courses do not have a central timetable.

Interrupting a course

The vice-chancellor's decision concerning regulations for registration, deregistration and reporting results (Dnr LiU-2015-01241) states that interruptions in study are to be recorded in Ladok. Thus, all students who do not participate in a course for which they have registered must record the interruption, such that the registration on the course can be removed. Deregistration from a course is carried out using a web-based form: www.lith.liu.se/for-studenter/kurskomplettering?l=sv.

Cancelled courses

Courses with few participants (fewer than 10) may be cancelled or organised in a manner that differs from that stated in the course syllabus. The board of studies is to deliberate and decide whether a course is to be cancelled or changed from the course syllabus.

Regulations relating to examinations and examiners

Details are given in a decision in the university's rule book: http://styrdokument.liu.se/Regelsamling/VisaBeslut/622678.

Forms of examination

Examination

Written and oral examinations are held at least three times a year: once immediately after the end of the course, once in August, and once (usually) in one of the re-examination periods. Examinations held at other times are to follow a decision of the board of studies.

Principles for examination scheduling for courses that follow the study periods:

- courses given in VT1 are examined for the first time in March, with re-

examination in June and August
- courses given in VT2 are examined for the first time in May, with re-examination in August and October
- courses given in HT1 are examined for the first time in October, with re-examination in January and August
- courses given in HT2 are examined for the first time in January, with re-examination at Easter and in August.

The examination schedule is based on the structure of timetable modules, but there may be deviations from this, mainly in the case of courses that are studied and examined for several programmes and in lower grades (i.e. 1 and 2).

- Examinations for courses that the board of studies has decided are to be held in alternate years are held only three times during the year in which the course is given.
- Examinations for courses that are cancelled or rescheduled such that they are not given in one or several years are held three times during the year that immediately follows the course, with examination scheduling that corresponds to the scheduling that was in force before the course was cancelled or rescheduled.
- If teaching is no longer given for a course, three examination occurrences are held during the immediately subsequent year, while examinations are at the same time held for any replacement course that is given, or alternatively in association with other re-examination opportunities. Furthermore, an examination is held on one further occasion during the next subsequent year, unless the board of studies determines otherwise.
- If a course is given during several periods of the year (for programmes, or on different occasions for different programmes) the board or boards of studies determine together the scheduling and frequency of re-examination occasions.

Registration for examination

In order to take an examination, a student must register in advance at the Student Portal during the registration period, which opens 30 days before the date of the examination and closes 10 days before it. Candidates are informed of the location of the examination by email, four days in advance. Students who have not registered for an examination run the risk of being refused admittance to the examination, if space is not available.

Symbols used in the examination registration system:

** denotes that the examination is being given for the penultimate time.

* denotes that the examination is being given for the last time.

Code of conduct for students during examinations

Details are given in a decision in the university's rule book: http://styrdokument.liu.se/Regelsamling/VisaBeslut/622682.

Retakes for higher grade

Students at the Institute of Technology at LiU have the right to retake written examinations and computer-based examinations in an attempt to achieve a higher grade. This is valid for all examination components with code “TEN” and "DAT". The same right may not be exercised for other examination components, unless otherwise specified in the course syllabus.

Retakes of other forms of examination

Regulations concerning retakes of other forms of examination than written examinations and computer-based examinations are given in the LiU regulations for examinations and examiners, http://styrdokument.liu.se/Regelsamling/VisaBeslut/622678.

Plagiarism

For examinations that involve the writing of reports, in cases in which it can be assumed that the student has had access to other sources (such as during project work, writing essays, etc.), the material submitted must be prepared in accordance with principles for acceptable practice when referring to sources (references or quotations for which the source is specified) when the text, images, ideas, data, etc. of other people are used. It is also to be made clear whether the author has reused his or her own text, images, ideas, data, etc. from previous examinations.

A failure to specify such sources may be regarded as attempted deception during examination.

Attempts to cheat

In the event of a suspected attempt by a student to cheat during an examination, or when study performance is to be assessed as specified in Chapter 10 of the Higher Education Ordinance, the examiner is to report this to the disciplinary board of the university. Possible consequences for the student are suspension from study and a formal warning. More information is available at https://www.student.liu.se/studenttjanster/lagar-regler-rattigheter?l=sv.

Grades

The grades that are preferably to be used are Fail (U), Pass (3), Pass not without distinction (4) and Pass with distinction (5). Courses under the auspices of the faculty board of the Faculty of Science and Engineering (Institute of Technology) are to be given special attention in this regard.

1. Grades U, 3, 4, 5 are to be awarded for courses that have written examinations.
2. Grades Fail (U) and Pass (G) may be awarded for courses with a large degree of practical components such as laboratory work, project work and group work.

Examination components

1. Grades U, 3, 4, 5 are to be awarded for written examinations (TEN).
2. Grades Fail (U) and Pass (G) are to be used for undergraduate projects and other independent work.

3. Examination components for which the grades Fail (U) and Pass (G) may be awarded are laboratory work (LAB), project work (PRA), preparatory written examination (KTR), oral examination (MUN), computer-based examination (DAT), home assignment (HEM), and assignment (UPG).
4. Students receive grades either Fail (U) or Pass (G) for other examination components in which the examination criteria are satisfied principally through active attendance such as other examination (ANN), tutorial group (BAS) or examination item (MOM).

The examination results for a student are reported at the relevant department.

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.