



LUND UNIVERSITY
Faculty of Science

SYLLABUS

Date
16 December 2021

Reg. No.
U 2021/919

Syllabus for the course The Radiobiological Basis for Radiation Therapy, NME006F/NME007F

Swedish title: Den radiobiologiska grunden för strålbehandling

The course syllabus was confirmed by the Faculty board for graduate studies 16 December 2021. The course is in the third cycle and amounts to 6 credits (theoretical part and advanced part, course code NME007F), alternatively 3 credits (theoretical part only, course code NME006F).

The course syllabus is formally approved in Swedish. This is a translation.

Learning outcomes

Theoretical part (NME006F 3 credits):

On completion of the course, participants shall be able to:

Knowledge and understanding

- Describe the sequence of events and mechanisms that can lead to radiobiological effects at the cellular, tissue and organ levels, for a given type of tissue or tumour at different times after exposure, including radiochemical reactions, DNA damage, repair mechanisms, cell death, effects on the expression of gene and protein synthesis and immunological reactions.
- Describe factors in the exposure pattern or the biochemical environment that may modify the presence of radiobiological effects.
- Give examples of molecular biology techniques used for experimental studies of radiation biological effects.
- Indicate the starting points for mathematical radiobiological models, their applicability and the radiobiological mechanisms that are taken into account.

Skills and abilities

- Analyze a specific radiobiological effect relevant to a given radiotherapeutic modality, based on the prevailing state of knowledge.
- Account for clinically relevant radiation effects with respect to tumour control and normal tissue toxicity for different radiotherapeutic modalities and clinical applications.

Judgement and approach

- Summarize today's challenges for a given type of radiation therapy and the approaches explored to meet these challenges.
- Identify parts where the student currently lacks or would need to supplement their knowledge base.

Theoretical part + advanced part (NME007F 6 credits): For the NME007F 6 credits, participants shall also be able to:

- Demonstrate the ability to identify, formulate and apply research-related questions in radiation biology.
- Suggest a pre-clinical or clinical study that can be conducted to investigate this radiobiological effect.

Course content

Radiobiology is a field of knowledge and research in the borderland between physics, chemistry, biology, and medicine. Radiobiology is currently undergoing an increasingly diversified development and there is a need for a cross-disciplinary understanding. This course aims to provide an in-depth understanding in different sub-areas and convey a more complete picture of radiobiological phenomena, how they can be investigated and how they are applied in different radiotherapeutic applications.

The course comprises radiolysis, radical reactions in an intracellular environment, ROS metabolism, DNA damage and repair mechanisms, radiation sensitivity, radiation effects on the expression of genes and proteins, radiation-induced cell death, immune system and its response to radiation, vascular effects, non-target effects, danger and rescue signals, radio sensitizing and protective factors, importance of oxygen concentration, low and high dose rates, mechanistic mathematical modelling, radiation proteomics, clinical efficacy toxicity of radionuclide therapy, external radiotherapy, brachytherapy and proton therapy.

Teaching

The course is conducted in two parts, one theoretical part and one advanced part.

Theoretical part (NME006F 3 credits): The theoretical overview part consists of two weeks of lectures, provided by distance learning. In parallel with the lectures, time will be given to individual reflection upon the course content, with the aim of identifying and discussing knowledge gaps and parts that are difficult to understand, jointly at the end of the lecture period, and individually summarizing these reflections in a written report.

Theoretical part + advanced part (NME007F 6 credits): In addition to the theoretical part, participants conduct a work within an elective sub-area, resulting in a comprehensive written report. This is done by participants identifying a knowledge gap within the field, suggesting a pre-clinical or clinical study, providing an in-depth justification for the proposed study based on literature reviews, and planning the logistics for its implementation. The starting point for the work is the course objectives, as well as processed instructions from the Swedish Research Council and the Cancer Foundation. In addition, the student must peer-review a colleague student's report and submit written comments. The student's own work will be presented orally at a seminar jointly for all students, where the peer-reviewing student opposes.

Assessment

Assessment (NME006F, 3 credits) is based on attendance, as well as an individual written report.

Assessment (NME007F, 6 credits) is based on attendance, individual in-depth written report, oral presentation, and peer-review/opposition (written and oral) on another student's report.

Grading scale

Possible grades are Pass and Fail.

To pass the course NME006F (3 credits), the student must attend at least 80 % of the lectures and demonstrate an approved written report.

To pass the course NME007F (6 credits) the student must attend at least 80 % of the lectures, provide written comments on another student's report, demonstrate active participation and opposition at the seminar discussion, and demonstrate an approved, comprehensive written report.

Language of instruction

The language of instruction will be English or, if all attendees are Swedish speaking, in Swedish.

Entry requirements

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Additional information

The course credits cannot be transferred to the second-cycle medical physics degree programme.