PhD course in Medical Imaging

Course content:

The aim of the course is to give an introduction in medical imaging, where students and researchers get a comprehensive overview of all the advanced diagnostic modalities used in radiology and nuclear medicine today. During the course, the students also get an introduction to research in the field of medical imaging and future aspects of these techniques. In the course topics in MR, CT, PET-CT and Ultrasound will be teached, in addition to radiation risk and protection. All lectures are given by national and international experts and researchers in the field of medical imaging.

Learning outcome:

The participants shall get a basic understanding in the following areas:

- Knowledge in MR-, CT-, UL- and PET-CT technology, image reconstruction and clinical application of the different modalities to know the differences between the modalities in different clinical settings
- Knowledge in radiation risk and radiation protection
- Knowledge in new technology and future perspectives in MR-, CT-, UL- and PET-CT imaging

Admission:

To participate in this course, admission to a Ph.D programme at a Norwegian university or University college is necessary. PhD candidates from other Norwegian institutions participating in the course may apply for a travel- and accommodation grant from MedIm - Norwegian Research School in Medical Imaging. Further information on these grants: www.medicalimaging.no

Credits:

5 ECTS Points

Formal prerequisite knowledge:

Master of Science, Medical Doctors, admission to the Faculty of Medicines Medical Student Research Program (Forskerlinjen) or admission to the master programme in Physics.

Teaching:

The course is taught in Week 38 and 42 autumn 2013 at Oslo University Hospital, Rikshospitalet. The course is organized as full day teaching over 8 days (4 + 4 days). The participants must have time for literature studies and take home exercises after study period 1.

Evaluation and Exam:

Take-home exercise between part 1 and part 2 of the course for the PhD students (not the Master students or the students at the Medical Student Research Programme).

A take-home examination will be given to all students at the end of the course. Grading: Pass/fail.

Course administration:

Professor Atle Bjørnerud and Associate professor Anne Catrine Trægde Martinsen, The Physics institute, UiO and The Intervention Centre, Oslo University hospital.
Both Atle Bjørnerud and Anne Catrine Martinsen will participate during the course and be responsible for the course.

Required reading:

- A course compendium will be made, including the lecture notes
- Folwler (ed): Webb's Physics of Medical Imaging. CTC Press (2012)

Relevant additional literature:

- Jiang Hsieh: Computed tomography Principles, Design, Artifacts and Recent Advances. Wiley Interscience
- Jørgensen: CT teknikk –Indføring i CT-teknikkens grundprincipper. Forlaget UTOPIA (2005).
- The Physics of MRI. Kompendium for UIO- kurset MR-teori og medisinsk diagnostikk (fys-kjm4740 (http://www.uio.no/studier/emner/matnat/fys/FYS-KJM4740)
- Wahl: Principles and practice of PET and PET/CT. Wolters Kluwer (2009)

Lecturers:

International speakers:

- Mattias Van Osch, Leiden, Nederland
- Elly Castellano, London, UK

National speakers:

- Professor Atle Bjørnerud, The Physics institute, UiO and The Intervention Centre, Oslo University hospital
- Professor Sverre Holm, The Institute of informatics, UiO
- Professor Erik Fosse, The Faculty of medicine, UiO and The Intervention Centre, Oslo University hospital
- Professor Bjørn Edwin, The Faculty of medicine, UiO and The Intervention Centre, Oslo University hospital
- Professor Thor Edvardsen, The Faculty of medicine, UiO and the Department of cardiology, Oslo University hospital
- Professor Frode Willoch, The Faculty of medicine, UiO
- Ass professor Tor Endestad, The Insitute of psychology, UiO
- Ass professor Anne Catrine Trægde Martinsen, The Physics institute, UiO and The Intervention Centre, Oslo University hospital
- Ass professor Ole Jakob Elle, The Institute of informatics, UiO and The Intervention Centre, Oslo University hospital
- Ass professor Hilde Merethe Olerud, The Physics institute, UiO and the Norwegian radiation protection authorithy (NRPA)
- Medical physicist Trine Hjørnevik, The Intervention Centre, Oslo University hospital
- Section leader Per Kristian Hol, The Intervention Centre, Oslo University hospital
- Section leader Per Steinar Halvorsen, The Intervention Centre, Oslo University hospital
- Radiologist Einar Hopp, Dep of radiology and nuclear medicine, Oslo University hospital
- Radiologist Gaute Hagen, Dep of radiology and nuclear medicine, Oslo University hospital
- Radiologist John Hald, Dep of radiology and nuclear medicine, Oslo University hospital
- Radiologist Johan Baptist Dormagen, Dep of radiology and nuclear medicine, Oslo University hospital
- Radiologist Mogens Aaløkken, Dep of radiology and nuclear medicine, Oslo University hospital
- Radiologist Anne Günther, Dep of radiology and nuclear medicine, Oslo University hospital
- Radiologist Johan Hellund, Dep of radiology and nuclear medicine, Oslo University hospital
- Radiologist Anders Drolsum, Dep of radiology and nuclear medicine, Oslo University hospital
- Radiologist Andreas Abildgaard, Dep of radiology and nuclear medicine, Oslo University hospital
- Radiologist Tomas Skog, Dep of radiology and nuclear medicine, Oslo University hospital
- Lecturers from the Norwegian radiation protection authority

Part 1 (16.-19. September 2013)

Monday: MR imaging

09:00-11:30: MR technology (Bjørnerud)
- The basic principals of MR
- MR Image reconstruction
- Introduction to advanced MR imaging
- Introduction to post processing tools in MR

11:30-12:30: Lunch
12:30-16:00: MR in Radiology
- Abdominal MR (Abildgaard)
- Neuro MR (Hald)
- Cardiac MR (Hopp)
- Orthopedic MR
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Tuesday: CT imaging

09:00-11:30: CT technology (Martinsen)
- The basic principals of CT
- CT Image reconstruction
- Introduction to dynamic CT imaging
- Introduction to post processing tools in CT

11:30-12:30: Lunch
12:30-16:00: CT in radiology
- Abdominal CT (Hagen)
- Neuro CT (Skog)
- Cardiac CT (Günther)
- Orthopedic CT (Hellund)
- Trauma CT (Dormagen)

Wednesday: PET-CT-imaging

09:00-11:30: PET-CT technology (Hjørnevik)
- The basic principals for PET-CT
- PET-CT Image reconstruction
- Introduction to dynamic PET-CT imaging
- Introduction to post processing tools in PET-CT

11:30-12:30: Lunch
12:30-16:00: PET-CT in clinical use (Willoch)
- Abdominal PET-CT
- Neuro PET-CT
- Cardiac PET-CT
- Orthopedic PET-CT

Thursday: Ultrasound imaging

09:00-11:30: Ultra sound technology (Holm)
- The basic principals for US
- US Image reconstruction

- Introduction to dynamic US imaging
- Introduction to post processing tools in Us

11:30-12:30: Lunch
12:30-16:00: Ultrasound in clinical use
- Abdominal US (Drolsum)
- Cardiac US (Edvardsen)

Part 2 (14.-17. oktober 2013):

Monday: Avdanced MR imaging
09:00-12:00: Dynamic MR imaging and advanced analyses
- ASL (vanOsch)
- DSC (Bjørnerud)
- DTI (Bjørnerud)
- fMRI (Endestad)

12:00-13:00: Lunch
13:00-14:00: Ultra-high field MR and new applications–(vanOsch)

14:00-16:00: MR in the future; new methods and hybrid imaging technology (Bjørnerud)

Tuesday: Avdanced CT imaging
09:00-12:00: Image reconstruction
- Image reconstruction (Aaløkken)
  - Multiplanar image reconstruction
  - Maximum intensity projections
  - Minimum intensity projections
  - Volume rendering and 3D-technology
  - Post processing
- Image reconstruction (Castellano)
  - Filtered back projection
  - Iterative reconstruction

12:00-13:00: Lunch
12:30-15:30: Introduction to new techniques in CT imaging
- CT organ perfusion (Martinsen)
- CT myocard perfusion (Günther)
- Spectral imaging (Castellano)
- Virtual colography (Drolsum)

15:45-16:30: CT in the future; new methods and clinical advances

Wednesday: Radiation protection, radiation risk and the ALARA principal in medical imaging
09:00-11:30: Introduction to the radiation protection legalization (Olerud)
- Introduction to the radiation protection legalization in medicine
- Introduction to radiation physics
- Radiation protection in
  - Nuclear medicine
  - Conventional X ray

    - MR
    - Ultrasound

11:30-12:30: ”Radiation protection in practice” (Martinsen)

- Basic introduction in radiation protection, shielding, patient and occupational dosimetry and risk aspects when using ionizing radiation in clinical practice.

12:30-14:00: CT image optimization (Martinsen)

- “Best image quality and low radiation dose –is it possible? ”

14:00-16:00: Radiation protection in nuclear medicine (Hjørnevik)

- Handling isotopes
- Optimization of PET-CT examinations
- Protection principals
- Are the patients “radiant” after an examination in the Nuclear medicine department?

Thursday: Hybrid operating room (OR)

09:00-10:00: The industrial revolution in the health service (Fosse)

10:15-11:30: Experience from clinical use of hybrid OR

- Advanced Cardiac surgery (Fosse)
- Advanced neuro surgery (Meling)

11:30-12:30: Lunch

12:30-16:00: Experiences from an advanced MR-hybrid operation room

- High intensity focused Ultrasound (Hol)
- Imaging requirements in minimal invasive liver surgery (Edwin)
- Robotics and navigation technology (Elle)
- Experiences from an anesthesia point of view (Halvorsen)

16:00-16:30: Summary and information about the take home examination