Why study Radioecology?

- There is an urgent need for university trained candidates within radioecology.
- Radioecology or environmental radioactivity is the science that forms the fundament for assessing risks of radioactivity to humans and the environment.
- Radioecology deals with a continuum that starts with releases of radionuclides from a source, continues through the dispersal and retention of the contaminants by various transport and transfer processes, and ends with the determination of dose to be used to assess risks to human populations and to ecosystems.

Potential Working Positions

The courses in Radioecology will also be of relevance to those who want to work within:

- the nuclear industry and nuclear fuel cycle operations
- environmental regulation and management (ministries, directorates)
- radiation protection authorities
- non-nuclear industries with radioactivity in raw materials and releases (oil and gas industry, road construction, mining industry, forestry, etc)
- decommission of nuclear facilities
- nuclear waste storage
- radioactive contamination and clean-up, remediation

The courses in Radioecology will also be of relevance for those who want to:

- Enter PhD programmes within nuclear sciences
- Apply for research positions at institutions with research programs within nuclear and environmental sciences.
### Objectives

After the course the students should have an overview over radioecology and be able to conduct experimental radioecological studies. In order to accomplish this they need to acquire knowledge of:

- **Radioactive sources and understand the transport of radioactive substances in various ecosystems with special focus on physico-chemical forms (speciation) and their influence on mobility and biological uptake**
- **The basis for environmental impact and risk assessments and be able to conduct radioecological studies using tracer techniques, radiochemical separation techniques and advanced measurement methods**
- **Environmental impact and risk assessments and the use of effective countermeasures, i.e. competence that is needed within national preparedness associated with radioactive contamination**
- **How to prepare and deliver effective oral and written presentations of technical information and scientific results.**

The students will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

### Arrangement, Credits, language

The courses run in parallel over 3 weeks (Jan. 10th - 27th, 2017) in Aas (30 min by train South of Oslo), Norway. Lectures and 4 laboratory exercises are the same for the 2 courses. The course Radioecology (5 ECTS) only requires participation in the laboratory work and a short lab report form, whereas the Experimental Radioecology (10 ECTS) includes an extensive lab report and a term paper. All teaching will be in English.

### Admission Requirements

In order to apply for admission to join the courses please contact Ole Christian Lind (olelin@nmbu.no) to obtain a registration form. Pre-Registration/Intention to participate deadline: As soon as possible. Deadline to register and apply for admission as guest student: December 1st, 2016.

### Accommodation

Rooms at Campus Aas, 30 km South of Oslo or in nearby hotels. Request to mirian.wangen@nmbu.no for cheap accommodation as soon as possible.

### Course Programme Radioecology, January 10th - 27th, 2017

#### Lectures

- **Ca 40 hours**

#### Laboratory Exercises and demonstrations

- **Ca 26 hours**

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Laboratory Exercises and demonstrations</th>
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<tbody>
<tr>
<td><strong>Introduction: Speciation of radionuclides in the environment, radioecological aspects</strong></td>
<td>Lecture: Introduction to laboratory exercises</td>
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<tr>
<td><strong>Radiochemistry, nuclear chemistry, radioanalytical techniques, tracer and dating techniques</strong></td>
<td>Mesocosm experiments - Cf, Kd, kinetics (Fresh water, shrimps, snails, plants, 70 hours exposure)</td>
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<td><strong>Nuclear fuel cycle; Past, present and future sources of radionuclides in the environment</strong></td>
<td>Sequential extractions</td>
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<tr>
<td><strong>TENORM, gamma and Rn dose assessment</strong></td>
<td>Size/charge fractionation</td>
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<td><strong>NORM/TENORM with examples from Norway</strong></td>
<td>Digital autoradiography of contaminated sediments and organisms</td>
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<tr>
<td><strong>The Chernobyl and Fukushima accidents</strong></td>
<td>Lab. Demo.: Electron microscopy/Particle identification and characterization</td>
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<tr>
<td><strong>Radioactive particles</strong></td>
<td>Other exercises Ca 4 hours</td>
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<td><strong>Assessing impacts of ionizing radiation to non-human biota</strong></td>
<td>Case study: Preparedness and countermeasures</td>
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<td><strong>Biological effects of ionizing radiation to non-human biota (mechanisms, biomarkers)</strong></td>
<td>Obligatory deliverables (10 ECT Course)</td>
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<tr>
<td><strong>Terrestrial radioecology/Countermeasures</strong></td>
<td>Extensive laboratory report (ca 20 pages)</td>
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<tr>
<td><strong>Radionuclides in the Aquatic Environment</strong></td>
<td>Term paper (ca 15 pages)</td>
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<tr>
<td><strong>Modelling in Radioecology</strong></td>
<td>Obligatory deliverables (5 ECT Course)</td>
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<tr>
<td><strong>Preparedness, Environmental security</strong></td>
<td>Laboratory report (ca 10 pages)</td>
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### Summary of the courses

- **Experimental Radioecology (10 ECTS)**
  - Lectures, Lab exercises, term paper
- **Radioecology (5 ECTS)**
  - Lectures, Lab exercises