Development of Erasmus Mundus Joint Master program in Nuclear Decommissioning and Environmental Remediation

MINDER

MSc. **Master Programme in**
Nuclear Decommissioning and Environmental Remediation

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CERENA Centro de Recursos Naturais e Ambiente

U.PORTO FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO

UHASSELT

Norwegian University of Life Sciences

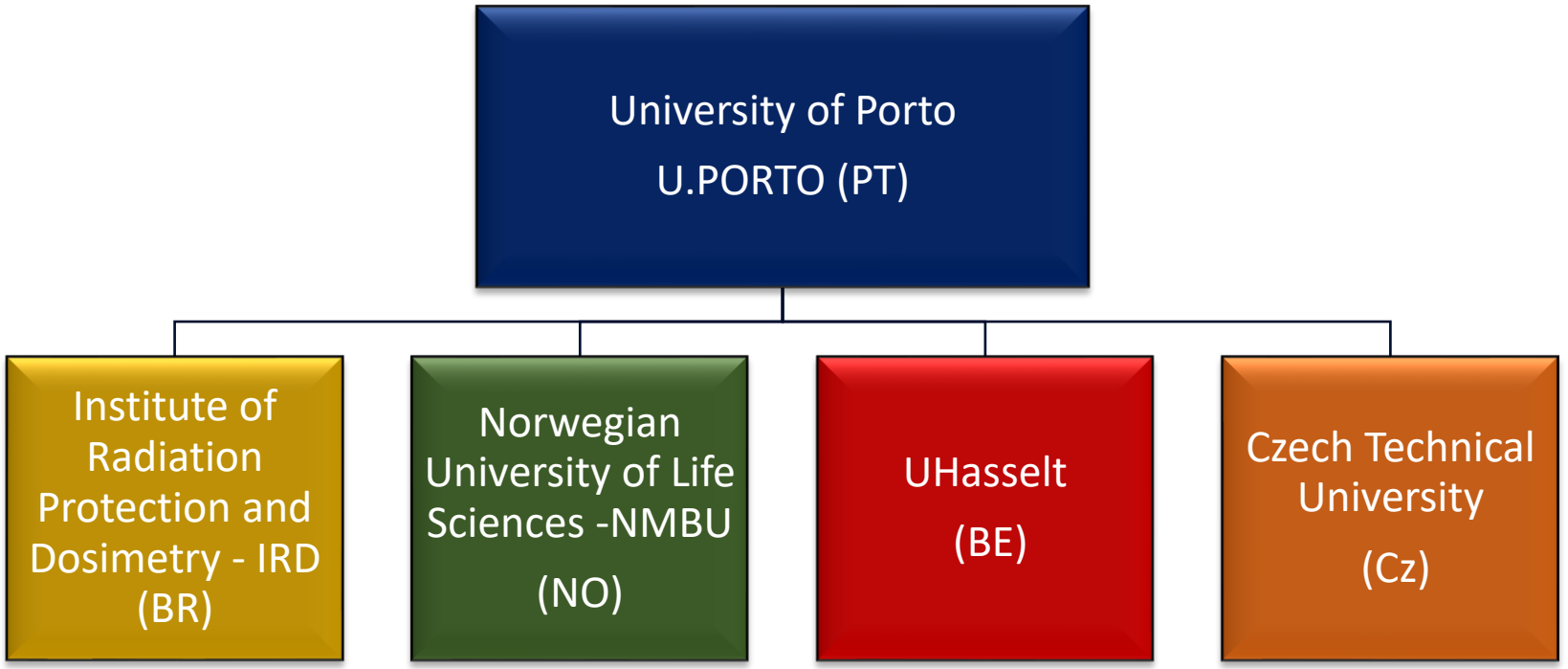
iRD

CTU CZECH TECHNICAL UNIVERSITY IN PRAGUE

20th CHERNE workshop (CHERNE 2025), 21-23 May, Valencia

MINDER - International Erasmus Joint Master on Nuclear Decommissioning and Environmental Remediation

Consortium: Europe, Latin America



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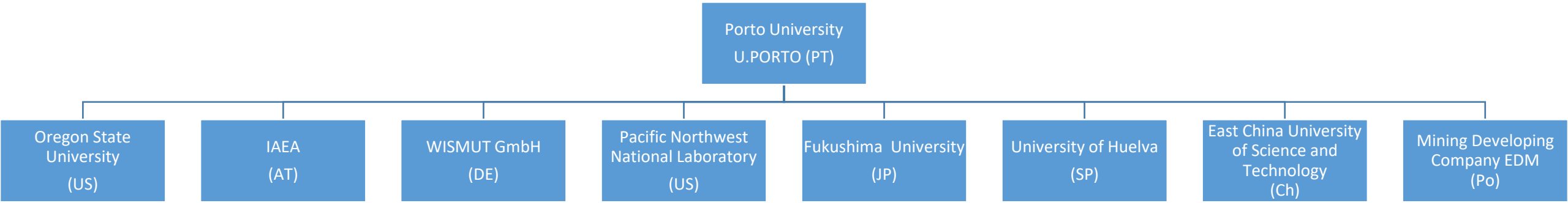
Erasmus Mundus Joint Masters Degrees

Consortium set-up: academic, scientific excellence and high-quality education

MINDER - International Erasmus Joint Master on Nuclear Decommissioning and Environmental Remediation

Support of Associated partners: Europe, Asia and USA



Associated Partners, contributing with case studies and topics for research and facilities for the development of the dissertation.

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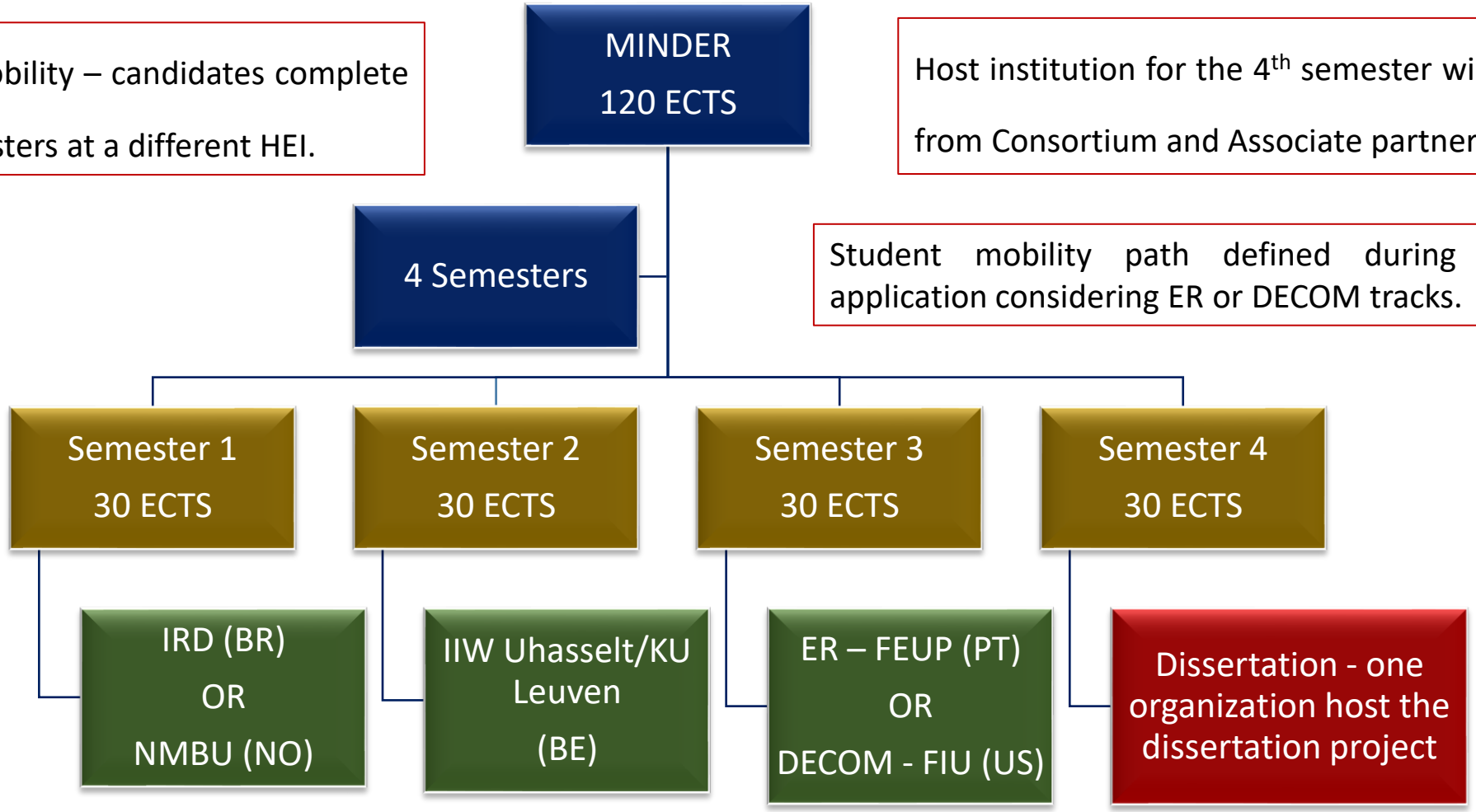
Compulsory mobility – candidates complete at least 2 semesters at a different HEI.



Host institution for the 4th semester will be from Consortium and Associate partners.

Student mobility path defined during the application considering ER or DECOM tracks.

Erasmus Mundus Joint Masters Degrees

Target groups (minimum Bachelor degree)

- Candidates with a **1st cycle of Higher Education** (Bachelor degree);
  - Candidates completing the **1st cycle HE**;
  - Young professionals at the **start of their career**;
  - Professionals from **public bodies** (regulators, policy-makers) and **private/public enterprises**;
  - **Experienced professionals and managers** who change their career orientation towards D&ER.

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Target groups (candidates from the scientific areas)

- Engineering
- Geosciences
- Physics
- Chemistry
- Biology
- Mathematics

- Environmental sciences
- Health sciences
- Other considered appropriate by the Scientific Committee of MINDER.

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Curriculum approved by the Senate of University of Porto (September 2023)

- **Topics common to D&ER**:

Semester 1 - IRD (Brazil) or (NMBU, Norway)
Radiation Protection
Nuclear, Radiological and NORM-Related Facilities
Introduction to D&ER
Radionuclide Transport and Fate in the Environment

SEM 2 IIW
UHasselt / KU Leuven
(program from slide 10)

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Erasmus Mundus Joint Masters Degrees

Curriculum approved by the Senate of University of Porto (September 2023)

- **Environmental Remediation topics**:

Semester 3 – FEUP (Portugal), ER Track
Investigation and Characterization for ER
Policy, Strategy and Licensing Process for ER
Environmental Remediation Technologies
Planning and Implementation ER Projects
Waste Management in ER Projects

- **Decommissioning topics**:

Semester 3 – FIU (USA), DECOM Track
Installation Characterization
Policy, Strategy and Licensing Process for Decom.
Decommissioning Technologies
Planning and Implementation of Decom. Projects
Waste Management in Decom. Projects

Final qualification - **European Joint Master Degree in D&ER** awarded by all universities of the consortium MINDER.

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30 ECTS – UHasselt/KU Leuven & SCK CEN MINDER program in 2nd semester 2025-2026

Course (SEM 2 – 2025-2026)	ECTS	Faculty/institute
Decision Support for Sustainability	6	SCK CEN
Circular Technologies	6	Faculty of Engineering Technology
Novel technologies for the energy transition	4	
Machine learning	4	
Globalization and sustainable development	3	Faculty of Business Economics
Environmental Policy	3	Faculty of Sciences
Concepts of Data Science	4	

Course Content

Course	ECTS	Teaching staff
Decision Support for Sustainability	6	Coordinator Catrinel Turcanu (SCK CEN)
		Lecture: 30 h Practice/Excercises: 24 h

- Tools, models, and instruments → measure and improve the sustainability of products

- Programmatic content:
  1. **Sustainability assessment**
  2. **Risk perception** and **risk communication**
  3. **Societal constraints** and ways to overcome
  4. **Stakeholder involvement**
  5. **Multi-criteria decision analysis (MCDA)**
  6. **Ethical considerations** for Decommissioning & Environmental Remediation projects
  7. **Participatory decision-making** in Decommissioning & Environmental Remediation projects

Course Content

Course	ECTS	Teaching staff
Circular Technologies	6	Coordinator: Prof dr. Wouter Schroeyers
		Application college: 50 h

- Programmatic content:
  1. **Waste and residue management technologies** for different waste/residue types: technical description and environmental impact
  2. Technological methods and case studies for **sustainable materials management** and promoting a **circular economy**
  3. Sustainable materials management applied to **NORM processing industries**
  4. Sustainable materials management applied in the **nuclear sector**

Course Content

Course	ECTS	Teaching staff
Novel technologies for the energy transition	4	Coordinator: Prof. dr. ir. Momo SAFARI
		Application college: 30 h

- Programmatic content:
  1. Introduction to the **basics of climate change and global warming**
  2. The **need for technological innovations** in the **energy sector**
  3. **Hydrogen economy**
  4. **Electrolyzer & fuel cell**
  5. **Power to molecules**
  6. **Biofuels**
  7. **Carbon capture and storage**
  8. **Disruptive photovoltaics**

Course Content

Course	ECTS	Teaching staff
Machine learning	4	Coordinator dr. Nikolaos TSIOGKAS
		Lecture: 20 h Practice/Excercises: 20 h

- Programmatic content:
  1. Introduction to machine learning
  2. **Machine learning principles, methodologies and data preparation**
  3. **Application** of machine learning **algorithms for regression and classification**:
     - Introduction, evaluation (measures and methodologies) and algorithms
     - Scoring with classification models: approach and evaluation
     - Common classification issues (unbalanced class distribution and costs)
     - Regression: introduction, evaluation (measures; compromise between bias and variance) and algorithms
     - Clustering: Partition, density and hierarchical algorithms
     - Evaluation measures
  4. **Anomaly detection**: introduction, algorithms
  5. Machine learning **engineering libraries and procedur**es

Course Content

Course	ECTS	Teaching staff
Globalization and sustainable development	3	Coordinator Prof. dr. Wim Lambrechts
		Lecture: 12 h Workshops: 4 h

- Programmatic content:
  1. **Contemporary issues** relating to relations between the global North and South: focus on sustainable development / sustainable development goals
  2. Contemporary **social phenomena in the global south and challenges** to sustainable development in a **variety of domains (e.g. education, law, international politics, health, economics and management, etc.)**
  3. The course exposes students to **plurality of perspectives on local and societal challenges**

Course Content

Course	ECTS	Teaching staff
Environmental Policy	3	Coordinator Prof.dr. Tim Nawrot
		Lecture: 14 h Practice/Excercises: 21 h Tutorial group: 2 h

- Programmatic content:
  1. **Global, European and Flemish environmental law and policy concepts**
  2. **Cost-benefit analyses**
  3. **Dose-response relations** for public health
  4. **Meta-analytical analysis via forest and funnel plots**
  5. The **precautionary principle**

Course Content

Course	ECTS	Teaching staff
Concepts of Data Science	4	Coordinator Prof dr. Geert Jan Bex
		Lecture: 18 h Practice/Excercises: 7 h

- Programmatic content:
  1. **Reproducible workflows**: version control systems, software environments and containers
  2. **Aspects of software engineering**: functional versus object-oriented programming
  3. **Data science algorithms**: case study
  4. Aspects of **research data management**
  5. **Research data and GDPR**
  6. **Ethical aspects and concerns for data scientists**

Future Plan

- **02/2024 (after accreditation by coordinator):** submission to EU (EMJM) funds for 4 editions of the program (scholarships cover the study period, research, placement activities, dissertation preparation, and defense, in line with the requirement of the joint Master) – February 2024 (tentative)!

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Thank You!

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