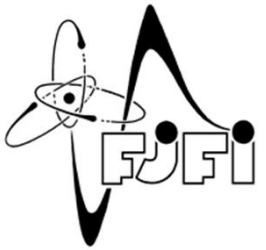



# Vzdělávání v jaderných oborech v České republice

Tomáš Čechák

ČVUT v Praze, FJFI

CENEN

**Czech Technical University in Prague**
Centre for Radiochemistry and Radiation Chemistry

**Czech Technical University in Prague**
Department of Dosimetry and Ionizing Radiation

**Czech Technical University in Prague**
Department of Nuclear Chemistry

**University of West Bohemia in Pilsen**
Department of Electric Power Engineering and Ecology

**Czech Technical University in Prague**
Department of Nuclear Reactors

**University of West Bohemia in Pilsen**
Department of Power System Engineering

**Czech Technical University in Prague**
Division of Power Engineering of the Department of Fluid Dynamics and Power Engineering

**Brno University of Technology**
Department of Power Engineering

**Czech Technical University in Prague**
Department of Electric Power Engineering

**Brno University of Technology**
Department of Electric Power Engineering

**VŠB-Technical University of Ostrava**
Department of Power Engineering of the Faculty

**ICT in Prague**
Department of Power Engineering

The CENEN Association is a voluntary academic association of educational institutions offering teaching and training in the area of Nuclear Engineering. It is striving to develop and maintain a high standard of Czech nuclear education and to reach its integration into the all-European context.

CENEN was established in Prague on 3rd May 2005.


# Czech Nuclear Education Network

http://www.cenen.cz

# *European Nuclear Education Network*

- **ENEN's mission is the preservation and further development of expertise in the nuclear fields by higher Education and Training.**

**The general objectives of the ENEN Association are defined as follows:**

With respect to the Academia:

- to develop a more harmonized approach for education in the nuclear sciences and nuclear engineering in Europe;
- to integrate European education and training in nuclear safety and radiation protection; and
- to achieve better co-operation and sharing of academic resources and capabilities at the national and international level.

**With respect to the End Users, such as nuclear industries, research centers, regulatory bodies and nuclear applications:**

- to create a secure basis of skills and knowledge of value to the EU;
- to maintain an adequate supply of qualified human resources for design, construction, operation and maintenance of nuclear infrastructures, industries and power plants; and
- to maintain the necessary competence and expertise for the continued safe use of nuclear energy and applications of radiation and nuclear techniques in agriculture, industry and medicine.

## *European Nuclear Education Network*

- TEACHING AND ACADEMIC AFFAIRS AREA (TAAA)
- **The objective of the Area is to disseminate the relevant knowledge of nuclear education.**
- The scope of the Area is:
- To evaluate applications for the European Master of Science in Nuclear Engineering certification;
- To promote student and faculty exchange by encouraging and supporting the organisation of international exchange courses by ENEN members;
- To support the organisation of high-quality nuclear related education by ENEN members;
- To evaluate ENEN exchange courses and award the International ENEN Course label, in collaboration with the ENEN Quality Assurance Committee.

*European Nuclear Education Network*

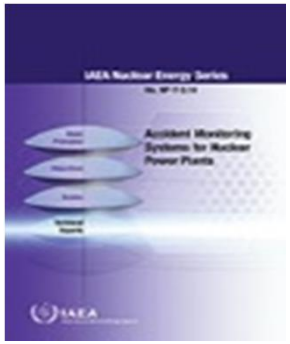
# ENETRAP Project

# EUROPEAN NETWORK ON EDUCATION AND TRAINING IN RADIOLOGICAL PROTECTION

**ADVANCED NETWORKING FOR NUCLEAR EDUCATION, TRAINING AND TRANSFER OF EXPERTISE**

IAEA
International Atomic Energy Agency

- The establishment of sustainable education and training programmes are fundamental to safety. This view is supported by several General Conference Resolutions, dating back to 1992, by which the Agency was requested, inter alia to intensify postgraduate educational and specialized training courses in appropriate official languages of the Agency, and to develop, in a systematic manner, syllabuses and training material for specific target groups.
- The Fukushima Daiichi Accident STI/PUB/1710 1254 pp.; 2015


**Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards**
Series No. GSR Part 3, published Saturday, July 19, 2014.


- fostering engineering education and training

**BASIC INFORMATION**
**Last update :** 2015-08-31

# **Title :** BNEN master-after-master in nuclear engineering

Country : Belgium
**Organisation :** SCKCEN
**Language :** English
**Duration :** The BNEN academic year runs from September until the end of June: 24 weeks of courses and 11 weeks for project work and examinations.
**ENEN European Master :** Yes

## Å **Table 2:** KSC for the MPE as Physical Scientist

- Å K22 Explain in detail and quantitatively the main types of sensors, their mode of action and response: mechanical (position, velocity, force, pressure, sound and ultrasound), temperature, electric and magnetic fields, voltage, ionizing electromagnetic radiation (include gas-filled (including cavity theory, Bragg-Gray principle, conversion of charge to absorbed dose), semiconductor, scintillation-optical systems (solids and liquids), storage TL phosphor systems, optically stimulated luminescence (OSL), films (including radiochromic), non-ionizing electromagnetic radiation, ionizing particles, chemical and biochemical.
- Å K23 Explain quantitatively the following characteristics of ionizing radiation sensors / detectors: pulse height spectrum and energy resolution, counting curves and plateau, detection efficiency and energy response, dead time, detection threshold and temporal resolution.
- Å K24 Explain in detail equipment used for gamma and x-ray spectrometry.


## Goals of CHERNE

- to share competencies and facilities in organising teaching activities for their students, mainly at the Master level

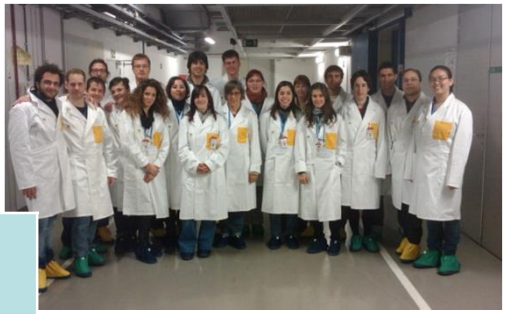
**FULL MEMBERS.**

Universidad Politécnica de Valencia (UPV), Valencia (Spain),
Institut Supérieur Industriel de Bruxelles (ISIB) - (Belgium),
University of Hasselt, Diepenbeek (Belgium),
University of Applied Sciences Aachen, Jülich Campus (Germany),
Instituto Superior Tecnico (IST), Lisboa (Portugal),
**Czech Technical University in Prague (Czech Republic),**
Facoltà d'Ingegneria, Alma Mater Studiorum - Università di Bologna (Italia),
National Technical University of Athens (Greece),
Universidad de Salamanca, (Spain),
Aristotle University of Thessaloniki (Greece)

CHERNE

COOPERATION FOR HIGHER EDUCATION ON RADIOLOGICAL AND NUCLEAR ENGINEERING

| Year | course | held in | participating |
|---|---|---|---|
| 2002 | PAN-1 | Prague | CVUT, ISIB & UPV |



**PAN** stands for **P**ractical **A**pproach to **N**uclear techniques.

| | | |
|---|---|---|
| **Monday 19/03** | **8:30- 9:30**<br>**9:30-10:30**<br><br>**10:45- 11:30**<br>**11:30- 12:15** | **access formalities at SCK-CEN**<br>**Introduction to the course, presentation of first week, presentation of participants; Michèle Coek**<br>**Lecture L4: Dosimetry in radiation protection ; Lenka Thinova**<br>**Lecture L2 Radiological emergencies ; Frieder Hoyler** |
| | 12:30 ï 13:45 | lunch |
| | 14:00-17:00 | 3 exercises in parallel:<br>E1-Activation measurements at the reactor BR1<br>E2-Radiological emergency exercise<br>E3-Anthropogammametry |
| **Tuesday 20/03** | 8:30-9:15<br>9:30-12:30 | Lecture L3 Health risks of external and internal exposition to radiation<br>visits at SCK-CEN geological waste disposal, hot cells and/or BR2 reactor |
| | 12:40 ï 13:45 | lunch |
| | 14:00-17:00 | 3 exercises in parallel:<br>E1-Activation measurements at the reactor BR1<br>E2-Radiological emergency exercise |

INTERNATIONAL EXCHANGE
ERASMUS STUDENT NETWORK

# ERASMUS

***Course on Application of Ionizing Radiation***

*Cooperation in the ATHENS project*
***A**dvanced **T**echnology **H**igher **E**ducation **N**etwork, **S**ocrates*

***FNSPE CTU Prague - March 14 to 18 2016***

# INI 2015

- The Intercontinental Nuclear Institute (INI) is organized to promote long-term sustainability of nuclear power program and infrastructure through capacity building, global dialogue and technical engagement in the field of nuclear science and technology and nuclear power reactor technology. It is developed in cooperation with the Government of U.S. ï Czech Civil Nuclear Cooperation Center (CNCC) and the University of Massachusetts Lowell and is supported by the International Atomic Energy Agency. The INI program will provide experiential learning supported through subject matter experts in reactor physics, design features, planning, licensing, operations, engineering, management, economics, safety and security, radiation detection and measurement, nonproliferation and nuclear security and physical protection.

# STROJNÍ INŽENÝRSTVÍ Energetika
# FSI ĹVUT v Praze

- Studijní obor navazuje na znalosti ze sdílení tepla, přenosu hmoty, mechaniky tekutin a transformací energie získané během studia bakalářského studijního programu Teoretické základy strojního inženýrství. Tyto znalosti jsou dále prohlubovány a aplikovány v odborných předmětech. Studenti magisterského studijního programu Energetika získají komplexní znalosti z energetiky zaměřené především do oblasti vývoje, projektování, konstruování a technologií energetických strojů a systémů. Jsou tedy připraveni řešit teoretické i aplikované odborné problémy v různých odvětvích energetiky, tj. v oblasti výroby i spotřeby elektřiny, tepla a chladu. Konkrétně jde o široký obor, který se zabývá projekcí, konstrukcí a provozem: energetických strojů a zařízení pro fosilní i jaderné elektrárny, é .

**Navazující magisterské studium**

- **1. ROČNÍK – 2. SEMESTR (1)**

- Průmyslová energetika
- Biomasa a obnovitelné zdroje energie
- Ekologie energetických zařízení
- Jaderná energetika

ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE | FAKULTA STROJNÍ

# Jaderná energetická zařízení

- Úvod do jaderné energetiky, charakteristika atomového a jaderného výkonu a současný stav a perspektivy. Nejdůležitější poznatky o atomech a jejich jádrech, základní principy uvolňování jaderné energie, štěpná řetězová reakce. Vývin tepla v reaktoru a odvod tepelné energie z aktivní zóny. Vyhoření a spotřeba paliva, izotopické složení vyhořelého paliva. Základní materiály jaderných reaktorů. Základní typy jaderných reaktorů, tlakovodní reaktory a jejich hlavní přednosti a nedostatky. Palivový cyklus jaderné energetiky, produkce plutonia a jeho využití v rychlých množivých reaktorech. Reaktorové záření, jeho detekce a kvantifikace, určení dávek a ekvivalentních dávek záření. Problematika jaderné bezpečnosti a její technické zajištění. Dosavadní provozní zkušenosti včetně analýzy dvou hlavních radiačních havárií (TMI-2, Černobyl-4). Jaderná syntéza, hlavní technické charakteristiky a současný stav, nedávné dosažené výsledky.(Pro oborové studium Tepelná energetická zařízení)

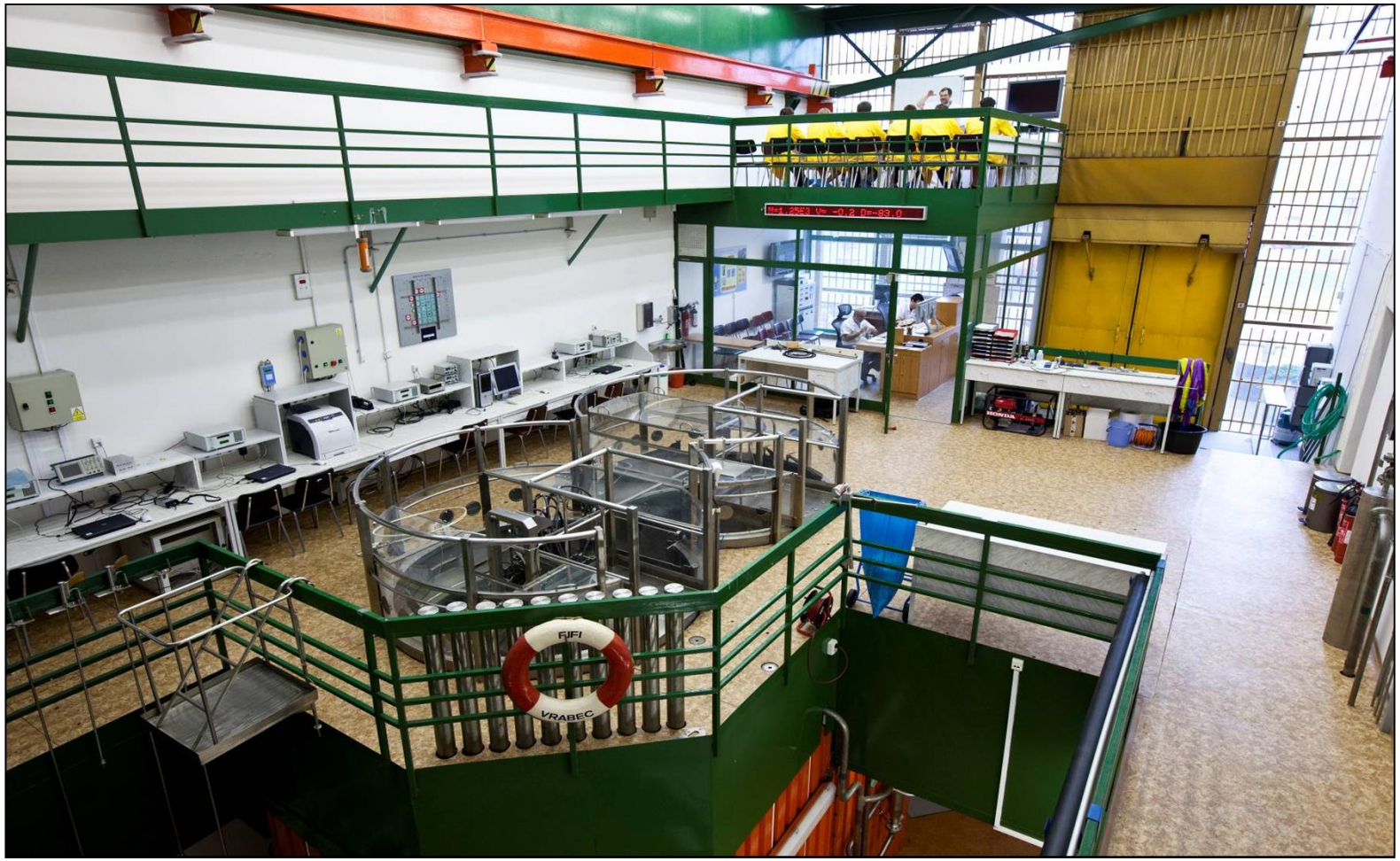
ZÁPADOČESKÁ UNIVERZITA V PLZNI

# Fakulta strojní

- **Studijní obor: Stavba jadernÝch energetických zaŚízení**
- Studijní obor je orientován pŚevážnÝ na potŚeby ļ eského výzkumu, výroby a provozu jadernÝch energetických zaŚízení. Studium je zamÝŚleno, na základÝ vlastních více neģ padesátiletých zkuģeností v budování jaderných oborŢ, na potŚebné znalosti z matematiky, fyziky, chemie, základŢ strojírenství, elektrotechniky, rozģíŚené o reaktorovou fyziku, termohydrauliku a komplex jadernÝ energetických zaŚízení, tj. na konstrukci, technologii, výrobu, montáģ, uvedení do provozu a jejich hlediska provozní bezpeļ nosti a vliv na ģivotní prostŚedí. Absolvent je pŚipravený odborník pro projektové, konstrukļ ní, výpoļ tové, technologické, výrobní, provozní a servisní práce ve výzkumných ústavech, prŢmyslu, na jaderných elektrárnách, v provozech výzkumných a ģkolních reaktorŢ, na pracoviģtích radiaļ ní hygieny, prŢmyslové a zdravotnické defektoskopie.

# Training Reactor VR-1

www.ReactorVR1.eu



# E&T equipment and methodology


Základní kritický experiment na reaktoru

# Doktorské studium
# Doktorská témata nabízená ENEN

| |
|---|
| Development of a Multyphisics package for the Local Analyis of Power Oscillations in Fuel Assemblies |
| EPSRC ICO Centre for Doctoral Training in Nuclear Energy (60+ studentships over five years) |
| Grain size effects on helium and fission product behaviour in UO2 |
| NUCLEAR AND IONIZING RADIATIONS ENGINEERING PhD program |
| PETRUS: YTERA Doctoral Programme for Nuclear Engineering and Radiochemistry |
| PhD in COMPUTATIONAL NUCLEAR REACTOR |
| YTERA Doctoral Programme for Nuclear Engineering and Radiochemistry |

- **Title :** Hands on Training in Nuclear Chemistry II

- **Country :** Czech Replublic
- **Organisation :** CTU
- **Language :** English
- **Venue :** Czech Technical University in Prague
- **Start date :** Wednesday 6 January 2016
- **Level :** Master level (chemistry masters or engineers, and/or fresh PhD students), who need to extend their skills and knowledge to the field of nuclear and radiochemistry
- **Learning outcome :**
  The course provides fundamental theoretical knowledge of principles and concepts in nuclear chemistry necessary for understanding the processes and methods in radiochemistry, and practical hands-on training required for the work with open ionising radiation sources (handling of radioactive materials, application of radionuclides and ionizing radiation, etc.).

# Děkuji za pozornost