Course description

Department/Unit /	KKE / NSA			**Academic Year**	2023/2024
Title	Nuclear Systems			**Type of completion**	Pre-Exam Credit
Accredited/Credits	Yes, 3 Cred.			**Type of completion**	Combined
Number of hours	Lecture 1 [Hours/Week] Tutorial 2 [Hours/Week]				
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	YES
Winter semester	0 / -	0 / -	0 / -	**Min. (B+C) students**	not determined
Timetable	Yes			**Repeated registration**	NO
Language of instruction	English			**Semester taught**	Winter semester
Optional course	Yes			**Internship duration**	0
Evaluation scale	1|2|3|4				
No. of hours of on-premise					
Auto acc. of credit	Yes in the case of a previous evaluation 4 nebo nic.				
Periodicity	K				
Substituted course	KKE/NPPA				
Preclusive courses	N/A				
Prerequisite courses	N/A				
Informally recommended courses	N/A				
Courses depending on this Course	N/A				

Course objectives:

The course is intended to give students of technical fields a good insight into the following areas of nuclear systems: History and evolution of nuclear systems, machinery and equipment for nuclear systems, materials for nuclear systems, application of nuclear chemistry and physics, fission chain reaction and equipment for its utilization, shielding theory, basics of nuclear physics, introduction to nuclear reactor thermodynamics, nuclear reactors of generation III and IV, nuclear fusion and fusion systems, other nuclear applications (healthcare, agriculture, transportation, material testing), nuclear safety - introduction, Probabilistic Safety Assessment, human factor, external events, decommissioning of nuclear power plants.

Requirements on student

Self-study of the given topic and presentation.

Content

Contents of the lectures:
1. History and evolution of nuclear systems
2. Machinery and equipment for nuclear systems
3. Materials for nuclear systems
4. Application of nuclear chemistry and physics
5. Fission chain reaction and equipment for its utilization
6. Shielding theory
7. Basics of nuclear physics
8. Introduction to nuclear reactor thermodynamics
9. Nuclear reactors of generation III and IV
10. Nuclear fusion and fusion systems
11. Other nuclear applications (healthcare, agriculture, transportation, material testing)
12. Nuclear safety - introduction, Probabilistic Safety Assessment, human factor, external events
13. Decommissioning of nuclear power plants

Fields of study

1. Reuss, P. : Reactor Physics, EDP Sciences, 2008.
2. Lamarsh, J. R.: Introduction to Nuclear Engineering, Prentice Hall, 2001.
3. Stacey, M. Weston : Nuclear Reactor Physics, Second Edition. Wiley-VCH Verlag, 2007.
4. E. E. Lewis, Fundamentals of Nuclear Reactor Physics, Academic Press, 2008.
5. Crossland, I.G. : Nuclear fuel cycle science and engineering, Woodhead Publishing, 2012.
6. Prince, R.: Radiation protection at light water reactors, Springer, 2012.
7. McCormick, N. J.: Risk and safety analysis of nuclear systems, John Wiley & Sons, 2011.

Guarantors and lecturers

- **Guarantors:** Ing. Kateřina Bílá, Ph.D.
- **Lecturer:** Ing. Kateřina Bílá, Ph.D. (100%)
- **Tutorial lecturer:** Ing. Kateřina Bílá, Ph.D. (100%)

Literature

- **Basic:** Reuss, P. *Reactor Physics*. France, 2008. ISBN 978-2-7598-0041-4.
- **Extending:** IAEA. *Industrial Applications of Nuclear Energy*. Vienna, 2017.
- **Extending:** IAEA. *Nuclear or radiological facility decommissioning*. Vienna, 2011.
- **Recommended:** Introduction to Nuclear Engineering (Lamarsh, J. R.)
- **Recommended:** Nuclear fuel cycle science and engineering (Crossland, I.G)
- **Recommended:** Nuclear Reactor Physics (Stacey, M. Weston)
- **Recommended:** Radiation protection at light water reactors (Prince, R.)
- **Recommended:** McCormick, N. J. *Risk and safety analysis of nuclear systems*. John Wiley & Sons, 2011.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Preparation for an examination (30-60)	30
Presentation preparation (report in a foreign language) (10-15)	15
Contact hours	40
Total:	**85**

assessment methods

Knowledge - knowledge achieved by taking this course are verified by the following means:

Kolokvium

Group presentation at a seminar

Skills - skills achieved by taking this course are verified by the following means:

Group presentation at a seminar

Competences - competence achieved by taking this course are verified by the following means:

Group presentation at a seminar

prerequisite

Knowledge - students are expected to possess the following knowledge before the course commences to finish it successfully:

be able to explain basic principles of chemistry - atom structure, particles etc.

understand the basis of mathematics and physics (university knowledge level)

use independently theoretical knowledge in the field of mechanics, thermomechanics, elasticity and strength, material science and machine parts

be able of individual work and collaboration in group

very good knowledge of English

Skills - students are expected to possess the following skills before the course commences to finish it successfully:

ability to work with PC and basic SW (Word, Excel, PowerPoint), ability to search for information using available information sources, the ability to put the obtained information into context and ability to interpret the information

ability to synthesize analytical knowledge acquired in the previous subjects

Competences - students are expected to possess the following competences before the course commences to finish it successfully:

N/A

N/A

teaching methods

Knowledge - the following training methods are used to achieve the required knowledge:

Lecture

Self-study of literature

Practicum

Skills - the following training methods are used to achieve the required skills:

Lecture

Lecture supplemented with a discussion

Practicum

Competences - the following training methods are used to achieve the required competences:

Individual study

Students' portfolio

Discussion

learning outcomes

Knowledge - knowledge resulting from the course:

knowledge of basic principles of nuclear energetics - neutron characteristics, principle of fission chain reaction, neutrons diffusion and four factor formula

is able to describe different nuclear systems and ways of nuclear energy use

knowledge of thermodynamics basis

knowledge of nuclear reactor kinetics

Skills - skills resulting from the course:

ability to describe different systems that use nuclear energy

ability to calculate energy gain from nuclear reactions

apply basic approaches of probabilistic safety assessment

Competences - competences resulting from the course:

N/A

Course is included in study programmes: