COURSE DESCRIPTION CARD - SYLLABUS

Course name

Elective course D: Safety of nuclear power

Course

Field of study	Year/Semester
Power engineering	5/9
Area of study (specialization)	Profile of study
Nuclear power engineering	general academic
Level of study	Course offered in
First-cycle studies	polish
Form of study	Requirements
part-time	elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
20	10	-0
Tutorials	Projects/seminars	
-0	10	

Number of credit points

6

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

Prerequisites

Mathematics: algebra - functions, equations and inequalities, plane and space geometry, trigonometry, analytic geometry, basic probability theory, equations and systems of equations, elements of differential and integral calculus of functions of one variable at a level 6 PRK, solving algebraic equations and systems of algebraic equations, formulating physical problems in the language of mathematics, solving simple differential equations, Physics: fundamental lows of physics, rules of mass momentum and energy conservation in classical mechanics, statics, kinematics, dynamics, hydraulics and nuclear physics at level 6 PRK, application of integral calculus to calculate the geometric quantities (eg, surface areas) and physical quantities (eg, average values of velocity, momentum of inertia), solving typical problems in classical mechanics - statics, kinematics, dynamics and hydraulics.

Course objective

Purchase by the students basic knowledge and skills in safety of nuclear power technology safety and security rules and risk assessment methodology applied in nuclear industry.

Course-related learning outcomes

Knowledge

1. The student knows the safety rules applied in the nuclear power industry.

2. The student knows the construction of the nuclear power plant safety systems and understands their operation.

3. The student has an elementary knowledge of the impact of a nuclear power plant on the environment during normal operation and in emergency situations.

4. The student has a basic knowledge of the reliability and safety of technical systems, and in particular about the probabilistic risk assessment methodology (PRA).

5. The student knows the types and properties of radiation and its effect on living organisms and material of structures.

Skills

1. The student is able to estimate the reliability of a simple NPP safety system using the " event trees "or" fault trees "methodology.

2. The student is able to calculate the flow rate of water necessary for cooling turbine condensers during NPP normal operation and the water flow rate necessary to waste heat rejection in emergency situations.

3. The student is able to calculate, by using simplified methods, flow characteristics of emergency cooling systems of the NPP core.

4. The student is able to determine the temperature distributions in nuclear fuel during normal operation and in emergency situations.

5. The student can apply and convert units of physical quantities used in protection against radiation.

Social competences

1. The student understands the need for teamwork in solving theoretical and practical problems.

2. The student understands the necessity of systematically deepening and expanding his competences.

3. The student is aware of the controversy of nuclear energy in individual and social perception.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures

A 60-minute written exam. Time of the exam and a full list of questions are specified and published at the beginning of the semester. The exam consists in answering 4 selected questions. In doubtful cases, the exam is extended by the oral part. Students' activity is assessed on each lecture.

Laboratories

Continuous evaluation on each class, discussion of student decisions and solutions.

Design (project)

Continuous evaluation on each class, discussion of student decisions and solutions Final presentation of the project and its defense by the student or students teams

Grading system: 0-9 points = 2,0 (failed); 10-12 points = 3,0 (sufficient); 13-14 points = 3,5 (sufficient plus); 15-16 points = 4,0 (good); 17-18 points = 4,5 (good plus); 19-20 points = 5,0 (very good)

In order to pass the exam there is necessary to obtain minimum 10 points.

Programme content

Lectures

Security strategy in the nuclear power industry. Generations of nuclear power plants (NPP). NPP safety systems. NPP impact on the environment during normal operation. Water flow rate needed for cooling turbine condensers during NPP normal operation. Hazards in emergency situations. Waste heat and waste heat rejection. Classification of NPP accidents. Maximum hypothetical accident. Maximum design accident. Systems for immediate emergency reactor shutdown. NPP emergency cooling systems. NPP containment and its systems. Basics of the PRA methodology (Probabilistic Risk Assessment). Risk calculation.

Laboratories

Use of educational versions of commercial software for safety analysis of nuclear power plants. Creating simple computer programs for solving selected nuclear safety issues.

Design exercises

Conceptual design (one problem solved by 2-3 person team) of: thermal shield against radiation, biological shield against radiation, high pressure emergency core cooling system, reactor building spray system.

Teaching methods

Lectures

Lecture with multimedia presentation (including drawings, photos, animations) supplemented with examples considering different aspects of the issues presented, including: economic, environmental, legal and social.

Laboratories

Solving selected tasks by means of commercial and original software - discussion and evaluation obtained solutions.

Design classes

Discussing typical cases, discussion of proposed assumptions and solutions, detailed evaluation of projects by the tutor, presentations by students, work in teams, developing students skills through activity-, project-, and problem-based (APPB) learning.

Bibliography

Basic

1. Ablewicz Z., Dąbrowski W.B. Osłony przed promieniowaniem jonizującym. Arkady, W-wa 1986.

2. Ackermann G., Eksploatacja elektrowni jądrowych. WNT, W-wa 1987.

3. Hrynkiewicz Z. (Red.): Człowiek i promieniowanie jonizujące. PWN, W-wa, 2001.

4. Strupczewski A., Awarie reaktorowe a bezpieczeństwo energetyki jadrowej, WNT, W-wa, 1990.

5. Kiełkiewicz M. Jądrowe reaktory energetyczne. WNT, W-wa 1978.

6. Petrangeli G.: Nuclear Safety. 1st Ed. Butterworth-Heinemann, 2006

7. Elkmann P.:Emergency Planning for Nuclear Power Plants. CRC Press, 2009

Additional

Murray R.L., Nuclear Energy (6th Ed.), Elsevier, Amsterdam 2009.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,0
Classes requiring direct contact with the teacher	45	1,5
Student's own work (literature studies, preparation for design classes/laboratories, preparation for tests/exam) [1]	105	4,5

[1] delete or add other activities as appropriate