COURSE DESCRIPTION CARD - SYLLABUS

Course name
Nuclear Power [S1FT2>EJ]

Course

Field of study
Technical Physics

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

dr hab. Magdalena Elantkowska prof. PP
magdalena.elantkowska@put.poznan.pl

Lecturers

Prerequisites

Knowledge of physics, chemistry and mathematics (program basis for high schools, standard level). Skills in solving problems in physics based on the knowledge possessed, ability to extract information from the recommended sources. Understanding of the necessity of extending one’s competences, readiness to cooperate within a team.

Course objective

1. Transfer of fundamental knowledge in nuclear physics, within the range defined by the program relevant for the field of study. 2. Development of skills in solving elementary problems and performing simple experiments, as well as the analysis of results obtained, based on the knowledge possessed. 3. Development of skills in self-study and team work.

Course-related learning outcomes

Knowledge:
1. Student has knowledge in the field of physics, including mechanics, thermodynamics, atomic and nuclear physics and solid state physics, including knowledge necessary to understand the basic physical phenomena occurring in the field of nuclear energy.

2. Student has basic knowledge in the field of nuclear energy including construction of nuclear reactors, mechanisms of nuclear reaction, nuclear power plant failure, calculation methods of reactor physics.

Skills:
1. Student can acquire information from literature, databases and other sources; can integrate the obtained information, make their interpretation, as well as apply and formulate and justify opinions.
2. Student can prepare and present a brief presentation of the results of the engineering task.
3. Student has the ability to self-education, among others to improve professional skills.

Social competences:
1. Student can get actively involved in solving problems stated, develop and extend his (her) competences unaided.
2. Student can cooperate within a team, fulfill the duties resulting from division of team work, show responsibility for his (her) own work and joint responsibility for the results of team work.
3. Student is aware of the importance and understands the non-technical aspects and effects of the engineer-energy industry, including its impact on the environment, and the related responsibility for decisions.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge:
Lecture: written exam from selected issues in nuclear physics.
Evaluation criteria:
less than 50% - 2.0
50.1%-60.0% - 3.0
60.1%-70.0% - 3.5
70.1%-80.0% - 4.0
80.1%-90.0% - 4.5
from 90.1% - 5.0

Programme content

The lecture begins with a discussion of basic knowledge in the field of nuclear physics, discusses nuclear models, natural radioactivity and nuclear reactions. In the next stage, the physical basis of nuclear fission, the basics of nuclear reactor operation and reactor physics are discussed. Then types of reactors and reactor failures. In the final stage, it introduces thermonuclear fusion and presents the prospects for thermonuclear fusion.

Course topics

1. Structure and properties of the ground state of the nucleus.
2. Nuclear models - droplet model, Fermi gas model and shell model.
3. Natural and artificial radioactivity - alpha, beta and gamma decay.
4. Nuclear reactions - nuclear reactions with neutrons, direct reactions, reactions through a complex nucleus
5. Nuclear fission - basics of nuclear fission according to Bohr and Wheeler
based on the droplet nucleus model.
6. Nuclear fuel - uranium and its processing, uranium enrichment methods.
7. Natural nuclear reactor.
8 . Principles of operation of a nuclear reactor - fuel elements, control rods and safety rods, moderator and moderator efficiency, reactor multiplication factor, neutron escape and reflector.
9. Overview of types of power reactors - pressurized and boiling light water reactors, CANDU channel reactors, gas-graphite reactors, high-temperature reactors, fast breeder reactors.
10. Reactor failures.
11. Thermonuclear fusion and prospects for thermonuclear fusion.

Teaching methods

1. Lecture: multimedia presentation, illustrated with examples given in the presentation.

Bibliography

Basic:
1. P. Tipler, R. Llewellyn, Fizyka współczesna, Wydawnictwo Naukowe PWN, Warszawa 2011
2. L. Dobrzyński, Podstawy fizyki reaktorów jądrowych, Narodowe Centrum Badań Jądrowych w Świerku, Świerk 2013
3. E. Skrzypczak, Z. Szelfiński, Wstęp do fizyki jądra atomowego i cząstek elementarnych, Wydawnictwo Naukowe PWN, Warszawa 1995
4. T. Mayer-Kuckuk, Fizyka jądrowa, Wydawnictwo Naukowe PWN, Warszawa 1987
5. D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tom 5,Wydawnictwo Naukowe PWN,

Additional:
1. R. Eisberg, R. Resnick, Fizyka kwantowa, Wydawnictwo Naukowe PWN, Warszawa 1983
2. M. Kiełkiewicz, Podstawy fizyki reaktorów jądrowych, WPW

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00