POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name

Combinatorics and random variables [S2EJ1>KiZL]

Course

Field of study	Year/Semester
Nuclear Power Engineering	1/1
Area of study (specialization)	**Profile of study**
–	general academic
Level of study	**Course offered in**
second-cycle	Polish
Form of study	**Requirements**
full-time	elective

Number of hours

Lecture	Laboratory classes	Other
15	0	0
Tutorials	**Projects/seminars**	
15	0	

Number of credit points

2,00

Coordinators

Lecturers

Prerequisites

The student starting this course should have basic knowledge of mathematical logic, set theory, differential and integral calculus, special functions, properties and applications of Fourier and Laplace transforms, basics of probability theory and mathematical statistics. Should have the ability to express mathematical content orally and in writing, in both theoretical and practical texts. He should precisely formulate questions aimed at deepening understanding of a given topic or finding missing elements of reasoning. He/she should be aware of the variety of problems that appear in particular phases of the life cycle of technical objects. He/she should also have the ability to obtain information from the indicated literature in both Polish and English and be open to cooperation within a team.

Course objective

Mastering the knowledge of probabilistics and mathematical statistics necessary to correctly solve problems with random events and to formulate and verify statistical hypotheses in technical issues using appropriately selected tests. Developing students' skills in building scenarios for solving practical problems using the learned definitions, properties and theorems.

Course-related learning outcomes

Knowledge:

1. The student has systematic knowledge of mathematics, probabilistics and statistics used in technical

sciences.
2. The student has knowledge about the possibility of using selected distributions of random variables to model experimental results.
3. The student is able to determine the probability of occurrence of random events and test their independence.
4. The student has basic knowledge of stochastic processes and their possible applications.

Skills:
1. The student is able to analyze, model and solve selected elements supporting the management of the operation of simple and complex technical facilities using stochastic methods.
2. The student is able to make and check the correctness of assumptions when determining functional and numerical characteristics.
3. The student is able to select the appropriate tools and stochastic methods to solve energy problems.

Social competences:
1. The student is aware of initiating activities related to the formulation and transfer of information and cooperation in society in the field of energy.
2. The student has the ability to precisely formulate questions to deepen understanding of advanced probabilistic and statistical methods used in engineering practice.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures
• continuous assessment of activity for solving problems formulated for independent solving (participation in the final assessment 40%);
• assessment of the presentation of individually developed sets of tasks (participation in the final assessment 60%);
Final grade scale for lectures: from 45% - dst, from 55% dst plus, from 65% db, from 75% db plus, from 85% very good..
Exercise auditorium
The skills acquired during practical classes are verified on the basis of a colloquium assessed on a scale of 0-80 points and on the basis of current activity 0-20 points. The condition for receiving a positive grade is to obtain at least 45 possible points. Further marks for each additional 10 points.
Design
Phased assessment of the implementation of key project points. Assessment of the presentation and defense of the entire project.
The condition for obtaining credits for lectures and laboratory exercises is to obtain at least 50% of the maximum number of points of 20. Grading scale: 0-9 points = 2.0; 10-12 points = 3.0; 13-14 points = 3.5; 15-16 points = 4.0; 17-18 points = 4.5; 19-20 points = 5.0.
The condition for passing the project is its submission in electronic version and positive defense.

Programme content

Lectures: Elements of experiment planning. Random events in experiments. Testing the independence of random events. Random variables as models of the studied features of objects. Parametric families of probability distributions of the studied features and their functional and numerical characteristics. Reliability of non-renewable elements. Uptime models: Weibull distribution, gamma distribution, Rayleigh distribution, semi-normal distribution. Truncated distributions and mixtures of distributions. Expected remaining lifetime. The conditional probability of an item being fit. Lifetime classes - types of aging of elements. Probability of completing the task. The stream of renewal. The process of renewal. Renewal function. Nodal renewal theorem. Renewal count variance. Time until next damage. Alternative renewal stream. Component replacement strategies - preventive replacement. Stochastic processes in the assessment of system reliability - Poisson process, Markov process, semi-Markov process.
Auditorium exercises: The scope of topics and issues covered coincides with the theory presented in subsequent lectures. Students solve practical tasks and problems related to engineering issues, in particular in the field of energy, using the definitions, properties, theorems learned during the lecture, as well as the methodology of cognitive conduct and generalization of the obtained results.
Update: 14/06/2024

Course topics

T01: Probabilistic modeling of the experiment.
T02: Combinatorial methods in data analysis.
T03: Distributions of experimental results.
T04: Numerical characteristics of random variables.
T05: Modeling the lifetime of objects.
T06: Stochastic processes in the assessment of object reliability.
T07: Computer-aided calculations.

Teaching methods

LLectures: traditional form supported by a multimedia presentation supplemented with practical examples solved on the blackboard. Lectures are conducted in an interactive manner, with questions being formulated by both the lecturer and students. Presentation available after each lecture.
Auditorium exercises: students solve open tasks and practical problems on the blackboard, as well as discuss and formulate contextual conclusions. Individual or team development of research projects concerning the use of probabilistic methods to solve contemporary technical problems. Students receive sets of tasks one week in advance. Students' activity during classes is taken into account when assigning the final grade.
Update: 14/06/2024

Bibliography

Basic:
1. Bobrowski D., Probabilistyka w zastosowaniach technicznych. WNT, Warszawa.
2. Macha Ewald, Niezawodność maszyn, Politechnika Opolska, Opole 2001, wersja elektroniczna.
3.Bobrowski Dobiesław, Modele i metody matematyczne teorii niezawodności, Wydawnictwo Naukowo-Techniczne, Warszawa 1985.

Additional:
1. Aven Terje, Jensen Uwe, Stochastic models in reliability, Springer, 1999.
2. Devore Jay L., Probability and Statistics for Engineering and the Sciences.
3. Andrzejczak K., Statystyka elementarna z wykorzystaniem systemu Statgraphics. Wyd. PP, Poznań 1997.

Breakdown of average student's workload

	Hours	ECTS
Total workload	55	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)	25	1,00