

**PROCESY STOCHASTYCZNE
STOCHASTIC PROCESSES**

11120-23-C

ECTS: 5

YEAR: 2015Z

**COURSE CONTENT
CLASSES**

Markov chains: a stochastic matrix, classification of states, periodic chains, temporary and recurrent states, random walk, stationarity and ergodicity. Poisson processes: basic properties and direct construction, random field, complex, conditional and mixed Poisson process. Wiener processes: basic properties, Levy inequality, the continuity of the trajectory, the principle of reflection, the law of iterated logarithm, the zero-one law.

LECTURES

The definition of a stochastic process and the importance of the theory to other disciplines. Class of stochastic processes: Gaussian processes, processes with independent increments, processes with orthogonal increments, stationary processes and stationary processes in a broader sense. Finite Markov chains, classification of states, the stationary distribution, the ergodic theorem. Random walks. Poisson process, Wiener-Levy process. Stochastic integral with respect to the Wiener process. Stochastic differential equations and their stationary solutions.

EDUCATIONAL OBJECTIVE:

Understanding the modeling of phenomena in various fields by stochastic processes. The ability to recognize different types of stochastic processes. Understanding the meaning and significance of stationary distribution, and also its ambiguity, or lack thereof in the case of Markov chains with an infinite number of states.

**DESCRIPTION OF LEARNING OUTCOMES FOR THE COURSE IN RELATION TO FIELD AND MAJOR
LEARNING OUTCOMES**

Codes of learning outcomes in a major field of study: X2A_K01++, X2A_K02++, X2A_K05++, X2A_K06++, X2A_U02+++, X2A_U04+++, X2A_U06+++, X2A_U07+, X2A_W01+, X2A_W02+++, X2A_W03+,

Codes of learning outcomes in a major area of study: K2_K01++, K2_K02++, K2_K03+++, K2_K05++, K2_U18+++, K2_W02++, K2_W04+++, K2_W05+, K2_W07++,

LEARNING OUTCOMES:**Knowledge**

W1 - The student has a basic knowledge of the theory of stochastic processes.

W2 - Is familiar with the notion of stochastic process, the concept of trajectory.

W3 - Knows and understands the concept of stationarity.

W4 - Knows the concept of Markov processes, Poisson, Wiener.

W5 - Knows and understands the concept of stochastic derivative and integral, understands the importance of these concepts in experimental sciences.

Skills

U1 - Has the skill to formulate and solve problems on stochastic processes.

U2 - Has the skill to determine basic parameters of stochastic process.

U3 - Has the skill to recognize types of stochastic processes.

U4 - Has skill to compute (in simple cases) derivative and integral of a stochastic process.

Social competence

K1 - Knows the limits of her/his own knowledge and understands the need for further education.

K2 - Takes part in the various stages of group solving mathematical problems and actively participates in the discussion of the mathematical apparatus to solve these problems.

K3 - Is aware of the importance of science for the development of other scientific disciplines.

BASIC LITERATURE**SUPPLEMENTARY LITERATURE****Course/module:**

Procesy stochastyczne

Fields of education:

Obszar nauk ścisłych

Course status: facultative**Course group:** C - speciality course**ECTS code:** 11120-23-C**Field of study:** Mathematics**Specialty area:** Mathematics**Educational profile:****Form of study:** full-time**Level of study:** second degree studies**Year/semester:** 2 / 3**Type of course:**

Classes, Lecture

Number of hours per semester/week: Classes: 30, Lecture: 30**Teaching forms and methods**

Classes(K1, K2, K3, U1, U2, U3, U4, W1, W2, W3, W4, W5) : Illustration of the content of the lectures by problems and exercises., Lecture(K1, K2, K3, U1, U2, U3, U4, W1, W2, W3, W4, W5) :

Form and terms of the verification results:

CLASSES: Evaluation of the work and cooperation in the group - null(null) ; CLASSES: Written test - Verification of skills and competencies developed during solving problems.(K1, K2, K3, U1, U2, U3, U4, W1, W2, W3, W4, W5) ; LECTURE: Oral exam - Audit question on the test carried out during the written examination in the event of doubt as to the assessment.(K1, K2, K3, U1, U2, U3, U4, W1, W2, W3, W4, W5) ; LECTURE: Written exam - Multiple-choice test, yes/ no questions test - the test contains closed-ended questions and various types of open-ended questions. It verifies both the knowledge acquired during lectures and personal skills and competencies.(K1, K2, K3, U1, U2, U3, U4, W1, W2, W3, W4, W5)

Number of ECTS points: 5**Language of instruction:** Polish**Introductory courses:**

Analysis, Probability theory, Functional analysis

Preliminary requirements:

Preliminary requirements: basic knowledge of analysis, probability theory and functional analysis

Name of the organizational unit offering the course:

Katedra Analizy i Równań Różniczkowych,

Person in charge of the course:

dr hab. Artur Siemaszko, prof. UWM

Course coordinators:**Notes:**

Detailed description of the awarded ECTS points - part B

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The awarded number of ECTS points is composed of:

1. Contact hours with the academic teacher:

- participation in: classes	30 h.
- participation in: lecture	30 h.
- consultation	2 h.
	62 h.

2. Student's independent work:

- the assimilation of the content given during the lecture from notes and literature. solving exercises and problems with textbooks.	78 h.
	78 h.

1 ECTS point = 25-30 h of the average student's work, number of ECTS points = 140 h : 28 h/ECTS = 5,00 ECTS
on average: **5 ECTS**

- including the number of ECTS points for contact hours with direct participation of the academic teacher:	2,21 ECTS points,
- including the number of ECTS points for hours completed in the form of the student's independent work:	2,79 ECTS points,