STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Multidimensional statistical analysis**		Code
Field of study **Mathematics in Technology**	Profile of study (general academic, practical) **general academic**	Year /Semester **4 /7**
Elective path/specialty **-**	Subject offered in: **Polish**	Course (compulsory, elective) **elective**
Cycle of study: **First-cycle studies** **(Polish Qualifications Framework level six)**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **30** Classes: Laboratory: **30** Project/seminars: **-**		No. of credits **4**
Status of the course in the study program (Basic, major, other) **major**	(university-wide, from another field) **university-wide**	
Education areas and fields of science and art **The sciences** **Mathematical sciences**		ECTS distribution (number and %) **4 100%** **4 100%**

Responsible for subject / lecturer:

dr hab. Karol Andrzejczak
email: karol.andrzejczak@put.poznan.pl
tel. 61 665 23 49
Faculty of Electrical Engineering
ul. Piotrowo 3A, 60-965 Poznań

Responsible for subject / lecturer:

dr hab. inż. Katarzyna Filipiak
email: katarzyna.filipiak@put.poznan.pl
tel. 61 665 23 49
Faculty of Electrical Engineering
ul. Piotrowo 3A, 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student understands the role and significance of construction of mathematical reasoning. He/she knows the relationship between set theory, mathematical logic, differential and integral calculus and other branches of mathematics with calculus of probability and statistics. Knows at least one software package, used for symbolic computation, and one packet for statistical processing of data. [K_W01 (P6S_WG), K_W02 (P6S_WG)]
2	**Skills**	He / she has the ability to express mathematical content in speech and in writing, in the texts of both a theoretical and practical. Can apply basic probability distributions on technical issues. Can apply appropriate methods for parameter estimation and statistical hypotheses verification. Can use computer in determining statistics for technical data. [K_U01 (P6S_UW), K_U02 (P6S_UW)]
3	**Social competencies**	Student knows own limitation of their knowledge and understands the need for further education. Can accurately formulate questions that deepen their understanding of the topic or find missing elements of reasoning. [K_K01 (P6S_KK), K_K02 (P6S_KK)]

Assumptions and objectives of the course:

The aim of this course is to give the opportunity to learn and discuss basic problems of multidimensional mathematical statistics, including selected problems of probability theory as well as the properties of statistics and statistical methods used for the experimental data inference. Understanding the distribution of quadratic forms and multidimensional versions of limit theorems. Mastery tests for multidimensional data and the ability to use statistical packages in testing and modelling selected technical problems. Presented material should give the opportunity to solve selected engineering problems.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. The student has knowledge about basic theorems used in probability theory and multidimensional mathematical statistics – [K_W01 (P6S_WG), K_W02 (P6S_WG)]
2. The student knows how to collect observations and how to analyze the data – [K_W06 (P6S_WG), K_W07 (P6S_WG)]

Skills:

As a result of the course the student will be able to:

1. construct models and solve technical problems with one- and multi-variate distribution - [K_U01 (P6S_UW), K_U02 (P6S_UW), K_U05 (P6S_UW), K_U07 (P6S_UW)]

2. use methods of multidimensional statistics with computer-aided to study random phenomena and processes - [K_U05 (P6S_UW), K_U14 (P6S_UO)]

Social competencies:

As a result of the course the student will score competencies of:

1. precise formulation of questions, aimed at deepening their understanding of advanced probabilistic and statistics methods - [K_K01 (P6S_KK), K_K02 (P6S_KK)]
2. teamwork in solving complex research projects - [K_K05 (P6S_KR)]

Assessment methods of study outcomes

Lectures

- Continuous assessment activity for solving problems formulated for self-solving.
- Rating theoretical knowledge and practical skills shown on the written test.

Laboratories

- Current rating - granting bonuses for new skills of practical use of introduced principles and methods.
- Assessment of the knowledge and skills of its application on the basis of a report and presentation problematic tasks completed in 2-3 people groups with computer-aided.
- The final term paper evaluating the effectiveness of the use of the gained knowledge.

Course description

Elements of matrix algebra. Block matrices. Multidimensional distributions. Vector of expected values. Covariance and correlation matrices and their properties. Multinomial distribution. Multivariate normal distribution and its application in linear modelling. Multidimensional data and their presentation. Measures of data distance. Correlation diagram. Parameter estimation of multivariate distributions. T-square Hotelling statistic. Tests for one and a few vectors of expected values. Tests for the covariance matrix. Tests of multivariate normality. Tests of independence several sub-vectors. Analysis of variance and its applications. Application of mathematical, statistical and spreadsheet packages in stochastic and statistical issues modelling. Review of multivariate statistics methods: discriminant analysis, principal component analysis, factor analysis.

Applied methods of education:

- lectures - presenting the theory connected with a current students' knowledge, presenting a new topic preceded by a reminder of related content known to students from other subjects

- practical course (exercises) - solving examples on the blackboard, discussions

- laboratory course - group programming, simulations

Update: 10.2018

Basic bibliography:

1. Krzyśko Mirosław**,** Podstawy wielowymiarowego wnioskowania statystycznego, Wydawnictwo Naukowe UAM, Poznań 2009.
2. Renczer, A.C., Methods of multivariate analysis, Wiley, New York 2002.
3. Koronacki J., Ćwik J., Statystyczne systemy uczące się, Wydawnictwo Naukowo-Techniczne , W-wa 2005

Additional bibliography:

1. Morison D.F., Wielowymiarowa analiza statystyczna, PWN, W-wa 1990.
2. Brandt S., Analiza danych, Wydawnictwo Naukowe PWN, W-wa 1998.
3. Rao, C.R., Modele liniowe statystyki matematycznej, PWN, Warszawa 1982.

Result of average student's workload

Activity	Time (working hours)
1. Lectures attendance (15 x 2 h)	30
2. Practical course (laboratory) attendance (15 x 2 h)	30
3. consulting	2
4. preparing to presentation tasks	15
5. Preparing to the laboratory course	8
6. familiarization with the indicated literature / teaching materials (10 pages of scientific text = 1 hr.)	10
7. Practicing to exam (13 h + 2 h)	15

Student's workload

Source of workload	hours	ECTS
Total workload	110	4
Contact hours	65	2
Practical activities	50	2