DOCTORAL SCHOOL OF WROCŁAW UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPERVISOR/TEAM/ DECLARING/CONDUCTING COURSE: Jerzy Detyna
DEPARTMENT: Mechanical Department
SCIENTIFIC DISCIPLINE: Mechanical Engineering

COURSE CARD

Course name in Polish: Planowanie Eksperymentu i Statystyczna Analiza Danych
Course name in English: Experiment Planning and Statistical Data Analysis
Course language Polish / English*
University-wide general course type*:
The course is intended for all PhD students: YES / NO
1) BASIC COURSE
2) SPECIALIST COURSE
3) SEMINAR
4) HUMANISTIC COURSE
5) LANGUAGE

Subject code: MEQ100061W

* delete as applicable

	Lecture	Foreign language course	Seminar	Mixed forms
Number of hours of organized classes in university (ZZU)	30			
Grading	Exam	Exam	Oral presentation	Exam, inspection, evaluation classes
Number of ECTS points	**0**			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of probability theory: the concept of probability and its properties, independence of random events, basic continuous and discrete probability distributions, basic knowledge about one- and multidimensional random variables, Central Limit Theorem.
2. Range of knowledge in mathematical analysis and linear algebra corresponding to the first degree of polytechnic studies.

\

COURSE OBJECTIVES
C1. Knowledge of experimental planning techniques.
C2. Ability to select the test and sample size for a particular problem.
C3. Ability to determine point and interval estimators of unknown parameters.
C4. Knowledge of statistical test construction methods.
C5. Knowledge of linear and nonlinear correlation and regression.
C6 Implementation of known procedures in the selected statistical package (eg R, Statistica)

PROGRAM CONTENTS

DOCTORAL SCHOOL OF WROCŁAW UNIVERSITY OF SCIENCE AND TECHNOLOGY

Form of classes – lecture (Lec)		Number of hours
Lec1	Introduction - the basic concepts and problems of planning experiments - linear model and its analysis methods (regression analysis, variance analysis), - planning of the experiments number,	3
Lec2	Plans for factorial experiments - plans for total 2k factorial experiments, - plans for fractions of 2k-p factorial experiments, - plans for second order factorial experiments, - Box-Wilson method of seeking optimal conditions,	4
Lec3	Plans for block experiments - the issue of eliminating the impact of undesirable factors, - randomization, - plans for complete and incomplete blocks, - Latin and Greek-Latin squares,	3
Lec4	Optimal experiment plans for regression model estimation - accurate and approximate plans of the experiments, - criteria for the optimization of the experiment plans, - selected optimal plans, - iterative procedure of construction of D- and G-optimal plans, - design of experiments for the mixtures,	4
Lec5	Application of experiment planning for quality optimization - the concept of quality optimization at the product design stage, - Taguchi's method of planning experiments for *on-line* quality optimization, - development of *on-line* quality optimization methods.	3
Lec6	Estimation methods - point estimation - methods to determine the estimators, properties of estimators, - interval estimation, confidence intervals for selected models, determination of the necessary number of measurements to achieve the desired precision.	3
Lec7	Hypothesis testing - statistical tests - null and alternative hypotheses, test statistics, critical set, I- and II-type errors, test power, - test construction - the strongest tests, Neyman-Pearson lemma, uniformly strongest tests, methods of finding tests, determination of a set of critical tests by simulation method, - basic tests for one population for mean value, standard deviation and structural index, determining the necessary quantity of measurements needed to perform a test of given properties.	3
Lec8	Analysis of variance (ANOVA) - ANOVA as a procedure for comparing averages in many populations, planning experiments to perform ANOVA - interactions between factors, - ANOVA statistical model and statistical inference based on it.	3

Lec9	Fundamentals of correlation and regression - introductory remarks on multivariate distribution studies, methods of calculating correlation coefficients, - simple regression based on the least squares method, - basic information on curvilinear relationships, correlation ratio.	3
Lec10	Oral Exam	1
	Total hours:	**30**

TEACHING TOOLS USED
N1. Lectures in the form of multimedia presentations. N2. Presentations of selected applications of statistical methods with the use of professional numerical tools (eg. commercial - StatSoft Statistica package, non-commercial - R package). N3. Problem discussion.

ACHIEVED SUBJECT LEARNING OUTCOMES		
Type of learning outcome	Code of learning outcome	Assessment of learning outcome
Knowledge	**P8S_WG**	- student has a sound knowledge of basic subjects such as mathematics, physics, chemistry or others - has an advanced knowledge fundamental to a field relevant to his/her research, including the most advanced methods of research and verification of results achieved - has advanced knowledge of directional subjects in a given discipline or in interdisciplinary subjects - has knowledge at an advanced level of discipline and subject matter relevant to the field of research carried out, including the most recent research findings and scientific achievements
Skills	**P8S_UW**	- student has scientific and technological skills relevant to methods and methodology of conducting scientific research and critical evaluation of the results obtained - is able to creatively interpret the results obtained and to search for their application - is prepared to intensify research with commercial potential
Social competence	**P8S_KK**	- understands and accepts the functions of the doctoral student care in the process of research planning, implementation and analysis of research results
Social competence	**P8S_KO**	- student understands the importance and significance of conducting research and teaching activities - cooperates within the framework of scientific networks on methodological issues

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Guter R.S., Owczyński B.W., *Matematyczne opracowywanie wyników doświadczeń*, PWN, Warszawa 1967.

[2] Jańczewski D., Różycki C., Synoradzki L., *Projektowanie procesów technologicznych. Matematyczne metody planowania eksperymentów*, Oficyna Wyd. Politechniki Warszawskiej, Warszawa 2010.

[3] Kafadar, K., *Designing experiments in research and development*, w: Ghosh, S. (ed.), *Statistical design and analysis of industrial experiments*, M. Dekker, New York 1990

[4] Koronacki J., Mielniczuk J., *Statystyka dla studentów kierunków technicznych i przyrodniczych*, Wydawnictwa Naukowo-Techniczne, Warszawa, 2006.

[5] Mańczak K., *Technika planowania eksperymentu*, WNT, Warszawa 1976.

[6] Montgomery D.C., *Design and Analysis of Experiments*, wyd. VIII, Wiley, 2012.

[7] Mood A.M., Graybill F.A., Boes D.C., *Introduction to the theory of statistics*, McGraw-Hill Publishing Company, 1983.

[8] Oktaba W., *Elementy statystyki matematycznej i metodyka doświadczalnictwa*, PWN, Warszawa 1977.

[9] Ostasiewicz W. (red), *Statystyczne metody analizy danych*, Wyd. AE we Wrocławiu, 1999.

[10] Taguchi, G., *Experimental design for product design*, w: Ghosh, S. (ed.), *Statistical design and analysis of industrial experiments*, M. Dekker, New York 1990.

[11] Wawrzynek, J., *Statystyczne planowanie eksperymentów w zagadnieniach regresji w warunkach małej próby*, Prace Naukowe AE, Nr 656, Wrocław 1993.

SECONDARY LITERATURE:

[1] Biecek P., *Przewodnik po pakiecie R*, Oficyna Wydawnicza GIS, Wrocław, 2008.

[2] Domański Cz., Pruska K., *Nieklasyczne metody statystyczne*, PWE, Warszawa 2000.

[3] Miszczak W., *Statystyczne metody analizy danych. Materiały do ćwiczeń*, Wyd. AE we Wrocławiu, 1999.

[4] Ostasiewicz W., *Pomiar statystyczny*, Wyd. AE we Wrocławiu, 2003.

[5] Panek T., *Statystyczne metody wielowymiarowej analizy porównawczej*, Wyd. SGH, Warszawa 2009.

[6] Stanisz A., *Przystępny kurs statystyki z zastosowaniem Statistica PL na przykładach z medycyny*, tom 1-3, Wyd. StatSoft, Kraków 2006.

[7] Walesiak M., Gatnar E., *Statystyczna analiza danych z wykorzystaniem programu R*, PWN, Warszawa 2009.

[8] Wawrzynek J., *Planowanie eksperymentów zorientowane na doskonalenie produktu*, Wyd. UE, Wrocław 2009.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Jerzy D. Detyna, PhD, DSc, MSc Eng.,
Professor at Wroclaw University of Science
and Technology
mail: jerzy.detyna@pwr.edu.pl