COURSE DESCRIPTION CARD – SPECIMEN

<table>
<tr><td colspan="10">Faculty of Mechanical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6"></td><td>Degree level and programme type</td><td>Bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6"></td><td>Study profile</td><td></td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Mathematical Modelling</td><td>Course code</td><td>IS-FME-00188S</td></tr>
<tr><td>Course type</td><td></td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>summer</td></tr>
<tr><td>45</td><td>30</td><td></td><td>15</td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>7</td></tr>
<tr><td>Entry requirements</td><td colspan="9"></td></tr>
<tr><td>Course objectives</td><td colspan="9">Acquainting with statistical methods of experiment planning. Acquainting with methods of optimization. Getting to know the elements of calculus of variation and their applications to solve some engineering problems.</td></tr>
<tr><td>Course content</td><td colspan="9">Lecture and classes: Statistical foundations of the experiment planning: the method of selecting elements for the sample, the size of the sample, the distribution of the parameter in the sample, comparison of the distribution of the mean of the tested parameter Static optimization: linear programming, simplex algorithm; dual problem. Nonlinear programming: problem of nonlinear programming without constraints, gradient methods; constraint nonlinear programming problem, Lagrange function, Hessian. Dynamic optimization: Markov property, Bellman optimality principle and its applications. Elements of calculus of variation: Euler equation, Euler-Poisson equation. Isoparametric problem. Application of variational calculus. Pontryagin's maximum principle, time-optimal control. Project: Analysis of the selection of elements for the sample with the use of computer tools. Sensitivity analysis of solutions in the simplex method. Application of gradient methods. Stop criteria in gradient methods. Applications of the Bellman method.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Lecture, classes, projects</td></tr>
<tr><td>Assessment method</td><td colspan="9"></td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">knows and understands the basic elements of the concept of optimization and the concept of calculus of variation</td><td>MK2_W01</td></tr>
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LO2	is able to propose an appropriate algorithm to solve simple optimization problem	**MMK2_W01, MK2_U04**
LO3	knows and can use the methods of calculus of variation to solve simple optimization problems, including problems related to mechatronics	**MMK2_W01, MK2_U04**
LO4	is ready to analyze and interpret the necessary information from different sources	**MK2_K01**
Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	writing exam	L
LO3	Writing exam; tests; assessment of completed projects, current work progress, discussions and activity in the classes and projects;	L,C,P
LO4	Writing exam; tests; assessment of completed projects, current work progress, discussions and activity in the classes and projects	L,C,P
LO5	tests; assessment of completed projects, current work progress, discussions and activity in the classes and projects	C,P

Student workload (in hours)		**No. of hours**
Calculation	lecture attendance	**45**
	participation in classes, projects	**45**
	preparation for classes, projects	**46**
	working on projects, reports, etc.	**13**
	participation in student-teacher sessions related to the classes/seminar/project	**5**
	preparation for exam and participation in exam	**22**
	TOTAL:	**175**

Quantitative indicators	**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation	**97**	**3,9**
Student workload – practical activities	**105**	**4,2**

Basic references	1. D.A. McQuarrie, Mathematical Methods for Scientists and Engineers, University Science Books, 2003,	
Supplementary references	2. D.G.Zill, Differential Equations, Thomson, 2005	
Organisational unit conducting the course	Department of Robotics and Mechatronics	**Date of issuing the programme**
Author of the programme	Ewa Pawłuszewicz, DSc, Assoc. Prof.	**29.03.2021**

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work,

S – seminar