COURSE DESCRIPTION CARD – SPECIMEN

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Automatic Control and Robotics</td><td colspan="2">Degree level and programme type</td><td>Bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">general</td><td colspan="2">Study profile</td><td></td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Modern Control of Mechatronics Systems</td><td colspan="2">Course code</td><td>IS-FEE-10057W</td></tr>
<tr><td colspan="2">Course type</td><td>elective</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>winter</td></tr>
<tr><td>15</td><td></td><td></td><td>15</td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>5</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">This course deals with the study of control theory including advanced robust optimal methods, such as H-infinity, mu-Synthesis, LMI, mixed-sensitivity, loop-shaping, uncertain systems, nonlinear observers, feedback linearization, control Lyapunov functions. Moreover, these designs with its applications to the mechatronics systems, including electro-drives, electrical circuits, electro-mechanical, electro-pneumatics, and hydraulics. Major course topics include knowledge of linear/nonlinear and applications engineering principles and methodologies used to solve advanced problems in control systems.</td></tr>
<tr><td>Course content</td><td colspan="9">Principle subject outcomes include sensitivity and complementary sensitivity functions, H-2 and H-inf spaces. Dynamic systems with linear-parameter-varying. Design of structured and unstructured uncertainty. Robustness, small-gain theorem. Linear fractional transformation. Optimal control with H-2 or H-infinity. Mu-synthesis control. System order minimization. Stability of the nonlinear control systems according to control Lyapunov functions.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">power-point presentations, Matlab/Simulink software, Matlab/Simulink Toolboxes, project examples, MathWorks help, text books, other documents given by the teacher</td></tr>
<tr><td>Assessment method</td><td colspan="9">lecture – written exam, project – project completion, presentation and discussion, performance of the project</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="7">Learning outcomes</td><td colspan="2">Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="7">Basic knowledge of robust control design and application including optimal control, LFT models, and LPV systems</td><td colspan="2">SM_W11 SM_W05</td></tr>
<tr><td>LO2</td><td colspan="7">Basic knowledge of system order reduction and minimization methods, calculating of the system’s norms</td><td colspan="2">SM_W16</td></tr>
<tr><td>LO3</td><td colspan="7">Practical skills of stability calculating and control performance index for closed-loop dynamic systems</td><td colspan="2">SM_U12</td></tr>
<tr><td>LO4</td><td colspan="7">practical skills needed to develop and calculate the</td><td colspan="2">SM_U12 SM_U08</td></tr>
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	modelling of the uncertain systems and robustness	
LO5	skills and knowledge acquired to numerical calculations and simulation of linear/nonlinear control system using Matlab/Simulink	SM_U12
LO6	demand for cooperation with other student within group, as well as an increased awareness of its vital importance for development	SM_K01
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	written exam, project evaluation, activity on project classes	L, P
LO2	written exam, project evaluation, activity on project classes	L, P
LO3	written exam, project evaluation, activity on project classes	L, P
LO4	written exam, project evaluation, activity on project classes	L, P
LO5	written exam, project evaluation, activity on project classes	L, P
LO6	student activity on project classes	P
Student workload (in hours)		No. of hours
Calculation	lecture attendance	15
	participation in classes, laboratory classes, etc.	15
	preparation for classes, laboratory classes, projects, seminars, etc.	30
	working on projects, reports, etc.	20
	participation in student-teacher sessions related to the classes/seminar/project	8
	TOTAL:	88

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	38	1.5
Student workload – practical activities	54	2

Basic references	1. Matlab examples. 2. Robust Control Toolbox, R2023b. 3. Robust Control, Robust Control, Matlab videos, parts 1, 2, 3, 4, and 5. 4. Richard C. Dorf, Robert H. Bishop, Modern Control Systems, 14th edition, Pearson Education Inc, 2022. ISBN: 9780137307258.
Supplementary references	1. Teacher's materials and instructions. 2. www.mathworks.com.

Organisational unit conducting the course	Department of Automatic Control and Robotics	Date of issuing the programme
Author of the programme	Assoc Prof. Arkadiusz Mystkowski, PhD, DSc, Eng	27.01.2023

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

Please notice!
Depending on number of students enrolled for the subject hours of tuition are as follows (for each 30 hours given in course description card):
1 – 2 students - 5 hours of tuition hours;
3 – 4 students - 8 hours of tuition;
5 – 6 students - 11 hours of tuition;
7 – 8 students - 15 hours of tuition;
9 and more students - hours of tuition given by a teacher as regular classes.