# 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">-</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-10066S</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>summer</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"></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"></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"></td></tr>
<tr><td>LO4</td><td colspan="7">practical skills needed to develop and calculate the modelling of the uncertain systems and robustness</td><td colspan="2"></td></tr>
<tr><td>LO5</td><td colspan="7">skills and knowledge acquired to numerical calculations and simulation of linear/nonlinear control system using</td><td colspan="2"></td></tr>
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| | Matlab/Simulink | |
| **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 | **15** |
| | preparation for projects | **30** |
| | working on projects, reports, etc. | **40** |
| | participation in student-teacher sessions related to the project | **2** |
| | preparation to the exam | **23** |
| | **TOTAL:** | **125** |

| **Quantitative indicators** | **HOURS** | **No. of ECTS credits** |
|---|---|---|
| **Student workload – activities that require direct teacher participation** | **38** | **1.5** |
| **Student workload – practical activities** | **85** | **3** |

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| **Basic references** | 1. A.Isidori, Nonlinear control systems, Springer 1996<br>2. R.Marino, P.Tomei, Nonlinear control design, Prentice Hall, 1995<br>3. K. Zhou, J.C. Doyle, Essentials of robust control, Prentice Hall, 1998.<br>4. R.A. Freeman, P.V. Kokotović, Robust nonlinear control design, State-space and Lyapunov techniques, Birkhäuser, 2008.<br>5. Ogata K., Modern Control Engineering, 4th ed., Pearson Education International, 2002. |
| **Supplementary references** | 1. Dorf R.C., Bishop R.H., Modern Control Systems, 10th Edition, Prentice Hall, 2005.<br>2. Tewari A., Modern Control Design: With Matlab and Simulink, Wiley-IEEE Press, 2001.<br>3. Bequette B.W., Process Control, Modeling, Design and Simulation, Prentice Hall, 2003.<br>4. Potvin A. F., Nonlinear Control Design Toolbox, The MathWorks, Inc., Natick, MA., 1994.<br>5. The MathWorks, Control System ToolboxTM User's Guide, 8th ed., 2009. |

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| **Organisational unit conducting the course** | **Department of Automatic Control and Electronics** | **Date of issuing the programme** |
| **Author of the programme** | **Assoc. Prof. Arkadiusz Mystkowski, PhD, DSc, Eng** | **25.03.2020** |

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