## COURSE SPECIFICATION

| | | |
|---|---|---|
| Course code | full-time programme: | **M#2-S1-ME-211** |
| | part-time programme: | |
| Course title in Polish | **Podstawy automatyki** | |
| Course title in English | **Fundamentals of Control Engineering** | |
| Valid from (academic year) | **2024/2025** | |

## GENERAL INFORMATION

| | |
|---|---|
| Programme of study | **MECHANICAL ENGINEERING** |
| Level of qualification | **first-cycle** |
| Type of education | **academic** |
| Mode of study | **full-time programme** |
| Specialism | **all** |
| Department responsible | **Department of Mechatronics and Weapons Engineering** |
| Course leader | **dr hab. inż. Piotr Woś, prof. PŚk** |
| Approved by | **dr hab. Jakub Takosoglu, prof. PŚk, Dean of the Faculty of Mechatronics and Mechanical Engineering** |

## COURSE OVERVIEW

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|---|---|---|
| Course type | | **programme-specific** |
| Course status | | **compulsory** |
| Language of instruction | | **English** |
| Semester of delivery | full-time programme | **Semester II** |
| | part-time programme | |
| Pre-requisites | | |
| Examination required (YES/NO) | | **YES** |
| ECTS value | | **4** |

| Mode of instruction | | lecture | class | laboratory | project | seminar |
|---|---|---|---|---|---|---|
| No. of hours per semester | full-time programme | **15** | **15** | **15** | | |
| | part-time programme | | | | | |

## LEARNING OUTCOMES

| Category of outcome | Outcome code | Course learning outcomes | Corresponding programme outcome code |
|---|---|---|---|
| Knowledge | W01 | The student has a well-organised advanced knowledge of the types of automation systems, the principles of their operation and the purpose of their use. | MiBM1_W04 |
| | W02 | The student will have structured advanced knowledge in the modelling and simulation of mechanical, electrical and fluid systems, and the analysis of these systems in the time and frequency domains. | MiBM1_W04<br>MiBM1_W09<br>MiBM1_W16 |
| | W03 | The student has an organized and advanced knowledge of block diagram algebra. | MiBM1_W04 |
| | W04 | The student has structured advanced knowledge related to stability testing and quality assessment of automatic control systems. | MiBM1_W04 |
| | W05 | The student has an advanced knowledge of the possibilities of analysis and synthesis of automation systems, as well as of the measurement methods used in these systems. | MiBM1_W04<br>MiBM1_W12 |
| Skills | U01 | The student will be able to use the Laplace transform in the analysis of automation elements and systems, determine the response of the system to given inputs and the frequency characteristics. | MiBM1_U01<br>MiBM1_U07<br>MiBM1_U12 |
| | U02 | The student will be able to determine the equivalent transmittance of the system, study its stability and determine the values of quality indicators for a given automation system. | MiBM1_U07<br>MiBM1_U12 |
| | U03 | The student will be able to build a simulation model of an element or automation system and determine its response to a given input, and then synthesise it using basic methods. | MiBM1_U02<br>MiBM1_U07<br>MiBM1_U12 |
| Competence | K01 | The student is prepared to critically evaluate his or her knowledge and to improve professional qualifications, including through second and third cycle studies, postgraduate studies and attending professional courses. | MiBM1_K01<br>MiBM1_K03 |
| | K02 | The student is aware of the need to constantly update knowledge in the field of automation systems due to its dynamic development. | MiBM1_K01<br>MiBM1_K03<br>MiBM1_K04 |

## COURSE CONTENT

| Type of instruction lecture | Topics covered |
|---|---|

| | |
|---|---|
| lecture | Basic concepts of automation, general diagrams of automation systems and classification of automation systems, examples of automation systems. Description of linear elements and systems. Laplace transform, operator transfer function, determination of static characteristics and response to a given excitation from the operator transfer function.<br>Static and dynamic properties of basic linear elements: proportional, inertial, integrating, differentiating, oscillating and delaying, and their examples.<br>Flowchart algebra. Basic connections, transformation of block diagrams, methods of determining equivalent transfer functions of complex systems.<br>Frequency characteristics. Spectral transmittance, types of characteristics, frequency characteristics of basic elements, logarithmic characteristics for a series connection, basic methods of experimental determination of frequency characteristics.<br>Characteristics of typical control objects. Static and astatic objects and their step and frequency characteristics, examples of objects.<br>PID controllers. Structures and characteristics of PID controllers.<br>Stability of Linear Automation Systems. General stability condition, stability criterion: Hurwitz.<br>Quality of automation systems. Static accuracy, time waveform quality indicators, frequency response indicators, integral quality indicators.<br>Selected problems of synthesis of linear automation systems. Choice of controller type, choice of controller settings according to the main characteristics of the transient waveform, Ziegler-Nichols method. |
| class | Solving problems in the field of:<br>- Determination of equations of automation elements,<br>- Laplace transform and its use in automation,<br>- Determining the response of systems to a given input,<br>- Flowchart algebra,<br>- Frequency characteristics,<br>- Stability of linear systems,<br>- Quality evaluation of automation systems. |
| laboratory | Carry out laboratory exercises on:<br>- Modelling elements and systems,<br>- Determining the characteristics of basic elements<br>- Determining frequency characteristics<br>- Determining the characteristics of PID controllers,<br>- Identifying the parameters of the controlled object,<br>- Testing the automatic control system. |

## ASSESSMENT METHODS

| Outcome code | Methods of assessment *(Mark with an X where applicable)* | | | | | |
|---|---|---|---|---|---|---|
| | Oral examination | Written examination | Test | Project | Report | Other |
| W01 | | X | | | | |
| W02 | | X | | | | |
| W03 | | X | | | | |
| W04 | | X | | | | |
| W05 | | X | | | | |
| U01 | | | X | | X | |
| U02 | | | X | | X | |
| U03 | | | X | | X | |
| K01 | | | | | | X |

| | | | | | | |
|---|---|---|---|---|---|---|
| K02 | | | | | | X |

## ASSESSMENT TYPE AND CRITERIA

| Mode of instruction | Assessment type | Assessment criteria |
|---|---|---|
| lecture | examination assessment | Successful completion of the final examination. Obtain a minimum of 50% of the points. |
| class | non-examination assessment | The pass mark is a minimum of 50% for all the in-class tests. |
| laboratory | non-examination assessment | Positive completion of course reports. The final grade is the arithmetic average. |

## OVERALL STUDENT WORKLOAD

| ECTS weighting | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Activity type | Student workload | | | | | | | | | | Unit |
| | | full-time programme | | | | | part-time programme | | | | | |
| | | L | C | Lb | P | S | L | C | Lb | P | S | |
| 1. | Scheduled contact hours | 15 | 15 | 15 | | | | | | | | h |
| 2. | Other contact hours (office hours, examination) | 4 | 2 | 2 | | | | | | | | h |
| 3. | **Total number of contact hours** | **53** | | | | | | | | | | h |
| 4. | **Number of ECTS credits for contact hours** | **2,1** | | | | | | | | | | ECTS |
| 5. | **Number of independent study hours** | **47** | | | | | | | | | | h |
| 6. | **Number of ECTS credits for independent study hours** | **1,9** | | | | | | | | | | ECTS |
| 7. | **Number of practical hours** | **67** | | | | | | | | | | h |
| 8. | **Number of ECTS credits for practical hours** | **2,7** | | | | | | | | | | ECTS |
| 9. | **Total study time** | **100** | | | | | | | | | | h |
| 10. | **ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time* | **4** | | | | | | | | | | ECTS |

## READING LIST


1. Chłędowski M., Pieniążek J.: Podstawy automatyki: w ćwiczeniach i zadaniach, Oficyna Wydawnicza Politechniki Rzeszowskiej, 2004.
2. Chłędowski M.: Wykłady z automatyki dla mechaników, Oficyna Wydawnicza Politechniki Rzeszowskiej, 2003.
3. Horla D.: Podstawy automatyki: ćwiczenia rachunkowe. Cz. 1, Wydawnictwo Politechniki Poznańskiej, 2014.
4. Siemieniako F.: Podstawy automatyki z zadaniami, Wydawnictwa Politechniki Białostockiej, 1996.
5. Mazur E., Kozłowski J.: Podstawy automatyki, Wydawnictwa Politechniki Częstochowskiej, 1995.

6. Grzelka J., Mazur E., Tutak W.: Podstawy automatyki: zbiór zadań z rozwiązaniami, Wydawnictwa Politechniki Częstochowskiej, 2000.
7. Kaczorek T.: Podstawy automatyki, Politechnika Warszawska, 1966.
8. Żelazny M.: Podstawy automatyki, PWN, 1976.
9. Amborski K.: Teoria sterowania w ćwiczeniach, PWN, 1978.
10. Stefański T.: Teoria sterowania t. 1, Wydawnictwo Politechniki Świętokrzyskiej Świętokrzyskiej, 2002.