

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Podstawy automatyki 1**  
 Name in English: **Fundamentals of control engineering 1**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ELR042101**  
 Group of courses: **NO**

|  | Lecture     | Classes              | Laboratory | Project | Seminar |
|--|-------------|----------------------|------------|---------|---------|
| Number of hours of organized classes in University (ZZU):                        | 30          | 15                   |            |         |         |
| Number of hours of total student workload (CNPS):                                | 90          | 30                   |            |         |         |
| Form of crediting:   | examination | crediting with grade |            |         |         |
| For group of courses mark (X) final course:                                      |             |                      |            |         |         |
| Number of ECTS points:   | 3           | 1                    |            |         |         |
| including number of ECTS points for practical (P) classes :                      |             | 1                    |            |         |         |
| including number of ECTS points for direct teacher-student contact (BK) classes: | 2.10        | 0.70                 |            |         |         |

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of fundamentals of electrotechnics, differential calculus and complex functions and numbers.
2. Practical ability to use differential calculus and complex functions.
3. Ability of application of Laplace and Fourier transforms.

**SUBJECT OBJECTIVES**

- C1. Development and progress of theoretical knowledge concerning compensation allowing to get required parameters of control systems.
- C2. Gaining of theoretical knowledge concerning static, dynamic and quality as well as stability of continuous linear control systems.
- C3. Development and progress of practical abilities of mathematical analysis, synthesis, stability estimation and design of adequate compensation of to continuous linear control systems.
- C4. Gaining abilities of practical analysis and synthesis of continuous linear control systems.

**SUBJECT EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Has knowledge to build models , to estimate and calculate static and dynamic parameters of fundamental blocks of control systems.  
 PEK\_W02 Possesses knowledge concerning analysis, operation and quality of control systems.  
 PEK\_W03 Has knowledge concerning stability of control systems, development of compensation systems as well as improvement and optimisation of continuous linear control systems.

*relating to skills:*

- PEK\_U01 Is able to work out mathematical analysis and synthesis of fundamental elements and complex control systems.  
 PEK\_U02 Is able to make practical estimation of stability of control systems and design different types of compensators allowing to reach required performance of continuous linear control systems.

*relating to social competences:*

- PEK\_K01 Is aware of necessity of self-reliant information retrieval and creative using of obtained information.

| PROGRAMME CONTENT         |   |                  |
|---------------------------|---|------------------|
| Form of classes - lecture |   | Number of hours: |
| Lec 1                     | Introduction. Classification and structure of control systems.  | 2                |
| Lec 2                     | Methods of description of control systems.  | 2                |
| Lec 3                     | Basic control systems elements - elements: proportional, first order, integrating - ideal and with inertia, differentiating - ideal and with inertia. | 2                |
| Lec 4                     | Basic control systems elements – second order inertial element, second order oscillatory element.   | 2                |
| Lec 5                     | Basic control systems elements – elements with transport delay.   | 2                |
| Lec 6                     | Requirements for performance of control systems, performance indexes.   | 2                |
| Lec 7                     | Block-diagram algebra.  | 2                |
| Lec 8                     | Steady state performance of control systems.  | 2                |
| Lec 9                     | Stability - definition, basic stability condition. Routh stability criterion.   | 2                |
| Lec 10                    | Nyquist stability criterion - left-hand side criterion, logarithmic criterion.  | 2                |
| Lec 11                    | Stability analysis based on Ziegler-Nichols approximation.  | 2                |
| Lec 12                    | Methods of compensation of control systems.   | 2                |
| Lec 13                    | Synthesis of the series compensating units with use of the Nichols chart.   | 2                |
| Lec 14                    | Compensation techniques: parallel, in feedback, additive and predictive.  | 2                |
| Lec 15                    | Industrial controllers - types, construction, selection of the settings.  | 2                |
| Total hours:              |   | <b>30</b>        |

| Form of classes - class |   | Number of hours: |
|-------------------------|---|------------------|
| Cl 1                    | Introduction. Requirements to pass. Laplace transform and its application to description of control systems.                    | 2                |
| Cl 2                    | Time responses of fundamental blocks of control systems under standard input signals.   | 2                |
| Cl 3                    | Time and frequency responses of elements of control systems.  | 2                |
| Cl 4                    | Block-diagram algebra. Steady state errors of control systems.  | 2                |
| Cl 5                    | Stability analysis of control systems: Routh and Michajlow criteria.  | 2                |
| Cl 6                    | Stability analysis – Nyquist criterion, general and simplified, logarithmic criterion, determination of phase and gain margins. | 2                |
| Cl 7                    | Pass colloquium.  | 2                |
| Cl 8                    | Discussion of colloquium results, deep analysis of the most difficult problems.   | 1                |
| Total hours:            |   | <b>15</b>        |

| TEACHING TOOLS USED      |
|--------------------------|
| N1. Informative lecture. |
| N2. Classes              |
| N3. Student's own work   |

| EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT                                   |                               |  |
|---|-------------------------------|--|
| Evaluation<br><i>F – forming (during semester)<br/>P – concluding (at semester end)</i> | Educational effect number     | Way of evaluating educational effect achievement |
| F1(w)   | PEK_W01<br>PEK_W02<br>PEK_W03 | Presence at the lectures                         |
| F2(w)   | PEK_W01<br>PEK_W02<br>PEK_W03 | Written or oral examination                      |
| P(w)  | $P=0,1F1+0,9F2$               |  |
| F1(c)   | PEK_U01<br>PEK_U02<br>PEK_K01 | Activity at the classes                          |
| F2(c)   | PEK_U01<br>PEK_U02            | Results of short tests                           |
| F3(c)   | PEK_U01<br>PEK_U02            | Crediting test                                   |
| P(c)  | $P=0,2F1+0,2F2+0,6F3$         |  |

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

- [1] Greblicki W., Podstawy automatyki, Wydawnictwo Politechniki Wrocławskiej, Wrocław 2006
- [2] Kaczorek T., Podstawy teorii sterowania, WNT, Warszawa 2009
- [3] Mazurek J., Vogt H., Żydanowicz W., Podstawy automatyki, Wydawnictwo Politechniki Warszawskiej, Warszawa 2006
- [4] Staszewski J., Skrypt zadań z Podstaw Automatyki \*

\* position available at lecturer

### SECONDARY LITERATURE:

- [1] Horla D., Podstawy automatyki. Ćwiczenia rachunkowe. Cz.1, Wydawnictwo Politechniki Poznańskiej, Poznań 2004
- [2] Mazur E., Sosnowski M., Podstawy automatyki. Zbiór zadań, Wydawnictwo Politechniki Częstochowskiej, Częstochowa 2006.

## SUBJECT SUPERVISOR

Jan Iżykowski, jan.izykowski@pwr.edu.pl

### MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **ELR042101 - Fundamentals of control engineering 1** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable) | Subject objectives | Programme content  | Teaching tool number |
|----------------------------|---|--------------------|--|----------------------|
| PEK_W01                    | K1ETK_W05<br>K1ETK_W27  | C.1<br>C.2         | Lec1<br>Lec2<br>Lec3<br>Lec4   | N.1<br>N.3           |
| PEK_W02                    | K1ETK_W05<br>K1ETK_W27  | C.1<br>C.2         | Lec6<br>Lec7<br>Lec8   | N.1<br>N.3           |
| PEK_W03                    | K1ETK_W05<br>K1ETK_W27  | C.1<br>C.2         | Lec9<br>Lec10<br>Lec11<br>Lec12<br>Lec13<br>Lec14<br>Lec15   | N.1<br>N.3           |
| PEK_U01                    | K1ETK_U14<br>K1ETK_U24  | C.3<br>C.4         | CI1<br>CI2<br>CI3<br>CI7<br>CI8  | N.2<br>N.3           |
| PEK_U02                    | K1ETK_U14<br>K1ETK_U24  | C.3<br>C.4         | CI4<br>CI5<br>CI6<br>CI7<br>CI8  | N.2<br>N.3           |
| PEK_K01                    | K1ETK_K05   | C.3<br>C.4         | Lec1<br>Lec2<br>Lec3<br>Lec4<br>Lec5<br>Lec6<br>Lec7<br>Lec8<br>Lec9<br>Lec10<br>Lec11<br>Lec12<br>Lec13<br>Lec14<br>Lec15<br>CI1<br>CI2<br>CI3<br>CI4<br>CI5<br>CI6 | N.1<br>N.2<br>N.3    |