DESCRIPTION OF THE COURSES

- Course code: **ARR2504**
- Course title: **CONTROL OBJECT IDENTIFICATION**
- Language of the lecturer: **Polish, English**

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	**2**		**1**		
*Number of hours/semester**	**30**		**15**		
Form of the course completion	**Test**		**Performed laboratory assignments**		
ECTS credits	**2**		**1**		
Total Student's Workload	**90**				

- Level of the course (basic/advanced): **basic**
- Prerequisites: **credits for Linear algebra, Analysis, Stochastic processes, Control theory**
- Name, first name and degree of the lecturer/supervisor: **Kazimierz Wilkosz, PhD, DSc./Professor**
- Names, first names and degrees of the team's members: **dr. Robert Łukomski**
- Year: **1** Semester: **1 (the second-level study)**
- Type of the course (obligatory/optional): **obligatory**
- Aims of the course (effects of the course):
  - **familiarising with methods for control object identification,**
  - **competence in solving problems of control object identification,**
  - **use the software for solving identification problems with confidence.**
- Form of the teaching (traditional/e-learning): **traditional**
- Course description:

  Identification of static and dynamic, parametric and nonparametric, stationary and nonstationary models. Identification of models for systems with a feedback control loop. Identification of models for time series. Practical solving identification problems in the MATLAB environment (with use of Toolbox Identification).
- Lecture:

Particular lectures contents	*Number of hours*
1. Introduction. Basic terms and definition: dynamic systems, models of dynamic systems, identification, interpretation of identified model, identification process.	**2**
2. Identification of static models - the least squares method: a principle of the method, a recursive algorithm, a deterministic criterion for assessing model correctness.	**2**
3. Identification of static models with use of the least squares	**2**

method: statistical analysis of the results of identification.	
4. The identification experiment in the case of dynamic models: general characteristics, choice of sampling time, choice of input signals.	**2**
5. Identification of parametric dynamic models: the essence of identification, models ARX, ARMAX, estimation of parameters of models by the least squares method, the instrumental variable method and the maximum likelihood method.	**2**
6. Validation of parametric dynamic models.	**2**
7. Test.	**2**
8. Identification of nonstationary parametric dynamic models.	**2**
9. Identification of time-series models: time-series concept, properties of time-series (stationarity, stability), properties of time-series models (causality, stability, reversibility), process of identification of time-series models, stochastic time-series models (stationary and nonstationary models) and their properties.	**2**
10. Identification of the impulse response: recursive and nonrecursive methods.	**2**
11. Identification of power spectral density: description of a signal in the frequency domain, classical and modern identification methods.	**2**
12. Identification of the amplitude and phase characteristics with use of nonparametric methods: purpose of the identification, identification methods (frequency analysis, frequency analysis using correlation methods, spectral analysis), coherence function, input signals.	**2**
13. Identification of static and dynamic models with use of the stochastic approximation: the principle of the stochastic approximation, an algorithm of identification.	**2**
14. Identification of the models of feedback control systems: identifiability conditions, the problem of partial unfulfilment of identifiability conditions.	**2**
15. Test.	**2**

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:

  Individual solving the tasks, illustrating problems considered during the lectures. The laboratory exercises are as follows:

  1. **An introduction, the laboratory program. Mathematical models of control objects.**
  2. **Identification of static models - the least squares method.**
  3. **Identification of static models - the least squares method: Statistical analysis of the results of identification.**
  4. **Identification of static models - planning of active identification experiments.**
  5. **Identification of dynamic models - the ARX model.**
  6. **Identification of the impulse response.**
  7. **Identification of the amplitude and phase characteristics.**
- Project – the contents:

- Basic literature:
  1. **Królikowski A., Identyfikacja obiektów sterowania, Poznań, Wyd. Pol. Poznańskiej 2005.**
  2. **Królikowski A., Horla D., Identyfikacja obiektów sterowania: metody dyskretne, Poznań, Wyd. Pol. Poznańskiej 2005.**
  3. **Mańczak K., Nahorski Z., Komputerowa identyfikacja obiektów dynamicznych, Warszawa, PWN 1983.**
  4. **Pr. zb., Dynamika i identyfikacja obiektów. Zbiór zadań, Poznań, Wyd. Pol. Poznańskiej 1980.**
  5. **Pr. zb. pod red. Kasprzyk J., Identyfikacja procesów, Gliwice, Wyd. Pol. Śląskiej 2002.**
  6. **Zimmer A., Englot A., Identyfikacja obiektów i sygnałów. Teoria i praktyka dla użytkowników MATLABA, Kraków, Wyd. Pol. Krakowskiej 2005.**
- Additional literature:
  1. **Mańczak K., Metody identyfikacji wielowymiarowych obiektów sterowania, Warszawa, WNT 1979.**
  2. **Milkiewicz F., Wstęp do metod optymalizacji i identyfikacji obiektów przemysłowych, Gdańsk, Wyd. Pol. Gdańskiej 1979.**
  3. **Sawicki J., Królikowski A., Florek A., Dynamika i identyfikacja obiektów sterowania. Zbiór zadań, Warszawa, PWN 1986.**
  4. **Zimmer A., Identyfikacja obiektów i sygnałów. Teoria i praktyka dla użytkowników MATLABA. Kraków, Wyd. Pol. Krakowskiej 1998.**
- Conditions of the course acceptance/credition:
  ***Lectures*: positive final test**
  ***Laboratory*: positive evaluation of all performed assignments**

***** - depending on a system of studies