(*faculty stamp*)

Z1-PU7	WYDANIE N1	Strona 1 z 3

COURSE DESCRIPTION

1. Course title: SYSTEM IDENTIFICATION	**2. Course code**
3. Validity of course description: 2012/2013	
4. Level of studies: 2nd cycle of higher education	
5. Mode of studies: intramural studies	
6. Field of study: MACROCOURSE	(FACULTY SYMBOL) RAU
7. Profile of studies: All-academic	
8. Programme: AUTOMATIC CONTROL	
9. Semester: 1	
10. Faculty teaching the course: Institute of Automatic Control, RAu1	
11. Course instructor: Ewa Bielińska, Dsc. Eng.	
12. Course classification: common	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Fundamentals of system dynamics, matrix operation, probability and statistics, numerical methods. It is assumed that student starting this course has ability to use computers and Matlab.	
16. Course objectives: The aim of the course is to present the main problems of theory and practice of system identification. The course concerns identification of non-parametric and parametric dynamic models..	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Knowledge and comprehension of the basic terms used in system identification	EP, SP	WM	K_W12 K_W13
2.	Knowledge and comprehension of models and model structures, their properties and limitations	EP, SP	WM	K_W12 K_W13
3	Knowledge and comprehension of identification experiment, methods of data processing, parametric and non-parametric identification methods	EP, SP	WM	K_W12 K_W13
4.	Skills in conducting identification experiments	CL, PS	L	K_U20
5.	Skills in applying available programming tools for system identification	CL, PS	L	K_U1 K_U2 K_U3 K_U4 K_U20
6.	Ability to choose and apply proper identification methods to solve real world identification task	OP	P	K_U2 K_U3 K_U4 K_U19
7.	Understanding of the necessity for life-long learning, ability to inspire and organize the learning process of other people	CL, OP	L	K_K1
8.	Ability to cooperate and work in a team taking on different roles.	OS, OP	L, P	K_K3

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory: 45 / 0 / 0 / 0 / 30

19. Syllabus description:

Semester : 1

Lecture:

Introduction: Common terms used in system identification; Basic information about dynamic models; Variants of model description; How to interpret the noise source; Terms to characterize the model properties: Impulse response, Step response, Frequency response, Zeros and poles; Basic steps in system identification; Origins of system identification.
Systems: Linear Time Invariant discrete-time systems: Frequency response, Periodograms; 2 Stochastic processes: Definitions, Power spectrum , Ergodicity.
Examples of system identification:
Practice: Non-parametric methods Parametric approach, Calculations, Simulations;
Theoretical analysis: Influence of experiment design and system stimulation.
Nonparametric Identification:
Time-domain methods: Correlation analysis, analysis of correlation method;
Frequency-Response Analysis: Empirical Transfer Function estimate (ETFE), properties of ETFE, Spectral estimation, Relations to traditional spectral analysis, Efficient computation, Analysis of spectral estimation.
Identification Experiment:
Input Design: Input signals, Spectral properties, Pseudo-Random-Binary Sequence (PRBS) vs. WN, Persistent Excitation, Spectrum of Filtered Signals, Selection of the sampling interval; Closed loop system identification; Model verification.
Least Squares. Statistical Properties
Linear regressions, LS estimates: Statistical properties - bias, variance, covariance, Noise-variance estimationBest Linear Unbiased Estimate; Maximum Likelihood Estimate
Parameterized model structures
Models of LTI systems: One step linear predictor, Equation Error model structure, Output Error model structure, Examples of transfer function models
Parameter Estimation Methods
Minimum prediction error paradigm; Quadratic Criterion, MIMO Systems; Maximum Likelihood; Central limit theorem (generalization); Application to prediction error methods (special case)
Numerical methods
Recursive estimation: Recursive LS; Recursive algorithms with efficient matrix conversion

Laboratory:

1. Least squares method
2. Nonparametric models
3. Step response and FIR
4. ARX models
5. Real-world process identification
6. Time - varying models

20. Examination: yes

21. Primary sources:

1. Lennart Ljung. *System Identification: Theory for the user*. Prentice Hall
2. T.Soderstom, P.Stoica. *System Identification*. Prentice Hall

22. Secondary sources:

1. Kasprzyk J. (red).: *Identyfikacja Procesów*. Wydawnictwo Politechniki Śląskiej, Gliwice, 2002
2. Janiszowski K.: *Identyfikacja modeli parametrycznych w przykładach*. Akademicka Oficyna Wydawnicza EXIT, Warszawa, 2002.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	45 / 20
2	Classes	0 / 0
3	Laboratory	30 / 40
4	Project	0 / 0
5	BA/ MA Seminar	0 / 0
6	Other	15 /30
	Total number of hours	90 / 90

24. Total hours:180

25. Number of ECTS credits: 6

26. Number of ECTS credits allocated for contact hours: 3

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 3

26. Comments:

Approved:

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(date, Instructor's signature) (*date , the Director of the Faculty Unit signature)*