DZIEKAN
WYDZIAŁU ELEKTRONIKI WAT
prof. dr hab. inż. Marian WNUK

KARTA INFORMACYJNA PRZEDMIOTU

Nazwa:	Selected problems of dynamic systems theory /Wybrane zagadnienia systemów dynamicznych/	Selected problems of dynamic systems theory
Kod Erasmus:		
Język wykładowy:	English	
Strona WWW:		
Forma studiów:	Non-stationary	
Rodzaj studiów:	Second degree	
Rodzaj przedmiotu:	Obligatory	
Forma zajęć, liczba godzin/rygor:	L 20/+; L 6/z; T 4/z; Together: 30 (W 20/+; L 6/z; C 4/z; Razem: 30)	
Przedmioty wprowadzające:	Digital signal processing - Przetwarzanie sygnałów cyfrowych. Matlab programming	
Programy:	Semester II/Energetyka/Elektroenergetyka i Maszyny i urządzenia w energetyce	
Autor:	Prof. dr hab. inż. Stanisław Osowski	
Skrócony opis:	The subject introduces the basic notions of dynamic systems: state space and transfer function descriptions in continuous and discrete time, frequency characteristics, Bode plot, feedback systems, stability, margin of stability, chaotic systems, models of chosen dynamic devices used in power system, dynamic model of cooperating power systems.	
Pełny opis:	Wykłady /metody dydaktyczne: Wykład z podaniem informacji teoretycznych i analizą przykładów technicznych ilustrujących teorię systemów dynamicznych. Wykład z możliwym wykorzystaniem technik audiowizualnych; dyskusja; podanie zadań do samodzielnego rozwiązania i tematów do studiowania. Topics of the succeeding lectures (each topic corresponds to 2hours): 1. INTRODUCTORY NOTIONS OF DYNAMIC SYSTEMS Definition of dynamic systems, linear and nonlinear systems, continuous and discrete time systems, stationarity, deterministic and stochastic systems, chaotic systems, examples of chaotic systems. Description of dynamic systems in state space, linear approximation of nonlinear description 2. STATE SPACE DESCRIPTION OF LINEAR CONTINUOUS SYSTEMS Eigenvalues and eigenvectors, general form solution of state space equations. stability of dynamic systems, Lyapunov conditions of local and global stability. 3. DESCRIPTION OF CONTINUOUS TIME SYSTEMS IN COMPLEX FREQUENCY DOMAIN Laplace transformation, transfer function description of linear systems, impulse and step responses, frequency characteristics, different form descriptions of dynamic systems, second order systems and their characteristics. 4. STABILITY THEORY OF LINEAR COTINUOUS SYSTEMS Stability on the basis of transfer function, criteria of stability: Routh-Hurwitz criterion of linear time-invariant systems, Bode plots, margin of stability: gain margin and phase margin. Examples of margin determination. 5. FEEDBACK SYSTEMS Feedback structures, positive and negative feedback, Nyquist plot, stabilization of feedback systems, examples of feedback systems. **6.** DISCRETE TIME SYSTEMS	

	Descriptions of discrete systems: state space and transfer function Z-description, transformations between both descriptions, examples of transformations, FIR and IIR systems 7. STABILITY OF DISCRETE TIME SYSTEMS Stable transformations from continuous time to discrete time systems, BIBO stability, Lyapunov stability criteria of discrete time systems. 8. DYNAMIC MODELS OF ELECTRIC MACHINES Shunt and series DC machines, state space model of DC machines in Simulink. dynamic model of induction motor, Simulink implementation of the model. 9. DYNAMIC MACROMODEL OF POWER SYSTEM FOR FREQUENCY STABILIZATION Feedback structure for speed stabilization in power systems, cooperation of power systems, Simulink implementation of power macromodel, analysis of work at different loading conditions. 10. CHAOTIC SYSTEMS Definition of chaos, Lyapunov exponents, bifurcation, strange attractors, examples of chaotic systems. Ćwiczenia rachunkowe /metody dydaktyczne: : implementacja algorytmów modelowania systemów dynamicznych poprzez rozwiązywanie określonych zadań typu numerycznego. Topics of the succeeding tutorials (each topic corresponds to 2hours): 1) State space description of dynamic systems 2) Stability of continuous time and discrete time systems Ćwiczenia laboratoryjne/metody dydaktyczne: : implementacja algorytmów modelowania systemów dynamicznych przy uzyciu Simulinka, interpretacja wyników symulacji, organizacja badań i współdziałanie w grupie laboratoryjnej. Topics of the succeeding lab exercises (each topic corresponds to 2hours): 1) State space and transfer function descriptions of dynamic systems 2) Dynamic models of electrical machines 3) Dynamic model of the 2 cooperating power systems
Literatura:	**Basic**: ▪ D. Luenberger, Introduction to Dynamic Systems: Theory, Models, and Applications, Wiley, N.Y. 1979 ▪ S. Osowski: Modelowanie i symulacja układów i procesów dynamicznych. Warszawa 2006. **Complimentary**: ▪ Matlab user manual, Math Works, 2012
Efekty kształcenia:	W1 / Student acquires the deeper knowledge of the dynamic systems and processes occurring in the linear and nonlinear systems. K_W01 W2 / Student understands methods of analysis of performance of the dynamic systems in transient and steady states, including stability. He knows the computer tools to model the dynamic systems of technical nature. K_W07 U1 / Student knows how to use the professional literature, data base and other source to solve his own problems, he is able to integrate the knowledge coming from different sources and formulate his own conclusions. K_U01 U2 / Student knows how to prepare the documentation of his experiments, project. He is able to prepare report of these experiments and project. K_U03 K1 / Student is able to cooperate with other members of the group, performing different roles. K_K03

Metody i kryteria oceniania:	The subject is passed on the basis of final theoretical tests after taking into account the performance on the lab and the short introductory tests organized in the lectures. The final test checking the knowledge (W1, W2) and skill (U1, U2), is done in the written form. The final mark of the subject is done on the basis of the weighted average of the final written (1 hour) test assessed in points, points from the lab and the sum of points the student got from the short (5 minutes) tests organized in the lectures within the semester (U1, U2, W1, W2) Social competences are checked on the lab exercises and tutorials (K1). Scale of the marks: satisfactory (3) – student understands most of the topics presented in the lectures and is able to solve the simplest problems given in the final test connected with the contents of the lecture. good (4) – student knows and understands the topics considered in the lectures and is able to solve the most of problems given in the final test connected with the contents of the lecture. very good (5) – student knows and understands the topics considered in the lectures in an excellent way and is able to solve all problems given in the final test connected with the contents of the lecture. The marks 3.5 and 4.5 represent the intermediate levels between 3 and 4 and 4 and 5, respectively.
Bilans ECTS*) :	Commitment of student (in hours) 1. Lectures/20 2. Individual study of subject/7 3. Labs/6 4. Preparation to labs/7 5. Tutorials/4 6. Consultations/6 7. Preparation to exam/10 Total commitment of student: 60/2 ECTS Teacher commitment: 1.+3.+5.+6.=36/1 ECTS Practical exercises: 3.+5=10/0.5 ECTS
Praktyki zawodowe:	-

KIEROWNIK ZAKŁADU
Systemów Informacyjno-Pomiarowych
Instytutu Systemów Elektronicznych WEL
dr hab. inż. Marek KUCHTA

DYREKTOR
Instytutu Systemów Elektronicznych
Wydziału Elektroniki WAT
dr hab. inż. Jacek JAKUBOWSKI