SYLLABUS

1. Course title:

Nonlinear System Control

2. Code:

AR204

3. Cycle of study:

1

4. ECTS credits:

6

5. Type of course:

◉ Mandatory   ○ Elective

6. Prerequisites:

[AR103] Linear Automatic Control Systems I

7. Class restrictions:

8. Duration / semester:

1   6

9. Weekly contact hours:

9.1. Lectures: 3

9.2. Seminars: 1

9.3. Laboratory/Practice classes: 1

10. Faculty:

Faculty of Electrcial Engineering

11. Department/study program:

Electrcial Engineering and Computer Science

12. Lecturer:

PhD. Jakub Osmic, associate professor

13. Lecturer's e-mail:

jakub.osmic@untz.ba

14. Web site:

(max. 50 characters)

15. Course aims:

Introducing students with nonlinear phenomena and nonlinear elements of the control systems.
Overview, study and application of classical and advanced methods of analysis of nonlinear control systems.
Overview, study and application of classical and advanced synthesis methods for nonlinear control systems.

16. Learning outcomes:

At the end of the semester, successful students, who continued to perform their duties throughout the academic year, will be trained to:
• rule on techniques for modeling nonlinear systems
• rule on techniques for the linearization of nonlinear systems
• performs the analysis of nonlinear systems in the phase plane
• performs the analysis of nonlinear systems using Ljapunov's theory
• Performs analysis of nonlinear systems in the frequency domain using the concept of strictly positive real transfer functions, absolute stability, and describing function method
• performs the synthesis (design) of nonlinear systems and controllers.

17. Course content:

Introduction to Nonlinear Systems. Definition of state variables, state space and trajectory of the state of the nonlinear systems. Mathematical models of nonlinear systems. Nonlinear phenomena of dynamic systems. Typical nonlinear elements. Nonlinear systems of second order. Analysis of nonlinear systems in the phase plane. Method of isoclines. The basics of Lyapunov's theory. Stability concept. Asymptotic stability, exponential stability. Linearization and local stability. The first (indirect) method of Ljapunov. The second (direct) method of Lyapunov. Analysis of nonlinear systems in the frequency domain. Concept of passivity. Positive real transfer functions. Absolute stability concept. Method of describing function. Nonlinear system control. Sliding mode control. On-Off control. Feedback linearization. Gain scheduling. Adaptive systems. Auto tuning controllers.

18. Learning methods:

The following learning methods are planned:
-lectures
-auditory exercises
-laboratory exercises
-seminar papers / project assignments
-educational visits to firms that use nonlinear control systems.

19. Assessment methods:

At the half of the semester, students hold a colloquium that consists of lecture questions (theories) that were held in the first part of the semester. In addition, at half of the semester, students also have a colloquium that consists of tasks related to the analysis of nonlinear systems. The duration of both exams is two school hours. Both colloquiums are hold in writing. For each of the two exams, students can achieve a maximum of 100 points each with the weighted factor of ¼. Students on both mentioned parts must have at least 54 points. At the beginning of the second part of the semester, students receive seminar assignments that are required to be completed by the end of the semester. Seminar papers are evaluated with a maximum of 100 with the weight factor of seminar papers 15/100. The minimum number of points students have to complete on seminar papers is 54 points. In addition to this, after each laboratory exercise, students are required to submit a report on the results of laboratory exercises on the next laboratory exercises. At the final exam, students can achieve a maximum of 100 points and the weight factor of the final exam is 1/4. The minimum number of points that students have to complete on the final exam is 54. On the final exam, students answer the questions asked in a written from at duration of one school hour, then answer the questions verbally. The questions concern the analysis of nonlinear systems and the synthesis of nonlinear system controllers. For student activity, students can earn up to 5 points. Also, for the presence of lectures students can achieve a maximum of 5 points.

20. Assessment components:

Students cumulatively on the exam can achieve 100 points.

For pre-exam activities, students can achieve a maximum of 75 points

The first colloquium theory:

54-100 points, weight factor ¼

The first colloquial tasks

54-100 points, weight factor ¼

Seminar work: 54-100 points, weight factor 15/100

Activity in lectures: 5 points, weight factor 1

Attendance: 5 points, weight factor 1

Final Exam: 54 - 100 points, weight factor ¼.

21. Required reading list:

J. J. E. Slotine, W. Li, "Aplied nonlinear control", Prentice Hall, New Jersey, 1991.

H. K. Khalil, "Nonlinear systems", third edition, Prentice- Hall, New Jersey, 2002.

J. Osmić, N. Prljača, Z. Šehić, "Automatsko upravljanje I, zbirka riješenih zad

22. Web sources:

(max. 687 characters)

23. Applicable starting from the academic year:

2016/2017

24. Adopted in the Faculty/Academy session:

04.04.2016