University POLITEHNICA of Bucharest
Faculty of Engineering in Foreign Languages
Department/Chair German

# SUBJECT IDENTIFICATION

## 1. SUBJECT TITLE

Subject title: **Control System Theory II**
Tenured Professor: **prof.dr.ing. Sergiu Stelian ILIESCU**
Type: **training specialist**
Number of course hours: **28** hrs
Number of application hours : **14** hrs
Number of credit points: **3** PC
Semester: **8**
Package : **curricular area specialist**

Prerequisites: attending and / or promoting the following subjects:
**Maths, Physics, Electrotechnics, Mechanics, Control System Theory I.**

## 2. OBJECTIVES OF SUBJECT

- for courses:

The main objective is to continue deepening the fundamentals from Control System Theory I in time and frequency analysis. New aspects and mathematical approaches are revealed by the means of state space domain. Also, nonlinear systems analysis and synthesis methods are developed in the frequency domain and in the state-space. Fuzzy systems, neural and genetic systems are also studied to provide the student with a modern advanced view of systems theory.

- for applications:

Simulation, modeling and testing of nonlinear systems are meant to develop within dedicated environment like or using analog or digital equipments available in the special platform oriented lab.

## 3. SPECIFIC COMPETENCIES
**(within the competence range of the academic training programme)**

- developing systemic methods for theoretical and practical study of industrial process control with nonlinear models
- abilities and knowledge regarding simulation languages and dedicated control software on existing equipments, including fuzzy and neuro-genetics
- practical skills in building complex automatic control systems, containing both linear and nonlinear components

## 4. SYLLABUS ( 1 page )

### a. Course:

| Chapter | Contents | Nr. Hours |
|---|---|---|
| | **Part I: Linear Systems** | |
| 1. | Introduction. Linear models. | 1 |
| 2. | Linear systems. Root locus method | 3 |
| 3. | Linear systems. State space.<br>3.1 State space representation of linear systems<br>3.2 Time domain analysis within state space<br>3.3 Controlability. Observability<br>3.4 Transfer function and state space representation<br>3.5 Controller design | 8 |
| | **Part II: Nonlinear systems** | |
| 4. | Nonlinear systems.<br>4.1 Introduction.<br>4.2 Continuous and discontinuous nonlinearities. Linearization<br>4.3 Describing function<br>4.4 Stability<br>4.5 Building structures of nonlinear systems. Analysis and design methodologies | 5 |
| | **Part III: Inteligent control systems** | |
| 5. | Fuzzy systems<br>5.1 Introduction<br>5.2 Fuzzy logic basics. Basic rules in fuzzy logic<br>5.3 Fuzzy systems<br>5.4 Fuzzy control | 4 |
| 6. | Neural Networks<br>6.1 Introduction<br>6.2 Neural networks basics<br>6.3 Multilayer structures. The Perceptron<br>6.4 Neural networks control | 4 |
| 7. | Evolutionary algorithms<br>7.1 Evolutionary strategies. Examples<br>7.2 Genetic algorithms. Examples | 3 |
| | | **Total: 28** |

### b. Applications:

| | | |
|---|---|---|
| i. | SISO, MIMO representations. Analysis of control systems | 2 |
| ii. | Root locus | 2 |
| iii. | State-space representation | 4 |
| iv. | Controlability and observability | 2 |
| v. | Genetic algorithms. Evolutionary strategies in optimization techniques | 2 |
| vi. | Nonlinear systems. Fuzzy systems. Neural networks. | 2 |
| | | **Total: 14** |

## 5. ASSESSMENT

a) Activities assessed and their weighting :(according to the Graduating Regulations)

60% - class activity; 40% - exam.

b) Minimum passing requirements:
   - submission of homework / project assignments;
   - submission of solutions to given tasks
   - passing laboratory work;
   - scoring 50% out of total;
   - scoring 50% out of the final evaluation task;

## 6. BENCHMARKING ( presentation style, materials etc.)

Course lectures are interactively presented by means of Power Point slides as well as simulation platforms. Internet and CD hosting of presentation, curriculum and benchmarking. Lecture notes and lab sessions are printed, full availability in university library and on site.

## 7. BIBLIOGRAPHY


- Isermann, R. - Regelungstechnik I, Einfűhrung in Skriptform, Shaker Verlag, Aachen 2002.
- Isermann, R. – Ergänzungen zu Regelungstechnik I, Skript zur Vorlesung, TU Darmstadt, 2002
- Föllinger, O – Regelungstechnik, Hűthig, 1994
- Adamy, J. - Regelungstechnik II, Teil II: Nichtliniare Systeme, Skript zur Vorlesung, TU Darmstadt 1999.
- Adamy, J. - Regelungstechnik II, Teil I: Liniare Systeme, Skript zur Vorlesung, TU Darmstadt 2000.
- Adamy, J. – Fuzzy Logic, Neuronale Netze und Evolutionäre Algorithmen, Skript zur Vorlesung, TUD, Darmstadt 2002.
- Unbehauen, H. - Regelungstechnik I, Vieweg Verlag, 1992.
- Soare, C, Iliescu,St.,S., Fagarasan Ioana, Tudor, V., Niculescu F. Oana – Proiectarea asistata de calculator. Modelarea si simularea proceselor, Ed.AGIR, Bucuresti 2006.
- Soare, C, Iliescu,St.,S., Fagarasan Ioana, Tudor, V., Dragomir Otilia, Dragomir F. Proiectarea asistata de calculator. Conducerea avansata a proceselor, Ed.AGIR, Bucuresti 2006.


**HEAD OF DEPARTMENT / CHAIR** **TENURED PROFESSOR**

**Prof.dr.ing. Sergiu Stelian ILIESCU**