COURSE OUTLINE

1. GENERAL

SCHOOL	ENVIRONMENT AND AGRICULTURAL ENGINEERING		
ACADEMIC UNIT	NATURAL RESOURCES DEVELOPMENT & AGRICULTURAL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**217**	**SEMESTER**	**8th**
COURSE TITLE	AUTOMATIC PROCESS CONTROL		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
LECTURES	3	3
LABORATORY EXERCISES	1	1
TOTAL	4	4
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	SPECIALISED GENERAL KNOWLEDGE
PREREQUISITE COURSES:	• MATHEMATICS I • MATHEMATICS II • MEASUREMENTS AND SENSORS
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	To be constructed

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, the student(s) will:

- Have understood the methods for computation and analysis of the dynamic behavior of natural systems and processes, including basic concepts such as stability, transfer function, and frequency response.
- Be able to use and simplify block diagrams.
- Have understood the philosophy of state-space based control system design methods based on the mathematical model of the process dynamics.
- Have understood the concepts of controllability and observability, as well as their significance in

state feedback and state estimation.
- Be able to compute state feedback gains and observer gains for given eigenvalue specifications.
- Be able to check the stability of systems.
- Be knowledgeable in constructing and interpreting Nyquist and Bode diagrams and root locus plots.
- Understand the importance of the three control actions (proportional, integral, derivative).
- Can apply optimal parameter selection methods for PID controllers.
- Can distinguish the relationship between the mathematical description and the dynamic response characteristics of a physical system.
- Can calculate the dynamic response of processes in open or closed loops.
- Can design control systems based on the mathematical model of the process.
- Has the ability to use computational tools (such as MATLAB, etc.) for dynamic calculations and control system design.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Applying theoretical knowledge in practice
Working independently
Teamwork
Working in an interdisciplinary environment
Decision-making
Production of free, creative, and inductive thinking

3. SYLLABUS

Fundamental concepts. Signals and systems. Purpose of control and benefits of its application to systems and processes. Review of basic mathematical tools. Principles of mathematical modeling. Macroscopic process patterns. Dynamic behavior of typical processes. First-order systems. Connections of first-order systems. Second and higher order systems. Systems with time delay. Mathematical methods of dynamic system analysis. Analysis of linear systems in the state space. State-space representation of linear systems and calculation of response using the exponential matrix method. State variable transformations. Input/output behavior in the time domain. Serial and parallel connection of linear systems under state-space representation. State feedback and output feedback: State-space representation of the closed-loop system. Controllability and observability of systems. State feedback, selection of gains for predesigned closed-loop eigenvalues. State estimation and state observers. Asymptotic stability of linear systems. Solution of linear differential equations using the Laplace transformation method. Transfer function. Poles and zeros positioning. Stability of input/output. Calculation of frequency response. Bode diagrams. Linearization of nonlinear dynamic systems. Local asymptotic stability. The first Lyapunov method. Control systems with feedback. Measuring instruments. Elements of final control. Controllers with proportional, integral, and/or derivative action (PID). Control system block diagrams. Block diagram reduction. Closed-loop transfer functions. State-space representation of closed-loop systems. Analysis and design of control systems.

Steady-state error - significance of integral action. Sensitivity function. Closed-loop stability analysis. Algebraic stability criteria. Routh-Hurwitz stability criterion. Graphical stability criteria. Nyquist diagram. Nyquist stability criterion. Bode stability criterion. Gain and phase margins. Root locus diagram. Computation of performance criteria for regulatory systems and optimization.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching Laboratory education Communication with students
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	See table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	1. Written Examination (Conclusion on Theory): 100% 2. Technical laboratory reports: 40%. 3. Oral Examination in laboratory environment: 60%.

Activity	*Semester workload*
Lectures	90
Laboratory practice	30
Course total	***120***

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:

1. Automatic Control Systems, Pantelis Malatestas, TZIOLA Publications, Thessaloniki 2011.
2. Automatic Control Systems, B. Kuo and F. Golnaraghi, Stella Parikou and Co. Publications, Athens, 2010.
3. R. C. Dorf and R. H. Bishop, "Modern Control Systems", Tziola, 2003.
4. P. Dautidis, S. Mastrogeorgopoulos, S. Papadopoulou, "Process Control", Tziola, 2012.

5. Laboratory Exercises Brochure.