COURSE OUTLINE: APPLIED DIGITAL CONTROL

1. GENERAL

SCHOOL	Engineering		
DEPARTMENT	Electrical and Computer Engineering		
LEVEL OF STUDY	Undergraduate		
COURSE UNIT CODE	9.009	**SEMESTER**	9th
COURSE TITLE	**Applied Digital Control**		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory (Lectures)	3	3
Tutorial/Exercises	1	0.5
Laboratory	1	1.5
TOTAL	**5**	**5**

COURSE UNIT TYPE	Specialized knowledge/Skills development
PREREQUISITES	6.003 – Automatic Control Systems I
LANGUAGE OF INSTRUCTION/EXAMS	Greek
COURSE DELIVERED TO ERASMUS STUDENTS	No
WEB PAGE (URL)	https://eclass.hmu.gr/courses/ECE191/

2. LEARNING OUTCOMES

Learning Outcomes

- Learning and comprehending the basic principles and methodologies for the analysis and design of digital control systems.
- Learning and understanding the architecture, characteristics, integrated peripheral interfaces, and programming of microcontrollers.
- Acquiring the ability to synthesize the above knowledge for the practical implementation of integrated digital control systems.

General Skills

The study and successful completion of the course contribute to the development of general skills related to:

- Research, analysis, and synthesis of data and information, utilizing necessary technologies.
- Promotion of free, creative, and inductive thinking.
- Bridging theoretical knowledge with practical skills.
- Adaptability to new situations.
- Decision-making.

3. SYLLABUS

Theoretical lectures

- **Digital Control Systems:**
  Discrete signals, analog signal sampling, Z-transform and difference equations, discrete-time transfer functions, discrete-time state equations, discretization of analog systems and controllers, digital controller design, state observers.

- **Microcontroller-based Control Systems:**
  Architecture, input/output units, timer units, interfacing and control of external devices, interrupts characteristics and management, communication systems and protocols, programming in the C language.

- **Practical Implementation of Digital Control Systems:**
  Selection of technologies and implementation parameters for digital controllers, Real-time system programming.

Laboratory exercises

Familiarization with programming in the C language for 8-bit microcontrollers of the AVR family by Atmel/Microchip.

- Introduction to the programming environment – digital ports – basic peripheral interfacing.
- Interrupt mechanism - external interrupts.
- Timers/counters and automated waveform generation.
- A/D converter.
- Serial communication protocols.
- Design and implementation of digital controllers for servomechanisms.

Final Project

During the 9th week of the course, students undertake the completion of a final project, working in groups of 2-3 individuals. The project involves the study, design, practical implementation, and evaluation of an integrated digital control system for a real setup. The submission of the project is at the end of the semester, along with a detailed report and all accompanying documentation files. The evaluation of the project is based on the submitted files, as well as a presentation made in front of all students.

4. TEACHING METHODS - ASSESSMENT

<table>
<tr><td>MODE OF DELIVERY</td><td>In-Class Face-to-Face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td><td>▪ Use of ICTs in lecturing
▪ Use of ICTs in laboratory sessions
▪ Use of ICTs for the communication with students via the e-class platform</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Method description/Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Laboratory sessions</td><td>13</td></tr>
<tr><td>Final project preparation</td><td>48</td></tr>
<tr><td>Non-guided personal study</td><td>50</td></tr>
<tr><td>Total Hours</td><td>150</td></tr>
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<tr><td>ASSESSMENT METHODS</td><td>All announcements for the course regulations and complementary reading material are posted on the course web page. The course grade incorporates the following evaluation procedures:

1. Mid-term exam (15%)
2. Final Project evaluation (65 %)
3. Final written evaluation (20 %)</td></tr>
</table>

5. RECOMMENDED BIBLIOGRAPHY

-Recommended Bibliography:

- K. Ogata*, Discrete Time Control Systems*, Prentice Hall.
- B.C. Kuo, *Digital Control Systems*, Oxford University Press.
- J.B. Bridgett, *Digital Control Engineering with Micro-controllers*, Springer, 1998.
- R. Barnett & S. Cox, *Embedded C Programming and the Atmel AVR*, Cengage Learning, 2006.
- T. Wescott, *Applied Control Theory for Embedded Systems*, Newnes, 2006.
- Lecture notes.

Relevant Scientific Journals:

- Control Engineering Practice
- IEEE Control Systems Magazine