COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Digital Industry Technologies		
LEVEL OF STUDIES	Postgraduate (MSc on Robotics and Industrial Control)		
COURSE CODE	**009**	**SEMESTER**	3rd
COURSE TITLE	Data Driven Industrial 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		8
Total	3		8
COURSE TYPE *special background, specialised general knowledge, skills development*	Specialization Course		
PREREQUISITE COURSES:	---		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and/or English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, under conditions		
COURSE WEBSITE (URL)	https://ric-en.dind.uoa.gr/el/studies/curriculum/3rd_semester/data_driven_industrial_control/		

(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*

Aim of the course is to familiarize students with the design and implementation of data driven controllers and observers. Moreover, aim of the course is to familiarize students with the equipment required to apply these systems to industrial processes and manufacturing units.

Upon successful completion of the course, the student will be able to:

• Understand the inherent differences between data-driven controllers and model-based controllers for industrial processes and manufacturing units.

• Understand the design mechanisms of data-driven controllers.

• Implement data-driven controllers, with emphasis on issues concerning sensors, IoT connections and devices for data storage and processing.

• Develop and apply machine learning tools, with emphasis on industrial process identification.

• Design and implement adaptive controllers and observers, as well as software sensors, for industrial processes and manufacturing units.

• Design and implement safe-switching controllers and observers for industrial systems and subsystems.

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, Project planning and management Respect for difference and

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

(3) SYLLABUS

Model-based vs data-driven controller design. Data Collection: Sensors and IoT Devices, Big Data Infrastructure, Data storage and processing. Data Analysis and Machine learning algorithms. Data driven methods for Process Modelling. Mixed-logical models. Adaptive controller design. Data driven Intelligent controllers. Soft sensors. Iterative feedback controller tuning. Norm based controllers. Data driven switching controller and observer schemes. Data-driven modeling and control of large-scale systems. Application of data driven modeling and control schemes to robotic systems and processes. Data driven control simulation.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face, Synchronous and Asynchronous distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Supporting the learning process through • use of an electronic platform for interactive two-way communication and participation, • use of an electronic classroom platform for providing educational material, discussions, announcements, assignments, • e-mail communication, • use of projectors during lectures • use of software packages for simulation development • use of software packages that facilitate the implementation of data driven controllers • use of software packages to collect and exchange data among industrial subsystems
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*	
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*	The evaluation of postgraduate students and their performance in the course takes place at the end of each semester with written or oral examinations or assignments throughout the semester or can be based on intermediate progress exams, written assignments, laboratory exercises or a combination of all the above. The method of evaluation is defined by the instructor of the course and announced to the students. The language for written and oral examinations is the same with that used for teaching. The

Activity	***Semester Workload***
Lectures	39
Literature study & analysis	70
Project / Essay writing	91
Course Total	200

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	assignments essays may be written in Greek and/or English language. When conducting written or oral examinations as assessment methods, the integrity of the procedure must be ensured. Scoring is done on a scale of 0-10. The results of the examinations are announced by the instructor and sent to the Secretariat of the Postgraduate Program within four weeks at the latest from the examination of the course. The participation rate of exercises, assignments, etc. The final grade of the course is determined by the course instructor and announced to students at the beginning of the semester. Alternative assessment methods may be applied, such as the conduct of written or oral examinations using electronic means, provided that the integrity of the evaluation process is ensured and the provisions of the relevant regulations of the MSc are met. Alternative methods may also be applied for the assessment of students with disabilities and special educational needs following a decision of the Board of Directors and the recommendation of the head of the Department for Disabled Persons and taking into account the relevant instructions of the Accessibility Unit for Students with Disabilities.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. A. Khaki-Sedigh, An Introduction to Data-Driven Control Systems, Wiley, 2023.
2. A. S. Bazanella, L. Campestrini and D. Eckhard, Data-Driven Controller Design: The H2 Approach, Springer Netherlands, 2011.
3. Gerardus Blokdyk, Data Driven Control System A Complete Guide, Emereo Pty Limited, 2020.
4. R.-E. Precup, R.-C. Roman and A. Safaei, Data-Driven Model-Free Controllers, CRC Press, 2021.
5. J. Wang, R. A. Ramírez-Mendoza and R. Morales-Menéndez, Data Driven Strategies: Theory and Applications, CRC Press, 2023.
6. C. Novara and S. Formentin (eds), Data-Driven Modeling, Filtering and Control: Methods and Applications, Institution of Engineering and Technology, 2019.
7. S. X. Ding, Data-driven Design of Fault Diagnosis and Fault-tolerant Control Systems, Springer London, 2014.
8. B. Huang and R. Kadali, Dynamic Modeling, Predictive Control and Performance Monitoring: A Data-driven Subspace Approach, Springer, 2008.
9. S. L. Brunton and J. N. Kutz, Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control, Cambridge University Press, 2022.
10. M. Stefanovic and M. G. Safonov, Safe Adaptive Control: Data-driven Stability Analysis and Robust Synthesis, Springer, 2011.

- Relative academic journals:

1. Transactions on Industrial Informatics, Institute of Electrical and Electronics Engineers.
2. Transactions on Automation Science and Engineering, Institute of Electrical and Electronics Engineers.
3. Transactions on Automatic Control, Institute of Electrical and Electronics Engineers.
4. Transactions on Control Systems Technology, Institute of Electrical and Electronics Engineers.
5. Transactions on Systems, Man, and Cybernetics: Systems, Institute of Electrical and Electronics Engineers.
6. Automatica, International Federation of Automatic Control, Elsevier.
7. Systems and Control Letters, Elsevier.
8. Journal of Process Control, International Federation of Automatic Control, Elsevier.
9. Journal of the Franklin Institute, Elsevier.
10. International Journal of Systems Science, Taylor and Francis.