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	**012**	**SEMESTER**	3rd
COURSE TITLE	Pollution Control Systems in Industry		
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		7
Total	3		7
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.dind.uoa.gr/programma/mathimata/g_examino/systimata_elegchoy_rypansis_sti_biomichania/		

(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 introduce students to:

a) The basic pollutants emitted by industrial and other production units,

b) Issues related to sustainable industrial growth,

c) Pollution control measures, and

d) Legal frameworks and environmental regulations.

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

• Understand regulations for environmental protection against pollution-generating industrial activities.

• Categorize industrial pollutants (gaseous, liquid waste, solid waste, hazardous waste) with respect to the methods of their treatment.

• Analyze constraints and quality indices, imposed by environmental legislation.

• Analyze the correlation among estate planning, waste management, and industrial activity.

• Analyze and apply tools that minimize pollutants, through recycling, reuse, and recovery of valuable materials.

• Understand the basic physical, chemical, and biological processes for treating industrial waste, as they apply for solid, liquid, and gaseous pollutants.

• Model industrial pollution control systems.

• Design and implement controllers, regulating industrial systems towards minimization of industrial pollutants

• Analyze the correlation among environmental standards satisfaction, performance, and operational costs of production units. • Design and implement decision support systems for industrial waste management. • Analyze the operation of robotic cleaning systems. • Integrate all above methods and techniques to study and apply anti-pollution technologies in industrial and other production processes.
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* *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* *Project planning and management Respect for difference and 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

Wastes from different production sectors. Industrial Symbiosis and Estate Planning. Effluent/emission trading. Pollution prevention and Waste minimization by reuse and recovery, life cycle impacts and management strategies. Industrial wastewater treatment processes: Wastewater characteristics and regulations. Physical/Chemical / Biological methods of industrial wastewater treatment. Primary, secondary, and tertiary processing. Modelling of wastewater treatment processes. Advanced control techniques for effluent regulation. Robust and data driven control approaches. Supervisory control. Data acquisition systems and soft sensors. Industrial solid wastes: Classification, Economics, Recycling. Robotic applications in solid waste management. Robotic vision-based waste sorting. Combustion Control of Refuse-derived fuel (RDF) Modelling and Control of pyrolysis systems, incineration systems and gasification systems. Technologies and Decision Support Systems for solid waste management. Air pollution: Main atmospheric pollutants and transformations, Transport and Dispersion of air pollutants, Industrial Emission Reduction, Modelling and Control. Control equipment for particulate matter and gaseous pollutant. Hazardous waste cleaning robots.

(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 for simulation and implementation of pollution control systems • use of software packages to collect and exchange data among subsystems
TEACHING METHODS *The manner and methods of teaching are described in detail.*	

Activity	*Semester Workload*
Lectures	39

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*	<table><tr><td>Literature study & analysis</td><td>60</td></tr><tr><td>Project / Essay writing</td><td>76</td></tr><tr><td>Course Total</td><td>175</td></tr></table>
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.*	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 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. Ν. Μουσιόπουλος, Λ. Ντζιαχρήστος και Θ. Σλίνη, Τεχνική Προστασίας Περιβάλλοντος – Αρχές Αειφορίας, Ελληνικά Ακαδημαϊκά Ηλεκτρονικά Συγγράμματα και Βοηθήματα - Αποθετήριο "Κάλλιππος", 2015.
2. Α. Κούγκολος, Περιβαλλοντική Μηχανική: Ρύπανση και Προστασία Περιβάλλοντος, Εκδόσεις Τζιόλα & Υιοί ΑΕ, 2021.
3. Χ. Τράκας, G. Haberle, M. Harterich, R. Gscheidle και Π. Ανδρεάδης, Περιβαλλοντική Διαχείριση: Υγιεινή και Ασφάλεια Εργαζομένου, Μαρία Παρίκου & Σία ΕΠΕ, 2017.
4. Ε. Νταρακάς, Μ. Πεταλά και Β. Τσιρίδης, Περιβαλλοντική Χημεία και Μηχανική, Εκδόσεις Τζιόλα & Υιοί ΑΕ, 2019.
5. Δ. Κομίλης, Διαχείριση και Μηχανική Στερεών Αποβλήτων, Εκδόσεις Τζιόλα & Υιοί ΑΕ, 2021.
6. Ε. Γιδαράκος και Μ. Αϊβαλιώτη, Επικίνδυνα Απόβλητα: Διαχείριση - Επεξεργασία - Διάθεση, Εκδόσεις Πολυτεχνείου Κρήτης, 2021.
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9. Β. Χ. Γκέκας, Ε. Σ. Κατσιβέλα και Ν. Ε. Φραντζεσκάκη, Τεχνολογίες επεξεργασίας τοξικών και επικίνδυνων απόβλητων, Εκδόσεις Τζιόλα & Υιοί ΑΕ, 202.
10. A. Singh, M. Agrawal και S. B. Agrawal (eds), Water Pollution and Management Practices, Springer Singapore, 2021.
11. C. David Cooper και F. C. Alley, Air Pollution Control: A Design Approach, Waveland Press Inc, 2011.
12. C. Takahashi, M. Giuliani, B. Lennox, W. R. Hamel, R. Stolkin και C. Semini (eds), Robotics in Extreme Environments, Frontiers Research Topics, 2021.
13. F. R. Spellman, The Science of Environmental Pollution, CRC Press, 2021.
14. G. Chen, M. C. M. van Loosdrecht, G. A. Ekama and D. Brdjanovic, Biological Wastewater Treatment: Principles, Modeling and Design, IWA Publishing, 2020.
15. G. Venkatesan and J. Thirumal, Global Perspectives on Air Pollution Prevention and Control System Design, IGI Global, 2019.
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20. S. P. Singh, K. Rathinam, T. Gupta and A. K. Agarwal (eds), Pollution Control Technologies: Current Status and Future Prospects, 2021.
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25. Z. Zhang, A. Núñez-Delgado και W. Zhang, Gas (eds), Water and Solid Waste Treatment Technology, MDPI, 2021.

- Relative academic journals:

1. Journal of Industrial Pollution and Toxicity, Annex Publishers.
2. Journal of Environmental Pollution and Control, Annex Publishers.

3. Environmental Pollution, Elsevier.
4. Marine Pollution Bulletin, Elsevier.
5. Environmental Research, Elsevier.
6. Process Safety and Environmental Protection, Elsevier.
7. Atmospheric Pollution Research, Elsevier.
8. Hygiene and Environmental Health Advances, Elsevier.
9. International Journal of Hygiene and Environmental Health, Urban und Fischer Verlag Jena.
10. Journal of Hazardous Materials Advances, Elsevier.
11. Journal of Environmental Chemical Engineering, Elsevier.
12. Cleaner Chemical Engineering, Elsevier.
13. International Journal of Water and Wastewater Treatment, SciForschen.
14. Journal of Water Process Engineer, Elsevier.
15. Control Engineering Practice, International Federation of Automatic Control, Elsevier
16. IFAC Journal of Systems and Control, Elsevier
17. ISA Transactions