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	**005**	**SEMESTER**	2nd
COURSE TITLE	Autonomous Robotic Vehicles		
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/2nd_semester/autonomous_robotic_vehicles/		

(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 specific characteristics and applications of autonomous robotic vehicles of all categories, including the automatic control and trajectory design tools contributing to vehicles' autonomy. Upon successful completion of the course, students will be able to:

• Determine the dynamic characteristics of the main categories of autonomous robotic vehicles (Autonomous Robotic Vehicles (ARVs), Unmanned Aerial Vehicles (UAVs), Unmanned Ground Vehicles (UGVs), Unmanned Marine Vehicles (UMVs),

• Understand the principles, concepts, and the system characteristics, being related to the kinematic and dynamic analysis of autonomous robotic vehicles.

• Understand the principles of operation of specific sensors and actuators used in autonomous robotic vehicles.

• Understand and apply appropriate tools for the estimation of the position, the velocity, the orientation, and the trajectory estimation for autonomous robotic vehicles.

• Design and apply appropriate tools, tuning the performance variables of autonomous robotic vehicles.

• Understand and apply appropriate tools for navigation and control of autonomous robotic vehicles using artificial intelligence and discrete event system methods.

• Understand the operational characteristics of software packages used in the supervision of autonomous robotic vehicles.

• Utilize the above knowledge to implement integrated applications of autonomous robotic vehicles.
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

Types of Autonomous Robotic Vehicles (ARVs): Unmanned Aerial Vehicles (UAVs), Unmanned Ground Vehicles (UGVs), Unmanned Surface Vehicles (USVs) and Unmanned Underwater Vehicles (UUVs). Kinematics and dynamics of ARVs. Sensors and actuators of ARVs. Autonomous Navigation: position and course estimation, path planning techniques, Map representation. Control techniques for autonomous motion. AI and DES based methods for autonomous robotic vehicle navigation and Control. Autonomous robotic vehicle operation in unstructured environments. Robotic vehicle applications. Embedded and supervision software.

(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 robotic operating systems
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*	

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

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,*	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

laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	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. I. J. Cox and G. T. Wilfong (eds), Autonomous Robot Vehicles, Gordon T. Wilfong, Ingemar J. Cox, 1990.
2. T. S. Ng, Robotic Vehicles: Systems and Technology, Springer Nature Singapore, 2021
3. G. Rigatos and K. Busawon, Robotic Manipulators and Vehicles: Control, Estimation and Filtering, Springer International Publishing, 2018.
4. S. S. Ge and F. L. Lewis (eds), Autonomous Mobile Robots: Sensing, Control, Decision Making and Applications, CRC Press, 2018.
5. K. Nonami, F. Kendoul, S. Suzuki, W. Wang and D. Nakazawa, Autonomous Flying Robots: Unmanned Aerial Vehicles and Micro Aerial Vehicles, Springer Japan, 2010.
6. D. Driankov and A. Saffiotti (eds), Fuzzy Logic Techniques for Autonomous Vehicle Navigation, Physica-Verlag HD, 2013.
7. J. Yuh, T. Ura and G. A. Bekey, Underwater robots, Springer US, 2012.
8. D. Galar, U. Kumar and D. Seneviratne, Robots, Drones, UAVs and UGVs for Operation and Maintenance, CRC Press, 2020.
9. P. G. Fahlstrom, T. J. Gleason and M. H. Sadraey, Introduction to UAV Systems, Wiley, 2022.
10. P. K. Garg, Unmanned Aerial Vehicles: An Introduction, Mercury Learning and Information, 2021.
11. K. Namuduri, S. Chaumette, J. H. Kim, J. P. G. Sterbenz (eds), UAV Networks and Communications, Cambridge University Press, 2018.
12. M. H. Sadraey, Design of Unmanned Aerial Systems, Wiley, 2020.
13. G. Griffiths (ed), Technology and Applications of Autonomous Underwater Vehicles, Taylor & Francis, 2002.
14. G. M. Roman (ed), Underwater Vehicles: Design and Applications, Nova Science Publishers Inc, 2020.
15. S. A. Wadoo and P. Kachroo, Autonomous Underwater Vehicles: Modeling, Control Design and Simulation, CRC Press, 2017.
16. J. Yan, X. Yang, H. Zhao, X. Luo and X. Guan, Autonomous Underwater Vehicles: Localization, Tracking, and Formation, Springer Nature Singapore, 2021.
17. G. N. Roberts and R. Sutton (eds), Advances in Unmanned Marine Vehicles, Institution of Engineering and Technology, 2006.

- Relative academic journals:

1. Annual Review of Control, Robotics, and Autonomous Systems, Annual Reviews
2. Autonomous Robots, Springer
3. Frontiers in Robotics and AI, Frontiers.
4. International Journal of Connected and Automated Vehicles, SAE International
5. Journal of Autonomous Vehicles and Systems, ASME
6. Journal of Field Robotics, Wiley.
7. Journal of Intelligent & Robotic Systems, Springer.
8. Journal of Intelligent and Connected Vehicles, Emerald
9. Robotics and Automation Letters, Institute of Electrical and Electronics Engineers.
10. Transactions on Robotics, Institute of Electrical and Electronics Engineers.
11. Robotics and Automation Magazine, Institute of Electrical and Electronics Engineers.
12. Robotics and Autonomous Systems, Elsevier.
13. Transactions on Autonomous and Adaptive Systems, Association for Computing Machinery