AEEE414 - Robotics

Course Title	Robotics				
Course Code	AEEE414				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	4 / 1				
Teacher's Name	Dr Giorgos Demetriou / Prof. Christos Themistos				
ECTS	3	Lectures / week		Laboratories/week	
Course Purpose	The aim of the course is to familiarize the students with the concepts and the principles of robot arm manipulators and mobile robots. The course starts by presenting the kinematics and transformations for robotic manipulators and then it concentrates more on mobile robots. It presents the techniques and technology that enable mobility in a series of interacting modules. Each chapter covers a different aspect of mobility, as the course moves from low-level to high-level details. The first two chapters examine the robots' locomotion and principles of kinematics. This is followed by an in-depth view of perception, including descriptions of many "off-the-shelf" sensors and an analysis of the interpretation of sensed data. The final two chapters consider the higher-level challenges of localization and cognition, localization strategies, autonomous mapping, and navigation competence.				
Learning Outcomes	By the end of the course, students must be able to: 1. Review matrix transformation techniques in terms of reference and body attached coordinate frames. Classify by coordinate system and by Control Method, Robotic Applications (Welding, spray, parts handing and transfer, assembly operations, parts sorting, parts inspection etc.) 2. Understand the kinematics and dynamics of a robot arm manipulator. Familiarise with coordinate matrix transformation, link-joint parameters and Lagrange Polynomial theory to estimate the kinematics and dynamics of a robot arm manipulator. 3. Understand the basics of mobile robot locomotion. 4. Understand the principles of mobile robot kinematics. 5. Understand the principle of perception and have a good understanding of sensors (i.e. Vision, Laser, Sonar, encoders, etc.). 6. Understand localization, mapping, planning and navigation for robotic systems. 7. Familiarize with mobile robot programming and apply mapping, localization, planning and navigation techniques.				
Prerequisites	None		Corequisites	None	

Course Content	• **Robotics Manipulator classification**: Classification by robotic manipulators. • **Kinematics and Dynamics of Robotic Manipulators:** Coordinate transformations, Homogeneous Transformation Matrices, Link-Joint Parameters, DH Transformation Matrices, Locomotion principles • **Locomotion of mobile robots.** • **Mobile Robot Kinematics.** • **Perception for mobile robots.** • **Mobile Robot Localization.** • **Planning and Navigation for mobile robots.** • **Project**: Students in groups, develop and program mobile robots out of of-the-shelf parts (controllers, wheels, motor controllers, motors, etc).
Teaching Methodology	Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of traditional tools or using computer demonstration. Auditory exercises, where examples regarding matter represented at the lectures, are solved and further, questions related to particular open-ended topic issues are compiled by the students and answered, during the lecture or assigned as homework. Topic notes are compiled by students, during the lecture which serve to cover the main issues under consideration and can also be downloaded from the e-learning platform or the lecturer's webpage. Students are also advised to use the subject's textbook or reference books for further reading and practice in solving related exercises. Tutorial problems are also submitted as homework and these are solved during lectures or privately during lecturer's office hours. Furthermore, a semester project is assigned to the students. The students will develop and program a mobile robot. This work is performed in the Robotics and Automated Systems Lab of the University.
Bibliography	**Textbook** • Roland Siegwart, Illah Nourbakhsh and Davide Scaramuzza. "*Introduction to Autonomous Mobile Robots*", 2nd Edition, MIT Press, ISBN 0-262-19502-X, 2011 • J. J. Craig, Introduction to Robotics: Mechanics and Control, 4th Ed., Prentice Hall, 2017. **References** • K.M. Lynch and F.C. Park, Modern Robotics, Mechanics and Control, Cambridge University Press, 2017 • S. B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd Ed., Prentice Hall, 2010. • E. Wise, Applied Robotics, Prompt Publications, 2000.
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60%, respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as mid-term written exam, oral exam, quizzes, design assignments, design projects and laboratory experiments. The assessment weight, date and time of each type of continuous assessment is being set at the beginning

	of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Homework 10% • Mid-Term written exams 50% • Project 30% • Quizzes 10% Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable. The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in more complex design problems. The above criteria are weighted 30%, 40% and 30%, respectively. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	**English**