Course Title	**Analysis and control of robotic and autonomous systems**				
Course Code	**MME 525**				
Course Type	Elective				
Level	Postgraduate				
Year / Semester	Spring Semester				
Teacher's Name	Eftychios Christoforou				
ECTS	**8**	Lectures / week	3	Laboratories / week	0
Course Purpose and Objectives	The purpose of the course is to introduce students to advanced topics in robotics and autonomous systems. Mathematical methodologies used for their design, analysis, and control are presented. Advanced control theory and relevant implementation methods are examined, while specific applications are considered to exemplify the concepts. Students acquire theoretical background and develop relevant problem-solving skills applied to practical engineering problems.				
Learning Outcomes	• Be able to understand and analyze requirements of robotic and autonomous systems applications. • Understand the kinematics and dynamics of robotic systems and how the relevant equations of motion are formulated. • Ability to design controllers for robotic and autonomous systems. • Gain experience in simulation of robotic and autonomous systems. • Understand the concept of stability and the application of Lyapunov stability analysis. • Understand advanced topics in nonlinear systems control, including model-based schemes, passivity-based control, and adaptive control.				
Prerequisites	None	Required	None		
Course Content	The course introduces the students to advanced topics in robotic and autonomous systems: (a) Medical robotic systems & computer assisted surgery, (b) Robotics and assistive technologies to support independent living and ageing-in-place, (c) Multi-body kinematics and dynamics formulation, (d) Mobile/autonomous robotic systems analysis, (e) Stability and the method of Lyapunov, (f) Feedback control for manipulators, positioning and trajectory-tracking tasks, (g) Nonlinear model-based control for trajectory tracking and the computed-torque method, (h) Force control for robotic manipulators, (i) The concept of passivity and passivity-based control, (j) Adaptive control and its application to robotic manipulation, (k) Control of mobile robotic systems, (l) Dynamic simulation of robotic and autonomous systems, (m) Robot and autonomous systems design: safety, human factors, roboethics, privacy and security.				
Teaching Methodology	• 2 weekly lectures. • Project assignments (analytical problems, simulation and hands-on projects).				

	• During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Modeling and Control of Robot Manipulators. L. Sciavicco, B. Siciliano. Springer. • Robot Dynamics and Control. M.W. Spong, M. Vidyasagar. Wiley. • Applied nonlinear control. J.-J. Slotine and W. Li. Prentice Hall. • Passivity-based control of Euler-Lagrange systems. R. Ortega, A. Loria, P.J. Nicklasson, H. Sira-Ramirez. Springer. • Theory of robot control. C. Canudas de Wit, B. Siciliano, G. Bastin (Eds). Springer. • Control theory of non-linear mechanical systems. S. Arimoto. Oxford Univ. Press.
Assessment	• Project assignments 40% • Final exam 60%
Language	Greek