UNIVERSITY of NICOSIA

Course Code	Course Title	ECTS Credits
MENG-440	Mechatronics and Robotics	6
Department	**Semester**	**Prerequisites**
Engineering	Fall, Spring	PHYS-150, MATH-280
Type of Course	**Field**	**Language of Instruction**
Elective	Engineering	English
Level of Course	**Year of Study**	**Lecturer(s)**
1st Cycle	4th	Dr Eftychios Christoforou
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

The course aims at providing an introduction to robotics, the various types of robotic systems, their applications and the methodologies used for the mathematical analysis. The main focus of the course is on robotic manipulators and covers the kinematic analysis, dynamic analysis, motion planning, control, sensors and actuators, and various design issues.

Learning Outcomes:

After completion of the course students are expected to:

1. Identify and classify robotic systems, express the relevant terminology and cite their applications.
2. Understand the kinematics of robotic manipulators and be able to apply the mathematical methodologies used for kinematic analysis.
3. Understand the dynamics of robotic systems and how the relevant equations of motion are formulated.
4. Demonstrate the motion control methodologies as applied in robotics.
5. Differentiate sensors and actuators used in robotic systems and understand their principles of operation.
6. Design motion trajectories for robotic manipulation tasks.
7. State the specifications of a robotic system and evaluate it based on the needs of a specific application.

Course Contents:

1. Introduction to robotics: history, types of robotic systems and applications (industrial, medical, mobile, etc.).
2. Robotic manipulation systems: terminology, main parts, types of joints, end-effectors, and practical applications.
3. Mathematical background: coordinate transformations, rotation matrices, and homogeneous transformations.
4. Manipulator kinematics: forward kinematics analysis, Denavit-Hartenberg procedure, workspace.

5. Inverse manipulator kinematics: analytical solution, existence of solutions, multiple solutions.
6. Velocity kinematics: Jacobian matrix, inverse velocity kinematics, singular configurations, redundancy.
7. Dynamics: modeling using the method of Newton-Euler and the method of Lagrange, equations of motion and important properties.
8. Control: feedback control schemes, trajectory planning methods.
9. Sensors and actuators used in robotics: position, velocity and force sensors, electric actuators, hydraulic and pneumatic actuators.

Learning Activities and Teaching Methods:

Lectures, in-class examples and exercises.

Assessment Methods:

Midterm examination, homework, final examination.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
J. J. Craig	Introduction to Robotics	Pearson	2013	1292040041

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
L. Sciavicco, B. Siciliano	Modeling and Control of Robot Manipulators	Springer	2001	1852332212
M. W. Spong, M. Vidyasagar	Robot Dynamics and Control	Wiley	1989	047161243X