Course Syllabus

Course Code	Course Title	ECTS Credits
ECE-460	Introduction to Robotics	6
Prerequisites	**Department**	**Semester**
PHYS-150, MATH-280	Engineering	Fall, Spring
Type of Course	**Field**	**Language of Instruction**
Elective	Engineering	English
Level of Course	**Lecturer(s)**	**Year of Study**
1^{st} Cycle	Dr Stelios Neophytou	4^{th}
Mode of Delivery	**Work Placement**	**Corequisites**
Face-to-face	N/A	None

Course Objectives:

The main objectives of the course are to:

- Provide an introduction to robotics and the various types of robotic systems.
- Explain robotic manipulators.
- Provide understanding of the kinematic and dynamic analysis, motion planning, and control of robotic systems.
- Explain the role of sensors and actuators in robotic systems.
- Discuss various applications and 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 Content:

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 / Readings:

Title	Author(s)	Publisher	Year	ISBN
Introduction to Robotics: Mechanics and Control	J. J. Craig	Pearson	2018	9780133489798

Recommended Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Modeling and Control of Robot Manipulators	L. Sciavicco, B. Siciliano	Springer	2001	9781852332211
Robot Dynamics and Control	M. W. Spong, M. Vidyasagar	Wiley	1989	047161243X