COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
DEPARTMENT	Electrical and Computer Engineering		
LEVEL OF STUDY	Undergraduate		
COURSE UNIT CODE	8.012	**SEMESTER**	8
COURSE TITLE	Robotics I		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory lectures	3	2.5
Exercises	1	0.5
Laboratory exercises	1	1
TOTAL	5	4

COURSE UNIT TYPE	Specialized general knowledge/Skills development
PREREQUISITES	-
LANGUAGE OF INSTRUCTION/EXAMS	Greek
COURSE DELIVERED TO ERASMUS STUDENTS	No
WEB PAGE (URL)	

(2) LEARNING OUTCOMES

Learning Outcomes

- Understanding of important scientific topics of Robotics, as well as the operation principles of robotic systems
- Knowledge acquisition about the state-of-the-art of the robotic systems utilized in industry
- Knowledge acquisition about the kinematic modelling of robotic systems
- Ability to program an industrial robot, in order to execute tasks in industrial environment

General Skills

- Research, analysis and combination of data and information, utilizing the required technologies
- Promotion of free, creative and inductive thinking
- Connection of theoretical knowledge with practical skills
- Adaptation to new situations
- Decision making

(3) SYLLABUS

The aim of this course is to provide the students with the required knowledge and appropriate mathematical tools in order to understand in depth the function and operation principles, as well as the control methods of industrial robots. Furthermore, the course will provide the students with the opportunity to control and guide a 6-dof robot, both in a simulated and in a real environment.

- The role and current state of Robotics technology in industry and production lines. Examples of the use of robotic systems in industrial tasks (welding, finishing – cutting, assembly, painting and presentation of many other applications)
- Basic notions related to robotic manipulators, degrees of freedom, basic robotic joints, open-closed kinematic chains, accuracy, repeatability and load in industrial robots. Types of static robots, classification of robotic manipulators based on their geometry, correlation of industrial robotics with CAM systems. Various types of robotic grippers, sensors and actuators utilized in industrial robotic systems.
- Since the articulated robotic manipulators constitutes a kinematic chain of rigid objects that move in space, the basic required notions and mathematical tools are introduced through the kinematic analysis of rigid objects. An introduction on the homogeneous transformations is

provided: coordinate frames, position vectors, rotation matrices, homogeneous transformation synthesis. Description of orientation utilizing the Euler angles, consecutive rotations around principal axes, angle-axis representation and unit quaternions.

- Forward kinematics analysis of robotic manipulators: kinematic parameters and kinematic equations. Inverse kinematics analysis of robotic manipulators: existence of solutions, task space and methods solving the inverse kinematics problem. Jacobian matrix of a robotic manipulator: methods for computing and applications of the Jacobian matrix. Trajectory planning for robotic manipulators in joint space and Cartesian space (task space in which the gripper/end-effector is moving).
- Report on the high-level programming languages utilized in industrial robots. Project assignment related to the programming of a real industrial robotic manipulator for executing various assembly tasks and tasks requiring trajectory planning in general.

(4) TEACHING METHODS - ASSESSMENT

MODE OF DELIVERY	In-Class Face-to-Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	• Use of ICTs in lecturing • Use of ICTs in laboratory exercises. • Use of ICTs for the communication with students via the e-class platform
TEACHING ORGANIZATION	

Method description/Activity	Semester Workload
Lectures	39
Laboratory	13
Laboratory reports preparation	22
Non-guided individual study	46
Total	**120**

ASSESSMENT METHODS	1. Written exams (75%) 2. Laboratory reports (25%) The assessment criteria are clearly stated in the detailed description of the course located in the relevant course area in eClass.

(5) RECOMMENDED BIBLIOGRAPHY

Suggested Bibliography:

- "Introduction to Robotics: Mechanics and Control", Craig J.J, Pearson; 4th edition (February 23, 2017)
- "Robot Dynamics & Control", M.W. Spong, M. Vidyasagar, John Wiley & Sons, 1989.

Related scientific journals:

- IEEE Transactions on Robotics
- International Journal of Robotics Research
- Robotics and Computer-Integrated Manufacturing
- IEEE Robotics and Automation Letters