AUTOMATION AND ROBOTICS

Code: 322016

Main Scientific Area: Automation, energy and cyber-physical systems

Lecturer: Luís Carlos Novais Barbosa

Language of Instruction: Portuguese

Regime: S1

Contact Hours: 60h Total Workload: 108h

ECTS: 6,0

Objectives

Automation: The objective of this area of the discipline is to provide students with fundamental knowledge of programming programmable automatons using standardized languages, as well as providing a general overview of the equipment that involves automation techniques in the current industrial reality. It is intended that students acquire the ability to design solutions to automation problems considering the choice and integration of equipment currently on the market.

Robotics: The objective of this area of the discipline is to provide the student with the fundamental concepts associated with the design and implementation of robots, namely cinematic modelling, trajectory planning and position control; and, in configurations, locomotion, localization, perception and navigation systems for mobile robots.

Learning Outcomes

Skills to Develop:

Automation:

Ability to program programmable automatons to perform specific tasks.
Ability to analyse and select the appropriate equipment for a given automation application.
Competence in identifying and solving problems related to automated systems.

Robotics:

Ability to design and implement efficient and safe robotic systems.
Ability to model the cinematics and dynamics of robots for different applications.
Competence in planning trajectories and controlling the position of robots in dynamic environments.
Ability to integrate sensors and navigation systems into mobile robots to perform autonomous tasks.

Course Contents

Automation: Introduction to Automation (Definition; Objectives; Types); Sensors (Characteristics; Types of Sensors); Actuators (Industrial Actuators); “Programable Logic Controller” PLCs (Structure; Operation; Types; Selection of a PLC; Operation Modes); Grafsets (1st and 2nd level; Input and Output Maps; Stages; Transitions); Logical Representation (Ladder Programming).

Robotics: Introduction to Robotics (Definition; Types; Robots); Manipulator Robots (Components; Types of Joints; Grippers; Robot Configurations; Types of Drive; Safety; Kinematic and Dynamic Analysis; Offline and online robot programming); Autonomous Mobile Robotics (Basic concepts; Configurations; Locomotion Systems; Sensors; Localization; Sensory Perception and Interpretation; Navigation; Control; Representation of states of the world; Movement planning).

Recommended Bibliography

Automação/Automation:

· Automação João R. Caldas Pinto, técnicas de automação, 3ª ed. ETEP, 2010;

· J.Norberto Pires, Automação Industrial, 4ª ed., ETEP, 2007; António M. S. Francisco, Autómatos Programáveis, 4ªed. ETEP;

· Paulo Oliveira, Curso de Automação Industrial, 1ª ed, ETEP;

Robótica/Robotics:

· Diapositivos das Aulas.

· “Robotics, vision and control”, Peter Corke, Springer, 2011

· "Handbook of Robotics", B. Siciliano and O. Khatib (eds) Springer, 2008

· Matlab Image Processing Toolbox – User Guide Matlab

· Gary Bradski e Adrian Kaehler, (2008). Learning OpenCV: Computer Vision with the OpenCV Library, O’Reilly

· Gonzalez, R.C. e Woods, R.E., (2010). Processamento Digital de Imagens. 3ª, Pearson

Learning and Teaching Methods

Automation:

The syllabus covers everything from the introduction to automation to more advanced topics such as PLCs and Grafsets, which are essential tools in industrial automated systems.
The inclusion of sensors and actuators is essential for students to understand how automated systems perceive and act on the environment.
The study of PLCs and ladder programming provides students with practical skills to program automation systems, aligning to equip them with programming knowledge of programmable automatons and devise solutions to automation problems.

Robotics:

The syllabus covers everything from the introduction to robotics to more advanced aspects, such as kinematic and dynamic analysis of manipulator robots and autonomous mobile robotics.
Topics on manipulator robots and mobile robotics cover components, joint types, locomotion systems, sensors, localization, navigation, and control, all essential for designing and implementing robots and autonomous systems.

Offline and online robot programming is also included, which enables students to develop practical skills in programming and controlling robots, aligning with the goal of equipping them with fundamental concepts associated with the design and implementation of robots.
Therefore, the program contents are consistent with the objectives of the UC, covering everything from introductory concepts to practical skills necessary for students to become competent in automation and robotics.

Assessment Methods

The students' final classification is obtained based on the following assessment elements:

Practical Component (20%+20%):

· 1st Practical work – (0 to 20 points, minimum grade 9.5 points) – Report with oral defense (individual);

· 2nd Practical work – (0 to 20 points, minimum grade 9.5 points) – Report with oral defense (individual);

Theoretical Component (60%):

· Global test (0 to 20 values, minimum grade 9.5 values).

The student will be approved for the subject when the average of the assessment elements is greater than or equal to 9.5 points.

Normal_season_grade = 1st_practical_work x 0.20 + 2nd_practical_work x 0.20 + Global_test x 0.60

According to the normal season equation, the student will be approved for the curricular unit when the grade achieved is greater than or equal to 9.5. Otherwise, the student can submit to the Appeal Period or Special Period (if eligible), both in the practical and theoretical components.