ISEL
ADEM
Área Departamental de Engenharia Mecânica

Curricular Unit Form (FUC)

Course:	**INDUSTRIAL ENGINEERING MANAGEMENT**					
Curricular Unit (UC)	**Fundamentals of Industrial Robotics**			Mandatory		
				Optional	**X**	
Scientific Area:	Energy and Systems Control					
Year: **1º**	Semester: **1º**	ECTS: **5**		Total Hours: **3**		
Contact Hours:	T:	TP:**45**	PL:	S:	OT:	TT:
Professor in charge		Academic Degree /Title		Position		
Francisco M. de Oliveira Campos		**PhD**		**Assistant professor**		

T- Theoretical ; TP – Theory and practice ; PL – Laboratory ; S – Seminar ; OT –Tutorial ; TT – Total of contact hours

Entry into Force	Semester: **Winter**	Academic Year: **2016/2017**

Objectives of the curricular unit and competences (max. 1000 characters)

At the end of the course the student should:
i) Be able to program a robot manipulator to perform palletizing operations.
ii) Identify which programming structures are suitable to each problem and have methods to debug and optimize robot control programs.
iii) Identify the hardware and software components in a robotic system and diagnose faults in the system.
iv) Understand the principles and the importance of the sensory and actuator systems most commonly used in mobile robots
v) Identify the main control problems associated with mobile robots.
vi) Be able to analyse and operate Flexible Manufacturing Systems (FMS).

Syllabus (max. 1000 characters)

1. ROBOT MANIPULATORS
Introduction- Robot system components, robot kinematic configurations,sensors and actuators;
Robot programming- Robot programming languages; control levels in a robot manipulator system.
Industrial robots- Specifications of industrial robots; kinematic configurations of industrial robots and their applications.
2. MOBILE ROBOTICS- Mobile robot configurations; sensors, actuators and control units; sensor data processing and integration; application of concepts to Automated Guided Vehicles (AGV).
3. FLEXIBLE MANUFACTURING SYSTEMS
Flexible Manufacturing Systems (FMS) components- Material transfering, storage, processing and quality control systems.
FMS Control and Monitoring- control levels and communication networks; control and monitoring software - main features and relation to MRP, JIT and group technology concepts.

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Demonstration of the syllabus coherence with curricular unit's objectives (max. 1000 characters)
The correspondences between teaching goals and the course chapters are described in the mapping shown below: i to iii) - Chapter 1: presents the fundamentals of robot manipulators, namely, the components of the robotic system, the control levels involved and the specificities of programming languages. iv and v) - Chapter 2: presents the drive systems and sensors most commonly used in mobile robots. The control problems and sensor data processing are addressed and the AGV is used as a case study. vi) - Chapter 3: conveys the fundamental concepts that underly the operation of a FMS, thus allowing students to analyse and operate these systems.

Teaching methodologies (including evaluation) (max. 1000 characters)
This course is organized in classroom lectures and laboratory sessions. The lectures will address each course topic, provide case studies and solve sample problems. In practical sessions students are asked to study the equipment, perform experiments or develop programs to operate the equipment of the FMS in the Robotics Laboratory. In order to be approved, students must: 1 – Accomplish the laboratory exercises and deliver the corresponding reports, which will be discussed with the teacher, 2 – Pass a written exam.

Demonstration of the teaching methodologies coherence with the curricular unit's objectives (max. 3000 characters)
The concepts related to each course topic are presented in classroom lectures. The correspondence between each competence and the practical exercises are as follows: i to iii) Exercises in robot programming with a simulation software and a real robot. iv and v) Report on the study of the mobile robot provided in the Laboratory. Exercise in parameter tuning of a path following controller. vi) Report on the study of the FMS provided in the Laboratory. Exercises in communication configuration, planning, control and monitoring of the FMS.

Main Bibliography (max. 1000 characters)
Robotic Engineering – An Integrated Approach. Klafter, R.D., Chielewski, T. A., Negin. M. Prentice-Hall, 1989.

Curricular Unit Form (FUC)

Implementation of Robot Systems. An introduction to robotics, automation, and successful systems integration in manufacturing. Mike Wilson, Elsevier, 2015.
Automation, Production Systems, and Computer-Integrated Manufacturing. Mikell P. Groover, Pearson, 2014.
Computer Integrated Manufacturing. James A. Rehg, Henry W. Kraebber, Pearson, 2004.