INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Automation Systems			Field of study	Automation		
Master in	Industrial Engineering - Mechanical Engineering			School	School of Technology and Management		
Academic Year	2020/2021	Year of study	1	Level	2-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9572-356-1105-00-20		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	-	30	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tuturial; O - Other

Name(s) of lecturer(s): Paulo Jorge Pinto Leitão, Henrique Jose Alves Teixeira, Jose Fernando Lopes Barbosa

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Know the industrial automation technologies and systems, namely robotics, numerical control, automatic storage and transport systems, production and assembly lines, and computer aided tools.
2. Obtain knowledge of industrial robotics, namely in terms of classification, kinematics, sensors and actuators, and typical applications.
3. Operate and program industrial robots.
4. Knowledge about flexible Manufacturing Systems (FMS) and Computer Integrated Manufacturing (CIM).
5. Obtain knowledge of lean manufacturing techniques.
6. Model and analyze discrete event-driven systems using Petri nets.
7. Obtain knowledge of distributed supervisory control systems using multi-agent systems.
8. Design, implement and integrate automation equipments, cells or processes at the shop floor level.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Execute operations using Boolean algebra, binary arithmetic and numeration systems.
2. Apply the basic concepts of industrial automation, namely programmable logic controllers.
3. Elaborate computational programs.

Course contents

Introduction to industrial automation systems. Technologies of industrial automation systems. Computer integrated manufacturing. Distributed supervisory control systems. Modeling discrete event-drive system using Petri nets. Integration of manufacturing systems.

Course contents (extended version)

1. Introduction to industrial automation systems
   - Definition, automation types, production types, production activities and manufacturing functions.
2. Technologies of industrial automation systems
   - Industrial robotics, numerical control, automatic storage and transport systems.
3. Computer integrated manufacturing
   - Flexible manufacturing systems (FMS), computer integrated manufacturing (CIM).
   - Computational tools to support manufacturing activities (CAD, CAM, CAE, CAPP, etc.).
   - Lean manufacturing.
   - Manufacturing control systems.
4. Distributed supervisory control systems
   - Requirements for the distributed control of industrial processes.
   - Multi-agent systems.
   - Service-orientated architectures.
   - The IEC 61499 - Function Blocks standard
   - Application domains: manufacturing, smart grids, logistics, traffic control, etc.
5. Modeling discrete event-drive system using Petri nets
   - Modeling analysis and requirements. Modeling languages for discrete event-driven systems.
   - Petri nets: definition, symbology, basic rules and properties.
   - Analysis and validation of Petri nets.
   - Temporized Petri nets. High-level Petri nets.
6. Integration of manufacturing systems
   - Need for the integration of systems and associated problems.
   - Integration levels. Mechanisms and architectures for integration. Interoperability.

Recommended reading

1. “Automation, Production Systems and CIM”, M. P. Groover , Prentice-Hall, 1987.
2. "Computer Systems for Automation and Control", Gustaf Olsson, G. Piani, Prentice Hall, 1992.
3. “Computer Integrated Manufacturing and Engineering”, U. Rembold, B. O. Nnaji, Addison-Wesley, 1993.
4. “Applications of Petri Nets in Manufacturing Systems. Modelling, Control and Performance Analysis”, Alan A. Desrochers and Robert Y. Al-Jaar, IEEE Press, 1994.
5. “Industrial Robotics: Technology, Programming and Applications”, M. Groover, M. Weiss, R. Nagel, N. Odrey, McGraw-Hill, 1986.

Teaching and learning methods

Theoretical classes: exposition of the proposed topics. Practical classes: realization of exercises and laboratorial works to help to consolidate the expected learning outcomes. Learning complemented with the development of a mini- project to be implemented preferentially during the non-presential hours.

Assessment methods

- Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 50% (The approval requires the achievement of a minimum score of 35%.)
  - Laboratory Work - 50% (Considers the results obtained in the laboratory works and the participation in the classrooms.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Paulo Jorge Pinto Leitão	José Luís Sousa de Magalhaes Lima	José Alexandre de Carvalho Gonçalves	Paulo Alexandre Vara Alves
15-10-2020	15-10-2020	16-10-2020	23-11-2020