Course Unit	Option - null			Field of study	Biomedical Sciences		
Master in	Biomedical Technology - Medical Signals and Instrumentation			School	School of Technology and Management		
Academic Year	2019/2020	Year of study	1	Level	2-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	5025-422-1204-04-19		

Workload (hours)	162	Contact hours	T -	TP 60	PL -	TC -	S -	E -	OT -	O -

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

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Understand the context and importance of robotics in the different society sectors, and particularly in medical environments.
2. Obtain knowledge and understand the basic concepts of robotics, namely in terms of classification, kinematics, sensors and actuators, and typical applications.
3. Operate and program manipulators (arm-robots).
4. Know the robotics technology applied to (tele-)surgery and rehabilitation.
5. Understand the basic concepts of mobile robotics, both at the hardware and supervisory control levels.
6. Understand and apply methods for the sensorial perception and interpretation, methods for the control of robots.
7. Understand and apply methods for the navigation of robots in known or unknown environments, using planning and navigation algorithms.
8. Know and apply the robotics technology to the field of the patient assistance.

Prerequisites

Before the course unit the learner is expected to be able to:
Apply knowledge in programming.

Course contents

Introduction to robotics: definition, advantages, classification and application domains. Manipulator robotics: configurations, type of joints, types of power in robotics, kinematics and dynamics analysis, sensors and actuators, programming, security, and typical applications. Autonomous mobile robotics: basic concepts, locomotion systems, sensors, sensorial perception and interpretation, control, motion planning and typical applications.

Course contents (extended version)

1. Introduction to robotics
   - Contextualization, definition, history, advantages, classification and application domains.
2. Manipulator robotics
   - Components, types of joints, robot configurations, types of power in robotics, security.
   - Kinematics and dynamics analysis.
   - On-line and off-line programming.
   - Sensors and actuators.
   - Typical applications: rehabilitation and health care, and (tele-)surgery.
3. Autonomous mobile robotics
   - Basic concepts, configurations, locomotion systems.
   - Sensors, localization methods, sensorial perception and interpretation.
   - Navigation, control of mobile robots and motion planning.
   - Typical applications: hospitalar services, assistance to the mobility of patients.

Recommended reading

1. "Handbook of Robotics", B. Siciliano and O. Khatib (eds) Springer, 2008.
2. “Multi-Agent Systems: An Introduction to Distributed Artificial Intelligence”, J. Ferber, Addison-Wesley, 1999.
3. "Principles of Robot Motion: Theory, Algorithms, and Implementations", H. Choset, K. M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki, S. Thrun, Bradford Book, MIT Press, 2005.
4. "Robotics: Control, Sensing, Vision and Intelligence", K. Fu, R. C. Gonzalez, C. S. G. Lee, McGraw-Hill, 1987.
5. "Computational Principles of Mobile Robotics", G. Dudek and M. Jenkin, Cambridge University Press, 2000.

Teaching and learning methods

Theoretical classes: exposition of the proposed topics. Practical and laboratorial classes: realization of exercises and laboratorial works to help to consolidate the expected learning outcomes. Learning complemented with the development of a laboratorial project, preferentially developed 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% (Includes the participation in the laboratorial classes and the development of mini-projects.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Paulo Jorge Pinto Leitão	José Luís Sousa de Magalhaes Lima	Fernando Jorge Coutinho Monteiro	Paulo Alexandre Vara Alves
06-03-2020	06-03-2020	06-03-2020	07-03-2020