Università degli Studi della Basilicata
Scuola di Ingegneria

COURSE: Robotics (Module 1 of Automatic Control)			
ACADEMIC YEAR: 2019-20			
TYPE OF EDUCATIONAL ACTIVITY: Characterizing			
TEACHER: Fabrizio Caccavale			
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phone: 0971-205198		mobile (optional):	
Language: Italian			
ECTS: 6 (4,5 lessons, 1,5 tutorials/practice)	n. of hours: 54 (36 lessons, 18 tutorials/practice)	Campus: Potenza/Matera Dept./School: School of Engineering Program: Computer Engineering and Information Technologies	Semester: I

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

The goal of the course is to provide the basic skills for modelling and analyzing robotic manipulators, with special emphasis on kinematics, motion planning and performance evaluation of open-chain robotic manipulators for industrial use.

PRE-REQUIREMENTS

Knowledge of the methodologies and skills learned in the mathematics, physics, circuits, signals and systems, and electronics courses.

SYLLABUS

Introduction to robotics (4 hrs lessons): characteristic elements of a robotic manipulator; manipulation structures; taxonomy of robotic manipulators.

Kinematics of open-chain robotic manipulators (12 hrs lessons, 8 hrs practice/tutorials): rotation matrices and Euler angles; homogeneous transformations; direct kinematics; joint-space and operational space; workspace of a robotic manipulator, kinematic redundancy, accuracy and repeatability; kinematic calibration; closed-form solutions to inverse kinematics.

Differential kinematics and statics of open-chain robotic manipulators (8 hrs lessons, 6 hrs practice/tutorials): geometric and analytic Jacobian; kinematic redundancy analysis; kinematic singularities; algorithmic solutions to inverse kinematics; statics; manipulability measures.

Dynamics of open-chain manipulators (2 hrs lessons): Lagrange formulation; properties of the dynamic model; elements identification of dynamic parameters; computation of direct and inverse dynamics.

Trajectory planning (4 hrs lessons, 4 hrs practice/tutorials): joint-space trajectory planning; operational-space trajectory planning.

Control (2 hrs lessons): general schemes for motion control of robotic manipulators in the joint space and in the operational space; elements of interaction control.

Sensory systems and control unit of robotic manipulators (4 hrs lessons): sensors and actuators, functional architecture of a control unit for robotic manipulators; hardware architecture; programming environments.

TEACHING METHODS

The course is organized as follows:

- Theoretical lessons (36 hrs)
- Classroom tutorials (14 hrs)
- Presentation of design examples of planning and kinematic control software for robotic systems (4 hrs)

EVALUATION METHODS

The evaluation is based on the discussion of a project work and an oral test.

The project work is assigned at the end of the course to groups of students. The project work must be submitted before the exam (usually 1 week before) and is evaluated by the professor, who can ask modifications and/or integrations.

The oral test is aimed at:

- discussing the project work, so as to evaluate problem solving and presentation skills,
- assessing the knowledge and the ability to link and compare the topics covered during the course.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

- Slides of the lectures available at http://www2.unibas.it/caccavale/rob.html or http://docenti.unibas.it/site/home/docente.html?m=003376.
- Textbooks:
  - ✓ B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo. Robotica: Modellistica, Pianificazione e Controllo (III edizione). McGraw-Hill, Italia, 2008

INTERACTION WITH STUDENTS

Learning goals, contents, evaluation methods and educational material are illustrated in detail at the beginning of the course.

Receiving hours: Wednesday 10:30-12:30, Room 74, 5th floor, School of Engineering building. The Professor can be contacted at the end of the lessons and/or by e-mail as well.

EXAMINATION SESSIONS (FORECAST)[1]

28/01/2021, 25/02/2021, 07/04/2021, 06/05/2021, 24/06/2021, 27/07/2021, 28/09/2021, 09/11/2021, 16/12/2021

SEMINARS BY EXTERNAL EXPERTS YES X NO □

FURTHER INFORMATION

[1] Subject to possible changes: check the web site of the Teacher or the Department/School for updates.