COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	POLITEHNICA University of Bucharest
1.2 Faculty	Faculty of Electronics, Telecommunications and Information Technology
1.3 Department	Department of Applied Electronics and Information Engineering
1.4 Domain of studies	Electronic Engineering, Telecommunications and Informational Technologies
1.5 Cycle of studies	License (engineering)
1.6 Program of studies/Qualification	Applied Electronics

2. Course identification information

2.1 Name of the course				Robotics (RO)			
2.2 Lecturer				Dr. Ing. Constantin Negrescu			
2.3 Instructor for practical activities				Dr. Ing. Constantin Negrescu			
2.4 Year of studies	IV	2.5 Semester	II	2.6 Evaluation type	Verification	2.7 Course choice type	Compulsory

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week, out of which	4	3.2 course	3	3.3 practical activities	1
3.4 Total hours in the curricula, out of which	56	3.5 course	42	3.6 practical activities	14

Distribution of time	ore
Study according to the manual, course support, bibliography and hand notes	34
Supplemental documentation (library, electronic access resources, in the field, etc)	5
Preparation for practical activities, homework, essays, portfolios, etc.	5
Tutoring	0
Examinations	4
Other activities	0

3.7 Total hours of individual study	48
3.9 Total hours per semester	104
3.10 Number of ECTS credit points	4

4. Prerequisites (if applicable)

4.1 curricular	Mathematical Analysis and Differential Calculus Coputer Systems Architecture Automatic System Theory
4.2 competence-based	General programming knowledge

5. Requisites (if applicable)

5.1 for running the course	Not applicable. Attendance according to UPB regulations
5.2 for running of the applications	Mandatory attendance to laboratories, according to UPB regulations

6. Specific competences

Professional competences	Proiectare asistată, si realizare a sistemelor robotice complexe prin integrarea subsistemelor componente
Transversal competences	Îndeplinirea sarcinilor profesionale cu identificare exactă a obiectivelor de realizat, a unor factori potenţiali de risc, a resurselor disponibile, a aspectelor economico financiare, condiţiilor de finalizare a acestora, etapelor de lucru, timpului de lucru şi termenelor de realizare aferente. Executarea responsabilă a unor sarcini de lucru în echipă pluridisciplinară, cu asumarea de roluri pe diferite paliere ierarhice.

7. Course objectives (as implied by the grid of specific competences)

7.1 General objective of the course	Disciplina reprezinta o sinteza interdisciplinara care ii permite inginerului in devenire sa realizeze corelari intre domenii aparent disjuncte. Obiectivul general al cursului de Robotica il reprezinta studiul sistemelor capabile sa subsituie sau sa complementeze activitatea umana sub aspectele sale motrice, senzoriale si intelectuale. Robotica inglobeaza preocupari teoretice si aplicatiile acestora legate de automatizarea complexa a numeroase sectoare de activitate.
7.2 Specific objectives	• introducere in robotica si taxonomie • modele matematice directe si inverse ale structurilor robotice • sisteme de coordonate • sisteme senzoriale proprioceptive si exteroceptive in robotica • controlul clasic al structurilor robotice • controlul robotic neconventional • structuri de comanda .

8. Content

8.1 Lectures	Teaching techniques	Remarks
1. Introduction in Robotics a) object of the discipline Robotics b) Robots, mobile robots (RM), autonomous robots, taxonomy, specific, composing subsystems c) Robots generations. Programming and control levels. Autonomy levels. d) Implementation and utilization	The lectures are presented on the table, constantly consulting the students in order to verify the degree of knowledge assimilation, according to the University POLITEHNICA of Bucharest Graduating Regulation.	3 hours
2. Mathematic models of the robotic structures a) cinematic (geometric) models b) cinematic speed models c) dynamic models d) applicability, specific mobility configurations		9 hours
3. Coordinate systems and RM navigation a) the navigation RM problem (formulation, local and global navigation) b) relative and absolute localization methods (odometry, active balize) c) movement planning (definition, base elements, configuration space, movement planning techniques)		9 hours
4. Sensorial proprioceptive and exerioceptive systems a) position and speed traductors b) effort sensors (compliancy types), contact, close		6 hours

zone, far zone c) sensorial fusion: concept, fusion types, multisensor system architecture		
5. Classic control of robotic structures a) base principles, b) using models in tracking movement trajectories c) hybrid control position-force d) real time operating systems		6 hours
6. Unconventional Robotic control a) behavioral models (avoiding obstacles, reper following, leader following, etc) b) learning techniques		6 hours
7. Humanoid robots control structures a) institution robots b) biomimetic robots c) robotic networks		3 hours

Bibliography

1. Borangiu, Th. et al., Industrial Robotics: Theory, Modelling and Control, Multi-chapter book (Ed. Munir Merdan), Advanced Robotics Systems International, Vienna, Austria, 2006
2. Borangiu, Th. and Fl. Ionescu, Robot Modelling and Simulation, Romanian Academy Press and AGIR Press, Bucharest, 2002, ISBN 973-27-0927-8 and 973-8130-64-6, 16-380
3. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, Robot Modeling and Control, Wiley, 2005 - 496 pagini
4. Tadej Bajd (Author), Matjaz Mihelj (Author), Marko Munih (Author), Introduction to Robotics (SpringerBriefs in Applied Sciences and Technology) ISBN-13: 978-9400761001

8.2 Practical applications	Teaching techniques	Remarks
1. Software and hardware presentation	The lectures are presented on the table, constantly consulting the students in order to verify the degree of knowledge assimilation, according to the University POLITEHNICA of Bucharest Graduating Regulation.	2 ore
2. V+ language instruction set		2 ore
3. Assembly/ Disassembly applications		2 ore
4. Artificial vision system configuration		2 ore
5. ObjectFinder		2 ore
6. Visual tools		2 ore
7. Laboratory test		2 ore

Bibliography

Mark W. Spong, Seth Hutchinson, M. Vidyasagar, Robot Modeling and Control, Wiley, 2005 - 496 pagini

Microsoft Robotics Developer Studio 4 (RDS 4) - http://www.microsoft.com/robotics/#Learn

9. Bridging the course content with the expectations of the epistemic community representatives, professional associations and employers representatives for the domain of the program

The course represents an interdisciplinary synthesis which allows the student to make correlations between relatively disjoint domains. The general objective of the Robotics course is represented by the study of systems capable to replace or complement the human activity under his motric, sensorial and intellectual aspects. Robotics incorporates theoretical aspects and applications related to complex automation of some activity fields.

The course is structured in 7 chapters with the following objectives:

1. introduction in robotics and taxonomy
2. mathematic direct and inverse models of robotic structures
3. coordinate systems
4. proprioceptive and exerioceptive sensorial systems in robotics

5. classic control of robotic structures
6. unconventional robotic control
7. command structures of humanoid robots.

The laboratory has as a general objective learning the information's trained at the course by building of applicative programs using the robots in the Robotics Laboratory of the Faculty of Automatic Control and Computers, Department of Automatics and Industrial Informatics, building ED, room ED 013-014.

The study of robot manipulators, robot controllers and peripheral devices (hardware). The software architecture of a robot system. Robot – vision systems. Structured, high level robot programming languages in V+. Motion planning and conditioning, pick and place, palletizing / depalletizing, man machine communication applications. Design, editing and execution of V+ programs. The homework (project) requires solving a robotics application and conceiving a V+ robot control program.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final mark
10.4 Lectures	- knowledge fundamental theoretical concepts; - Knowing how to apply the theory to specific problems; - Differential analysis techniques and theoretical methods.	Two written tests checking, equal weights (substitutes exam, given the specific degree last quarter) during the semester, sustained data rate set at the beginning; Topics cover the entire field, making a comparative synthesis of theoretical material covering and explaining the exercises and models of application problems.	70%
10.5 Practical applications	- Knowledge of how to design an image analysis algorithm for solving a given problem; - Knowing how transposition into code [Matlab] an algorithm for image analysis; - Of demonstrating an image analysis algorithm implemented.	Final laboratory test, comprising a theoretical and practical part. The theoretical component is checked by choice test; practical component is assessed by checking the solution (implementation, testing, operation) the student a practical problem.	30%
10.6 Minimal performance standard			
- Solving a real problem (based on a simplified case) planning and management of movement for industrial robots; - Shaping a real problem (based on a simplified case) planning and management of movement for mobile robots			

Date	Lecturer	Instructor for practical activities
01.10.2013	Dr. Ing. C-tin. Negrescu	Dr. Ing. C-tin. Negrescu

Date of department approval Director of Department,