A) COURSE

Course Id:	Course
5723	Robotics B

Class Hours per Week	Lab hours per week	Complementary practices	Credits	Total hour course
3	2	3	8	48

B) GENERAL COURSE INFORMATION:

	EE (IEA)	ME (IM)	MME (IMA)	EME (IME)	MTE (IMT)
Level:					VIII
Course Type (Required/Elective)					elective
Prerequisite Course:					Robotics A (5719)
CACEI Classification:					IA

C) COURSE OBJECTIVE

At the end of the course, the student will be capable of:
The student will acquire and apply knowledge of advanced robotics in an application project. On the theoretical side of the course, the student will acquire the knowledge in modeling and control of different types of robots to execute his application project. On the practical side (laboratory and Project), the student will acquire the knowledge and skills to program and operate such robots.

D) TOPICS (CONTENTS AND METHODOLOGY)

1.- **INTRODUCTION (ROBOT TYPES, R4, R3, R5, R12)**		**2 Hours**
Specific Objective:	The student will have a general view of the architecture of different types of robots.	
1.1 Historical background 1.2 Types of robots		
Readings and other resources	Reading of reference R3, R5, R12 and R4. Also make available, according to the teacher, additional teaching materials through electronic means, for example through a distance learning platform (Moodle or equivalent).	
Teaching Methodologies	Subject exposition by means such as the blackboard and the multimedia projector.	
Learning Activities	Readings of the bibliography and practice of laboratory about robotics introduction	

2. INDUSTRIAL ROBOTS (R1, R2, R5, R3)		**8 Hours**
Specific Objective:	The student will understand advanced models and control algorithms for industrial robots.	

2.1 Dynamic model for industrial robots 2.2 Path planning using the dynamic model 2.3 Advanced control algorithms	
Readings and other resources	Reading of reference R1, R2, R5 and R3. Also make available, according to the teacher, additional teaching materials through electronic means, for example through a distance learning platform (Moodle or equivalent).
Teaching Methodologies	Subject exposition by means such as the blackboard and the multimedia projector. Individual and team work will be used during the course. Simulations in CAD software and programming will be carried out.
Learning Activities	Readings of the bibliography, homework's, exercises in class and practice of laboratory about robotics

3. PARALLEL ROBOTS (R5, R6)	**5 Hours**
Specific Objective:	The student will understand the architecture of parallel robots and the kinematic model of Delta type robots
3.1 Parallel robots, Delta-type parallel robot 3.2 Kinematic model of Delta-type parallel robots. 3.3 Point-to-point control of a Delta robot.	
Readings and other resources	Reading of reference R5 and R3. Also make available, according to the teacher, additional teaching materials through electronic means, for example through a distance learning platform (Moodle or equivalent).
Teaching Methodologies	Subject exposition by means such as the blackboard and the multimedia projector. Individual and team work will be used during the course. Simulations in CAD software and programming will be carried out.
Learning Activities	Readings of the bibliography, homework's, exercises in class and practice of laboratory about robotics

4. MOBILE ROBOTS (WHEELED MOBILE ROBOTS R4, R7)	**8 Hours**
Specific Objective:	The student will understand the architecture and kinematics of wheeled mobile.
4.1 Non-holonomic restrictions 4.2 Kinematic model of wheeled mobile robots 4.3 Path following without orientation control 4.4 Point stabilization (parking)	
Readings and other resources	Reading of reference R4 and R7. Also make available, according to the teacher, additional teaching materials through electronic means, for example through a distance learning platform (Moodle or equivalent).
Teaching Methodologies	Subject exposition by means such as the blackboard and the multimedia projector. Individual and team work will be used during the course. Simulations in CAD software and programming will be carried out.
Learning Activities	Readings of the bibliography, homework's, exercises in class and practice of laboratory about robotics

5. ROBOT VISION (R8, R9, R10, R11)	**9 Hours**
Specific Objective:	The student will comprehend the basics and application of computer vision for robotics.
5.1 Camera Models 5.2 Camera Calibration 5.3 Camera pose reconstruction from two images	
Readings and other resources	Reading of reference R8, R9, R10 and R11. Also make available, according to the teacher, additional teaching materials through electronic means, for example through a distance learning platform (Moodle or equivalent).

Teaching Methodologies	Subject exposition by means such as the blackboard and the multimedia projector. Individual and team work will be used during the course. Simulations in CAD software and programming will be carried out.
Learning Activities	Readings of the bibliography, homework's, exercises in class and practice of laboratory about robotics

6. PROJECT		**16 Hours**
Specific Objective:	The student will apply the theoretical knowledge acquired during the course, in an application project.	
6.1 Development of the project.		
Readings and other resources	Lectura de las referencias bibliográficas del curso y de las adicionales que el profesor determine.	
Teaching Methodologies	Conducción de deliberaciones, supervisión de proyecto.	
Learning Activities	Carrying out the project and the activities required for this (eg: research on topics relevant, design of components, assemblies, testing, etc).	

E) TEACHING AND LEARNING METHODOLOGIES

Subject exposition by means such as the blackboard and the multimedia projector. Execution of a robotics application project. Individual and team work will be used during the course. Simulations in cad software and programming will be carried out.

F) EVALUATION CRITERIA:

Evaluation:	Schedule	Suggested Form of Evaluation and weighing	Topics
1st Term	Session 16	Exam 85%, Homework 15%,	Units 1 to 3
2nd Term	Session 32	Exam 85%, Homework 15%,	Units 4 and 5
Project	Session 48	100% project evaluation	Unit 6
Final evaluation		50% (Average of the partial evaluations) 50% project	
Other activity:		approved laboratory	
Extraordinary Exam	According to schedule	100% Exam	100% of topics
Title Exam	According to schedule	100% Exam	100% of topics
Regularization Exam	According to schedule	100% Exam	100% of topics

G) BIBLIOGRAPHY AND ELECTRONIC RESOURCES

Main Books

R1. Modeling and Control of Robot Manipulators,
Lorenzo Sciavicco, Bruno Siciliano
McGraw Hill
1996
ISBN: 0-07-057217-8

R2. Robótica
John J. Craig
Pearson Education
3a Ed. 2006
ISBN: 970-26-0772-8

R3. Fundamentos de Robótica
Antonio Barrientos, Luís Felipe Peñín, Carlos Balaguer y Rafael Aracil
Mc Graw Hill
2a Ed. 2007
ISBN: 978-84-481-5636-7

R4. Robótica: Manipuladores y robots móviles
Aníbal Ollero Baturone
Ed. Alfaomega
2001
ISBN: 970-15-0758-4

R5. Robotics, Fundamental Concepts and Analysis
Ashitava Ghosal
Ed. Oxford
2006
ISBN-10: 0-19-567391-3

R6. M Lopez, E Castillo, G Garcıa, and A Bashir,
Delta robot: inverse, direct, and intermediate Jacobians
Proc. IMechE Vol. 220 Part C: J. Mechanical Engineering Science
C20304 © IMechE 2006, pp103-109.
ISBN-13: 9781846284045
ISBN-10: 184628404X

R7. Robot Motion and Control, recent developments
Krysztof Kozlowski (de)
Springer
2006
ISBN-13: 9781846284045
ISBN-10: 184628404X

R8. “Learning OpenCV”,
Gary Bradski and Adrian Kaehler.
O’Reilly. 2008.

R9. “Robot Vision”
Horn, B.K.P.
Mc Graw Hill
1986.

Complementary Books

R10. “Robótica: control, detección, visión e inteligencia”,
Fu,K.S., Gonzalez,R.C., Lee C.S.C.
Mc Graw Hill,
México, 1988.

R11. Robótica Industrial

Mikell P. Groover, Mitchell Weiss, Roger N. Nagel y Nicholas G. Odrey
McGRAW-HILL
1990
ISBN: 84-7615-302-3

R12. Practical and Experimental Robotics
Ferat Sahin y Pushkin Kachroo
CRC Press
2008
ISBN-13: 978-1-4200-5909-0

Internet Links