COURSE DATA

Data Subject	
Code	34688
Name	Automation Systems and Robotics
Cycle	Grade
ECTS Credits	6.0
Academic year	2019 - 2020

Study (s)

Degree	Center	Acad. year	Period
1400 - Degree in Computer Engineering	School of Engineering	4	Second term
1403 - Degree in Telematics Engineering	School of Engineering	4	Second term

Subject-matter

Degree	Subject-matter	Character
1400 - Degree in Computer Engineering	16 - Optional subject	Optional
1403 - Degree in Telematics Engineering	19 - Optional subjects	Optional

Coordination

Name	Department
DOMINGO ESTEVE, JUAN DE MATA	240 - Computer Science
VEGARA MESEGUER, FRANCISCO	240 - Computer Science

SUMMARY

This course presents to the student a general view of the knowledge, programming and use of devices for the interaction between computers and the real world. This includes robots, industrial automation systems, domotics and similar ones. The topics include from the acquisition of signals from the environment to the execution of actions that change this environment; this will include robots (either manipulators or autonomous robots) but also other devices for automation used in factories, homes or biomedical applications.

The main lines of the syllabus are as follows: measurement of physical magnitudes (sensorization). Movement generation (actuators). Communication devices (buses). Motor control. Manipulators and mobile robots. Perception and Intelligence.

The practical part is related with the use and programming of several sensors and actuators (for instance with the Arduino board or similar ones). A preliminary proposal consists on building a mobile robot for which the students, divided into several groups, will make the design and building of each of its modules (motor control, sensors, map building, trajectory planning, etc.).

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

This subject has not previous requirements.

OUTCOMES

1400 - Degree in Computer Engineering

- IC2 - Ability to analyse, evaluate and select the most appropriate hardware and software platforms to support embedded and real-time applications.
- IC3 - Ability to analyse, evaluate, select and configure hardware platforms for the development and implementation of computer applications and services.

LEARNING OUTCOMES

Skills to acquire

1. Determine, given a practical problem of automation, if it is a problem of sensorization, interconnection, programming or several of these simultaneously and determine which techniques and technologies should be used in that case.

2. Be able to choose, amongst the methods contained in the course, which one or group of them are suitable for the resolution of the problem at hand and be able to apply them.

3. Be able to construct models or compact representations of the flux of information in the real system to be automated and be able to program the devices needed to treat this information.

4. Be able to choose the appropriate sensors according to the nature of the processes to control as long as the acquisition devices (if needed, A/D conversion and capture of digital signals) being able to interpret correctly the specifications of the manufacturer.

5. Be able to choose the appropriate actuators with similar requirement to those of the former point.

6. Be able to implement basic control algorithms (PID or similar) on real devices that will also have to be chosen taking into account their input/output capabilities, their computational power, energy consumption and cost so that a reliable and effective automation solution can be implemented.

7. Be able to choose and implement the high level architecture more adequate for a complex automation system from those currently used (hierarchical, reactive, hybrid, etc.) understanding the advantages and drawbacks of each of them in the context of the required solution.

8. Be able to evaluate the quality of a solution calculating the appropriate efficiency measures and, if the solution is not satisfactory, be able to correct it. In an extreme case (the system is too complex of highly variable) be able to explain why the chosen solution does not work and look for alternatives in the bibliography.

Social abilities: Apart from the specific objectives formerly stated, during the course the instructor will promote the development of several generic competences amongst which we can point out:

1. Ability to identify the current technological systems as long as the decomposition of them into the different subsystems that make up the global system.
2. Promotion of the team work and the wise division of the work in tasks and sub-tasks.

DESCRIPTION OF CONTENTS

1. Nombre de la U.T. (English) Motivation and Introduction

Descripción de contenidos (English):
Necessity of the automation in real processes. Current possibilities of automation. Robots and their current use.

2. Nombre de la U.T. (English): Sensorization

Descripción de contenidos (English):
The information acquisition process. Types of sensors. Basic technologies and characteristics. Sensor choice and interpretation of the specifications. Characteristics of the signal. Digitalization. Signal preprocessing.

3. Nombre de la U.T. (English): Actuators and power.

Descripción de contenidos (English):
Actuator types. Technologies and basic characteristics. Actuator choice and interpretation of the specifications. Sources of energy: characteristics and limitations. Power devices: storage and regulation.

4. Nombre de la U.T. (English): Control techniques.

Descripción de contenidos (English):
Relationship between perception and action. The closed feedback control loop. Notion of controller. Types of controllers. Stability analysis, Parameter tuning.

5. Nombre de la U.T. (English): Software and intelligence

Architectures for the control of perception. Classification. Implementation: software, languages and real time issues. Artificial intelligence techniques: state spaces, learning algorithms.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	9,00	0
Development of individual work	23,00	0
Preparation of evaluation activities	18,00	0
Preparing lectures	26,00	0
Preparation of practical classes and problem	14,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

1 / Classroom work consisting of:

1.1 / Theory classes, which consist of the presentation and basic explanation of the corresponding matter. Periodically the lecturer will propose activities of short duration, which require the intervention of the students in order to confirm the understanding of the explained theory.

1.2 / Exercise classes, designed to solve problems of higher difficulty, either conceptual or temporal.

1.3 / Laboratory classes designed to experimentally verify some of the most relevant issues seen in the classes of theory.

2 / Non-classroom work consisting on:

2.1 / Resolution and reporting exercises. These classes are meant to solve bulletins exercises proposed by the teacher and/or exposure in public of the resolution of some of them.

2.2 / Preparation for the examinations.

2.3 / Preparation of the laboratory practice, for which the student must have read and assimilated the content of the practice bulletin, as well as having reviewed the relevant theory.

3 / Tutorials individual and/or collective:

Certain individual unscheduled tutoring hours will be scheduled per week to which students may attend to clarify their doubts, as well as hours of collective scheduled tutoring for the clarification of the doubts raised during exercises classes.

EVALUATION

Key results intended to be achieves as a result of the learning of this matter are essentially practical, and are measured by the degree in which the student has acquired the skills referred to in point VIII. For this purpose, the assessment will be based primarily in the resolution of practical problems, simplified ones in the case of the review or the exercises, and real ones for the proposed main work.

According to the new model, we intend to give the final exam a not excessive prominence, but without arriving to a continuous assessment model. Selected teaching evaluation mechanism consists of the following items and assessments:

Assessment of participation (up to 5% of the final mark)

Assistance and implementation of practical work (up to 15% of the final mark)

Resolution of exercises (up to 20% of the final mark)

Final exam (up to 60% of the final mark)

For students unable to attend regular class, an alternative model is offered in which the evaluation of attendance to practical classes and participation are replaced by some additional work and special tutoring assistance, with an equivalent total percentage.

In the second examination call the final mark will be obtained by averaging the exam with a weight of 80% and an exam on the submitted practical exercises with a weight of 20% in all cases. Furthermore, in the case of having failed the practical classes in the first call the alumni will have to submit them again, individually.

The minimum required to overcome the subject will be the equivalent to a 4 out of 10 in the final examination as in the resolution of exercises. Other assessable items are not subject to minimum.

In any case, this subject requires the personal assistance to the laboratory and the execution of exercises in a progressive manner, according to the basic paradigm of the Bolonia's model. Therefore, an alumni cannot be admitted to examination without having performed such tasks because he/she has not been enrolled during at least one term. This excludes the possibility of an advanced examination call for these alumni.

In any case, the evaluation of this subject will be done in compliance with the University Regulations in this regard, approved by the Governing Council on 30th May 2017 (ACGUV 108/2017). https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639

REFERENCES

Basic

- Tadej Bajd, Matja Mihelj, Jadran Lenarcic, Alec Stanovnik, Marko Munih
  Robotics.
  International Series on INTELLIGENT SYSTEMS, CONTROL, AND AUTOMATION: SCIENCE AND ENGINEERING, VOLUME 43, Ed. Springer-Verlag
  ISBN 978-90-481-3775-6
  Libro en línea desde la red de la UV en:
  http://link.springer.com/book/10.1007%2F978-90-481-3776-3
- Reza N. Jazar
  Theory of Applied Robotics: Kinematics, Dynamics, and Control, 2nd Edition
  Ed. Springer-Verlag
  ISBN 978-1-4419-1749-2
  Libro en línea desde la red de la UV en:
  http://link.springer.com/10.1007/978-1-4419-1750-8
- George Bekey,Robert Ambrose, Robert, Vijay Kumar
  Robotics : State Of The Art And Future Challenges
  Ed. World Scientific
  ISBN 13 978-1-84816-006-4
  Libro en línea desde la red de la UV en:
  http://site.ebrary.com/lib/universvaln/Doc?id=10688042
- Roland Siegwart, Illah R. Nourbakhsh. Davide Scaramuzza
  Introduction to Autonomous Mobile Robots (2nd Edition)
  Ed. The MIT Press
  ISBN 978-0-262-01534-6
  Libro en línea desde la red de la UV en:
  http://site.ebrary.com/lib/universvaln/Doc?id=10453037
- Mark Rollins
  LEGO Technic Robotics
  Ed. Apress
  ISBN 978-1-4302-4980-1
  Libro en línea desde la red de la UV en:
  http://link.springer.com/10.1007/978-1-4302-4981-8

Additional

- John-David Warren, Josh Adams, Halard Molle
  Arduino Robotics
  Ed. Apress
  ISBN 978-1-4302-3183-7
  Libro en línea desde la red de la UV en:
  http://link.springer.com/10.1007/978-1-4302-3184-4

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

1. Contenidos

Se reducen ligeramente los contenidos inicialmente recogidos en la guía docente, seleccionando los conceptos indispensables para adquirir las competencias

Se hará especial hincapié en las aplicaciones prácticas de la teoría más que en desarrollos demostrativos de teoremas o propiedades.

Debido a las características de la materia, las sesiones de laboratorio no se pueden realizar de manera no presencial, puesto que se necesita material hardware variado no disponible.

Por otro lado, tampoco es posible realizar (por las mismas razones) un pequeño proyecto distribuido por grupos sobre cuestiones relacionadas con la automatización y la robótica.

En la medida de lo posible se intentará suplir esas carencias con ejemplos y ejercicios relacionados (aunque no serán prácticos).

2. Volumen de trabajo y planificación temporal de la docencia

Se ha reducido la extensión de las clases de teoría para acortar la duración de las videoconferencias (aproximadamente entre 30 y 45 minutos).

Se ha trasladado ese tiempo adicional al tiempo de aprendizaje autónomo del estudiante y a la realización de ejercicios adicionales.

Se sustituyen las sesiones de prácticas por el análisis de ejemplos relacionados con la temática y la resolución de ejercicios de naturaleza similar.

Se mantiene la planificación temporal docente, tanto en días como en horario en lo referente a la teoría.

3. Metodología docente

Sustitución de las clases presenciales por videoconferencias síncronas mediante la creación de tareas de videoconferencia en el aula virtual y ejecución de estas por Blackboard Collaborate siguiendo el calendario establecido (día y hora).

Subida al aula virtual de los materiales para estas sesiones (apuntes). Mismos materiales previstos en la guía original para la docencia presencial excepto algunos documentos adicionales, para suplir en la medida de lo posible la no presencialidad.

Suministro de problemas resueltos y propuestos para su entrega y evaluación mediante la opción de "tarea" de aula virtual con resolución de dudas por el sistema tutorías establecido y presentación de la solución correcta a través de documentos en aula virtual.

Sistema de tutorías. Se mantiene el programa de tutorías virtuales con atención en un máximo de 48 horas (24 normalmente)) mediante correo electrónico. Si la consulta lo requiere, se adoptan otros medios de comunicación telemática.

4. Evaluación

La nueva valoración de las diferentes partes de las que consta la nota final será la siguiente:

Ejercicios propuestos entregables: 50% de la nota final, con:

Prueba de evaluación final: 50% de la nota final.

Dicho ejercicio constará de una serie de cuestiones teórico-prácticas para su desarrollo. Se subirá al aula virtual como tarea a la hora prevista del inicio del examen. La resolución del examen se enviará en forma de fichero (preferiblemente pdf) con un máximo de 5 minutos desde la hora de finalización de la prueba. Además, deberá haber una conexión con BBC a través de aula virtual, con conexión de cámara y desconexión de micro.

En cualquier caso, estos detalles serán consultados con los alumnos para llegar al mayor consenso tanto de formato como de mecanismo de comunicación.

En principio se podrá consultar los apuntes para la realización de la prueba

5. Bibliografía

No hay variaciones en este apartado respecto a la bibliografía propuesta en situación normal.