Project 1:
Title: Modelling magnetic materials in circuit simulators.

Abstract: There are several applications where non-linear magnetic materials (especially ferrites) are commonly used. Taking into account first-order characteristics of these materials (like saturation, variable differential permeability, etc.) is quite easy. It is quite more difficult to take into account more detailed behaviors; there are several approach in the technical literature and various models that try to approximate the real behavior of these materials, like for example [1].

In order characterize magnetic materials and find the parameters of the advanced models, accurate measurements are needed. Tradition approaches call for quite expensive instrumentation systems; lately a simplified method has been proposed [2] that reduce the cost and the complexity of the system at the expense of a quite more convoluted analysis of the results.

These methods are quite sensible to the details of the conditioning system and on the parasitics of the devices used; these method will benefit greatly from the availability of circuital models that can be integrated into circuit simulators programs. Proprietary models for proprietary programs do exist, but they are closed source and so they are difficult to modify when the simulation is not satisfactory.


Prerequisite: The student(s) is/are expected to learn how to use one of the available open source circuit simulator system [3] and to try to develop a macro-model of the magnetic materials that take into account the detailed behavior of the material. They must know basic calculus, basic electronics device and circuits, fundamentals of magnetic fields and transformer, and be at ease with computers and simulators. It helps if he or she has computer programming knowledge (any language).


Supervisor: Prof. Dr. Romano Giannetti

Format: better extensive, acceptable intensive.

Workload: 80 h x 2 students

Students: 2 (but can be assigned to one student, if he or she has sufficient prerequisites, with a reduction in goals).
Project 2:

**Title:** state of the art study in nervous system signal measurement.

**Abstract:** The advent of MTM (Mind To Machine) direct interfaces has been advertised as “the next year technology” for the last twenty years. There are a lot of partial, disconnected results in literature that are difficult to organize, parse and evaluate critically.

The objective of this work is to do an extensive state of the art bibliographic research and to write a technical resume of the recent techniques — with hard data like type of amplifier/conditioner used, electrodes, technical characteristics of the system (noise, resolution, autonomy) and a survey of the resulting applications.

**Prerequisite:** The student must know basic calculus, electronics device and circuits, and a good understanding of amplifiers characteristics. It helps if he or she has any knowledge of biomedical electronics or engineering.

**Supervisor:** Prof. Dr. Romano Giannetti

**Format:** extensive/intensive

**Workload:** 80 h

**Students:** 1 (but can be extended for two students, with additional goals).

Project 3:

**Title:** Research on Visible Light Communication techniques

**Abstract:** Solid state lighting is predicted to replace fluorescent and other lighting sources for general illumination, due to its reliability and the potential for highly efficient sources. Compared with other sources of illumination these devices can be modulated at high data rates, offering the opportunity for communications as well as illumination from these sources. Such Visible Light Communications (VLC) has been investigated in Japan by the Visible Light Communications Consortium (VLCC). The project consist of researching about the main modulation techniques in order to transmit information using VLC and their corresponding hardware implementation. If time allows it, a simple demonstration will also be built.

- **Previous knowledge:** electronics and communications.

- **Supervisor:** Javier Matanza Domingo

- **Workload:** Semestral or Summer-intensive

- **Workload per student:** 80 h

- **Number of students:** 2
### Project #4

**Title**  
RFID (Radio Frequency Identification)

**Project description**  
The goal of this project is to study the use of a radio frequency identification system. RFID systems installed in the laboratory with different types of tags (Siemens and I (Programmable Logic Controller) to be able to automatically control the path of a path.

**Prerequisites**  
Foundations of digital/logic systems and undergraduate-level programming.

**Supervisors**  
José Antonio Rodríguez Mondéjar

**Dedication**  
Any (summer intensive is preferred).

**Workload**  
80h or 160h, although the latter is desirable.

**No. of students**  
1 or 2. Preference: 1

### Project #5

**Title**  
Automated mounting system

**Project description**  
The aim of this project is to program an industrial robot to assemble a product with a system. The student will have to study the programming language of the ABB IRB developing a program to build a given design. As the bricks could in principle be arranged improved by incorporating a camera to deal with randomly positioned blocks.

**Prerequisites**  
Foundations of digital/logic systems and undergraduate-level programming.

**Supervisors**  
José Antonio Rodríguez Mondéjar

**Dedication**  
Any (summer intensive is preferred).

**Workload**  
80h or 160h, although the latter is desirable.

**No. of students**  
1 or 2. Preference: 1
Project #6

Title: Image-based inspection system

Final product quality control is a fundamental step in any manufacturing facility. Thanks to the rapid development of cameras and image processing algorithms over the past few years, this project is to implement an inspection system using a COGNEX camera that is able to interact with the camera's API (Application Programming Interface), the student will have to familiarize themselves. The provided by a conveyor system (e.g., LEGO brick constructions). Initially, all products will be feasible, but becomes harder if there is significant rotation. In case there is enough time left, the student.

Prerequisites: Foundations of digital/logic systems and undergraduate-level programming.

Supervisors: José Antonio Rodríguez Mondéjar and Jaime Boal Martín-Larrauri

Dedication: Any (summer intensive is preferred).

Workload: 80h or 160h, although the latter is desirable.

No. of students: Preferably 1, the project could be adapted for up to 2 students.

Project #7

Title: Automated warehouse

Using ICAI's mini-factory, this project intends to reproduce a simplified version of the job orders introduced through a touch panel, an ABB IRB 120 robot will automate the job. These pallets will be delivered to the assembly station using a conveyor belt. A touch panel to allow introducing job orders and keeping track of the remaining stock.

Prerequisites: Foundations of digital/logic systems and undergraduate-level programming.

Supervisors: José Antonio Rodríguez Mondéjar and Jaime Boal Martín-Larrauri

Dedication: Any (summer intensive is preferred).

Workload: 80h or 160h, although the latter is desirable.

No. of students: Preferably 1, the project could be adapted for up to 2 students.
Project 1

PROJECT TITLE: IMPLEMENTATION OF ALGORITHMS FOR A PHASE-FIELD MODEL

2) SUMMARY

We consider the slow decay from metastable states of different phase-field models which stand for the dynamic phase transition between two or more different states (thus allowing to study mixtures of two or more components). This model governs also the dynamics of the density of bacterial colony or the mass of growing tumor or even the glacier mass movement.

The proposed project has as main goal to solve the phase-field equation in the one-dimensional case by numerical integration, in order to confirm the predictions of the theory results.

3) Recommended previous knowledge: Manage of some programming language, as MATLAB in order to solve the differential equations by integration scheme (as fourth order Runge-Kutta).

4) Supervisor: Ángela Jiménez Casas

5) Format: Intensive or/and 2º semester

6) Number of hours per student: 100

7) Maximum number of students: 2

Project 2

PROJECT TITLE: IMPLEMENTATION OF ALGORITHMS FOR THE TREATMENT OF COMPEITION PROBLEMS IN POLITICAL ECONOMY (IV)

2) SUMMARY
The proposed project has as main goal the study of the best response for the government of a state in making decision problems related to the political attitude and vote intention of its population.

At this respect, some algorithms to solve problems of political competition when a one dimensional political space is considered (a circumference), will be developed and implemented by means of a high level program such as C or Mathematica.

3) Recommended previous knowledge: Manage of some programming language, as C, Visual Basic or Mathematica

4) Supervisor: Javier Rodrigo

5) Format: Intensive

6) Number of hours per student: 100

7) Maximum number of students: 2

Project 3

PROJECT TITLE: IMPLEMENTATION WITH THE SOFTWARE MATLAB OF COLLOCATION METHODS AND PATH FOLLOWING TECHNIQUES, TO GET BIFURCATION DIAGRAMS FOR STEADY-STATES SOLUTIONS OF REACTION-DIFFUSION EQUATIONS

2) SUMMARY

The proposed project will be divided in two parts:

- The main goal of the first part of the project will be to implement collocation methods and path following techniques with the software Matlab for a very general class of reaction-diffusion equations.
- The second part of the project will be focussed to get the bifurcation diagrams for steady-states solutions of a particular class of reaction-diffusion equations, of great interest from the point of view of the applications, through the files implemented in the first part of the project.
3) Recommended previous knowledge: Basic knowledge about differential equations and the software Matlab.

4) Supervisor: Santiago Cano Casanova

5) Format: Intensive or 2nd semester

6) Number of hours per student: 100

7) Maximum number of students: 1

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**Project 4**

**PROJECT TITLE:** IMPLEMENTATION WITH THE SOFTWARE MATLAB OF COLLOCATION METHODS AND PATH FOLLOWING TECHNIQUES, TO GET BIFURCATION DIAGRAMS FOR STEADY-STATES SOLUTIONS OF REACTION-DIFFUSION EQUATIONS

---

**2) SUMMARY**

The proposed project will be divided in two parts:

- The main goal of the first part of the project will be to implement *collocation methods* and *path following techniques* with the software Matlab for a very general class of reaction-diffusion equations.

- The second part of the project will be focussed to get the bifurcation diagrams for steady-states solutions of a particular class of reaction-diffusion equations, of great interest from the point of view of the applications, through the files implemented in the first part of the project.
7) Maximum number of students: 1

**ENERGY TECHNOLOGIES DEPARTMENT**

**Project 1**

**RESEARCH PROJECT CRM**

<table>
<thead>
<tr>
<th>Project</th>
<th>Analysis of different back-end strategies of nuclear used fuel.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>Nowadays many different back-end technologies and strategies exist, in order to ensure a safety management of the nuclear used fuel. This strategies are considered an important decision for the energy future. In this project, all the strategies are going to be analyzed from an economical point of view (open cycle, closed cycle, advanced cycle, reprocessing…) In order to establish conditions and ideas to select the better strategy.</td>
</tr>
<tr>
<td>Previous Knowledge</td>
<td>No previous knowledge is necessary</td>
</tr>
<tr>
<td>Supervisor</td>
<td>Yolanda Moratilla Soria</td>
</tr>
<tr>
<td>Formato</td>
<td>Indiferente</td>
</tr>
<tr>
<td>Carga de trabajo</td>
<td>200 h</td>
</tr>
<tr>
<td>Nº Alumnos</td>
<td>2</td>
</tr>
</tbody>
</table>
Project 1

Title: Electric vehicles and charging infrastructure in the US and in the EU

Summary: The deployment of plug-in electric vehicles (PEVs) has been highlighted as a transportation alternative with lower carbon emissions and as a flexible resource that can provide services to the electricity system. At the same time, battery technologies are becoming more competitive and therefore PEVs costs are decreasing. PEVs sector is developing differently around the world and the US is becoming a leader as companies such as Tesla Motors are becoming a major player in this market. The objective of this project is to describe the penetration levels of PEVs in the US, the development of charging infrastructure, and business models for fast charging and slow charging. In addition, the current situation in some European Union (EU) countries will be investigated. The project will make a literature survey on ongoing initiatives and developments. This work is continuation of a previous report that will be taken as starting point.

Previous knowledge: not required. Knowledge of electric power sector is an advantage.

Supervisors: Tomás Gómez San Román & José Pablo Chaves Ávila

Schedule: Intensive

Work load: 80h or 160h

Number of students: 2 or 3.
# ENVIRONMENTAL PROJECTS

## RESEARCH PROJECT 1

<table>
<thead>
<tr>
<th>Project</th>
<th>Anaerobic co-digestion and pretreatments (Laboratory work)</th>
</tr>
</thead>
</table>
| Abstract | Nowadays, anaerobic digestion and co-digestion are becoming new, more sustainable and better-established energy sources. It is for this reason that finding a simple, and affordable, way to characterize substrates and feedstocks from the biomethane or biogas production point of view is becoming increasingly important.  
In this project, an experimental method is going to be developed, in order to characterize the biological process. |
| Previous Knowledge | No previous knowledge is necessary |
| Supervisor | M. Mar Cledera Castro |
| Formato | Indiferente |
| Carga de trabajo | 200 h |
| Nº Alumnos | 2 |

## RESEARCH PROJECT 2

<table>
<thead>
<tr>
<th>Project</th>
<th>Waste-water disinfection with stabilized ClO2 (Laboratory work)</th>
</tr>
</thead>
</table>
| Abstract | Nowadays, disinfection of water is becoming a controversial aspect in environmental engineering and technology. Specially due to waste water regeneration and reuse.  
Actually, a new disinfection process has arise. This is the stabilized ClO2.  
In this project, an experimental method is going to be developed, in order to characterize the chemical process and its effectiveness. |
| Previous Knowledge | No previous knowledge is necessary |
**MANAGEMENT PROJECTS**

Project 1

**PROJECT TITLE: EXPLORE STATISTICS WITH R:**

2) SUMMARY

The proposed project has as main goal data analysis with an open source statistical programming language. The specific objectives can be listed as follows:

1. Learning to use R libraries necessary for data analysis and graphing, visualization and statistical inference.

2. Programming in R algorithms required for managing large databases.

3. Open Data information for further studies.

3) Recommended previous knowledge: statistics and manage of some programming language, as C, Visual Basic or Mathematica

4) Supervisor: Raquel Caro

5) Format: Intensive

6) Number of hours per student: 80

7) Maximum number of students: 2
MATERIALS SCIENCE PROJECTS

Project 1
- Modification of epoxy resins with graphite nanoplatelets. Mechanical properties. (2 students)

Project 2
- Modification of epoxy resins with carbon nanotubes and graphene. Mechanical, Thermal and electrical properties. (2 students)

Project 3
- Bone cements with carbon nanomaterials. (2 students)

Project 4
- Study of mechanical properties and antimicrobial activity of bone cements with antibiotics microencapsulated (2 students). 

Project 5
- Chemical Functionalization of nanomaterials. (2 students).

Project 6
- Mechanical study of mechanical, structural and PSA adhesives joints. (2 students)

Project 7
- Non Destructive Testing of composites and adhesive joints (2 student)

Project 8
- Biomechanical study of knee prosthesis (1 student)

Project 9
- Application of biodegradable adhesives in maxillofacial fractures (1 student)

Project 10
- Inorganic coatings with antimicrobial activity (1 student)

Project 11
- Bone cements with AgNP's (1)
MECHANICAL DEPARTMENT

No projects for 2016