RESEARCH PROJECTS 2022-2023

Interested in learning more about a particular project? Please send questions to Beth Slack (beth.slack@cooper.edu). Please **DO NOT** contact supervisors directly!

Department/Area

Electrical Engineering

Title/Name

Setting and testing power system protections

Abstract/Description

Protections are the silent centinels of the power system. Protections detect faults in the power system components (generators, lines, tranformers) and clear them by sending command actions to circuit breakers. Working in the proposed project, students will lean how to determine the settings of a state of the art protection device. Moreover, students will test the proper operation of the protection device in the laboratory.

Prerequisites

Required	Circuit theory and analysis
Recommended	AC circuit analysis

Supervisor(s)/Tutor(s)

Name(s)	Luis Rouco

Structure

Format	Semester (extensive, 15 weeks), Summer (intensive, preferably 8 weeks), Both are available *Both*
Workload	100 hours (4 ECTS) / 200 hours (8 ECTS) *Both*
Students	1, 2, 3, 4, 5 *3*

Department/Area

Mechanical, Materials, Electrical, Electronics/Control, Telematics/CompSc, Management, Applied Mathematics, IIT

Title/Name

Sci-fi for engineers. New subject proposal. II

Abstract/Description

The purpose of this investigation is to create a new subject for engineers. It is intended to cover different science fiewlds that are not usually included in the 'conventional'. Subject.

The procedure is as foillows:

1- Define 5 topics/ techonolgies (20h of live lessons).

2- Make a technical summary of the technology to be covered

3- Select material to support the lesson based in SCI-FI boofs / films / TV

4- Create the Syllabus of the subject

Some examples

- Water and sustainability (Dune).

- Mobility of the future: From Hyperloop to Star Trek teleportation

Excluded: (Alreqady developed)

- Time travel
- Autonomus vehicles
- AI and Morality
- Augmented reality
- Internet of drones

Prerequisites

Required	SCI fan
Recommended	

Supervisor(s)/Tutor(s)

Name(s)	Juan de Norverto

Structure

Format	Semester (extensive, 15 weeks), Summer (intensive, preferably 8 weeks), Both are available
Workload	100 hours (4 ECTS)
Students	1, 2 *(5 items per student)*

Department/Area

Mechanical

Title/Name

State of art for tea packing machine

Abstract/Description

Review on the main designs of tea packaging machines

Prerequisites

Required	Good English
Recommended	

Supervisor(s)/Tutor(s)

Name(s)	María Ana Sáenz

Structure

Format	Semester (extensive, 15 weeks)

Workload	100 hours (4 ECTS)
Students	1

Department/Area

Materials

Title/Name

Design and optimziation of a optical goniometer to determine surface energy

Abstract/Description

The measurement of surface tension and wettability of materials is fundamental for multiple applications (adhesion, coating, biology, hydrophobicity, etc.). The objectives of this project are the setting-up of an equipment for the measurement of these properties and the development of a method for surface tension calculation.

Prerequisites

Required	Matlab
Recommended	CAD software

Supervisor(s)/Tutor(s)

Name(s)	Eva Paz Jiménez - JC del Real

Structure

Format	Both are available
Workload	100 hours (4 ECTS) / 200 hours (8 ECTS) *Both*
Students	2

Department/Area

Materials

Title/Name

Analysis of dimensional stability of 3D printed parts

Abstract/Description

This projects aims the development and optimisation of a procedure to measure the dimensional accuracy of 3D printed parts. For that, 3D printed samples will be analised using an Optical Microscope. For the evaluation of the dmensional accuaracy it will be necessary the development of tool using Matlab or a simmilar SW.

Prerequisites

Required	Matlab;
Recommended	3D Printing skills; CAD software

Supervisor(s)/Tutor(s)

Name(s)	Eva Paz – Sara López de Armentia

Structure

Format	Both are available
Workload	100 hours (4 ECTS) / 200 hours (8 ECTS)
Students	2

Department/Area

Materials

Title/Name

Determination of the elastic properties of materials by Digital Imaging Correlation

Abstract/Description

This project aims to determine mechanical properties by Digital Imaging Correlation. The students should set up the method and compare it with other techniques, such as strain gages.

Prerequisites

Required	Basic knowledge of Materials Science.
Recommended	Basic knowledge of Experimental Stress Analisys

Supervisor(s)/Tutor(s)

Name(s)	JC del Real – Yolanda Ballesteros

Structure

Format	Both are available
Workload	100 hours (4 ECTS) / 200 hours (8 ECTS)
Students	2

Department/Area

Materials

Title/Name

Design and manufacturing Arcan device to measure shear and tensile properties of polymers and adhesive joints

Abstract/Description

The project aims to design and construct the necessary parts and elements to carry out the Arcan tests on polymeric and composite materials. These tests are fundamental in characterizing materials in shear or combinations of tensile and shear stresses.

To make this device, additive manufacturing techniques will be used. Finally, tests will be carried out to validate its operation once manufactured.

Prerequisites

Required	CAD software;
Recommended	3D Printing skills;

Supervisor(s)/Tutor(s)

Name(s)	Yolanda Ballesteros - JC del Real

Structure

Format	Both are available
Workload	100 hours (4 ECTS) / 200 hours (8 ECTS) *Both*
Students	2

Department/Area

Mechanical Engineering

Title/Name

Sustainability analysis of night trains

Abstract/Description

Night trains across Europe are experiencing a revival, as they are seen as an efficient, comfortable, and sustainable mode of travel. Trains are in general more carbon-friendly than other modes of transport and therefore contribute to mitigate climate change. However, (inter-)national transport policies typically favor air and road travel, making trains less affordable and convenient. In this project, students will use indicators to highlight the strengths and opportunities for night trains as an international mode of transport from the point of sustainability (including environmental impact, energy needs and socioeconomic aspects).

This project will be done in cooperation with the European Back-on-Track coalition, a lobby that hopes to recover conventional and night trains to the continent.

Although no fieldwork is expected, students are encourage to travel by train during their stay in Comillas and share their experiences.

Prerequisites

Required	
Recommended	Basic knowledge of concepts related to environmental management and sustainability

Supervisor(s)/Tutor(s)

Name(s)	Katia Hueso Kortekaas

Structure

Format	Semester (extensive, 15 weeks), Summer (intensive, preferably 8 weeks), Both are available
Workload	100 hours (4 ECTS)
Students	2

Department/Area

Telematics/CompSc,IIT

Title/Name

Wind turbine anomaly detection methods based on deep learning

Abstract/Description

Nowadays, the optimum use of wind turbines is an interesting topic due to its importance and impact on energy production. The continuous condition monitoring of their behavior observed helps to plan their maintenance and to optimize investments both in maintenance and replacement.

This work pays attention to the characterization of the power curve of a wind turbine in order to predict its performance expected. If the performance expected is not the real observed, a possible anomaly could be present.

The characterization of the power curve will be based on several deep-learning techniques working in an ensemble. For the development of this work, real data from a wind turbine will be used.

Prerequisites

Required	Python, machine learning techniques
Recommended	

Supervisor(s)/Tutor(s)

Name(s)	Miguel A. Sanz Bobi

Structure

Format	Semester (extensive, 15 weeks), Summer (intensive, preferably 8 weeks), Both are available
Workload	100 hours (4 ECTS)
Students	2

Department/Area

IIT

Title/Name

Simulation of a 100% renewable electricity market: long-term versus short-term marginal costs

Abstract/Description

Two simulation models based on mathematical programming will be specified and programmed to simulate a case study 100% renewable, with solar, wind, and storage. First, the investment cost minimization for a small case study will be programmed. Results and sensitivities to main invesment parameters will be analyzed. Second, a detailed hourly model for operational cost minimization will be programmed. Results and sensitivities to operational parameters will be analyzed. Long-term and short-term marginal costs would be derived and compared from the two previous models.

Prerequisites

Required	MATLAB optimization toolbox, Python
Recommended	GAMS or other optimization languages

Supervisor(s)/Tutor(s)

Name(s)	Tomás Gómez

Structure

Format	Semester (extensive, 15 weeks), Summer (intensive, preferably 8 weeks), Both are available
Workload	200 hours (8 ECTS)
Students	1, 2, 3 *[Borrar lo que no proceda. Número máximo de alumnos trabajando en equipo en el proyecto]*

Department/Area

Electronics, IIT

Title/Name

Automatic classification of biological powders with a submerged dielectric resonator biosensor and machine learning techniques

Abstract/Description

Dielectric resonator biosensors are a very promising technology due to their label-free detection, low-cost materials, and non-destructive interaction with the sample. The objective of the proposed project is to test a biosensor design with dry biological substances such as flour, coffee, or cocoa. The measurements will be analyzed with ML techniques to maximize biosensor accuracy. The results will be used to delimit the full potential of this technology for biomedical or food industry applications.

Prerequisites

Required	Electronic measurements
Recommended	It would be nice to have some knowledge of machine learning, but it could be learned during the project.

Supervisor(s)/Tutor(s)

Name(s)	Miguel Monteagudo Honrubia, Francisco Javier Herraiz Martínez, Javier Matanza Domingo

Structure

Format	Semester (extensive, 15 weeks), Summer (intensive, preferably 8 weeks), Both are available
Workload	200 hours (8 ECTS)
Students	1

Department/Area

Electronics, IIT

Title/Name

Biomolecule detection in organic dissolutions with a submerged dielectric resonator biosensor and machine learning techniques

Abstract/Description

Dielectric resonator biosensors are a very promising technology due to their label-free detection, low-cost materials, and non-destructive interaction with the sample. The objective of the proposed project is to test a biosensor design with biological dissolutions such as milk, juice, or soy milk. The measurements will be analyzed with ML techniques to maximize biosensor accuracy. The results will be used to delimit the full potential of this technology for biomedical or food industry applications.

Prerequisites

Required	Electronic measurements
Recommended	It would be nice to have some knowledge of machine learning, but it could be learned during the project.

Supervisor(s)/Tutor(s)

Name(s)	Miguel Monteagudo Honrubia, Francisco Javier Herraiz Martínez, Javier Matanza Domingo

Structure

Format	Semester (extensive, 15 weeks), Summer (intensive, preferably 8 weeks), Both are available
Workload	200 hours (8 ECTS)
Students	1