CORNELL-CANTABRIA EXCHANGE PROGRAM ENGINEERING COURSES AT SANTANDER

General Description

The University of Cantabria (Santander, Spain) offers its Cornell-Cantabria Exchange Program to international students wishing to spend a year or a semester abroad completing core subjects in the field of Engineering. The program covers topics usually taken during junior year by engineering students.

Entrants are required to have completed basic Engineering courses at the home institution. All courses are taught in English by prominent professors from the University of Cantabria and partner Universities.

Program details

The program offers the following unit Courses: Engineering Computation; Strength Of Materials; Introduction to Geotechnical Engineering; Fluid Mechanics; Geology; Mechanical Properties of Materials Engineering Economics and Management; Coastal Engineering; Uncertainty Analysis in Engineering; Environmental Engineering; Energy Systems; Introduction to Business Administration; Structural Analysis; Geotechnical Engineering: Foundations, excavations and tunnels; Hydrology; Construction of Civil Infrastructure; Heat Transfer.

Five courses are taught during the Fall Semester (late September through mid-February) and twelve during the Spring Semester (mid-February through June). A maximum of 20 international students is allowed for each unit course. Grading system is based on continuous evaluation, including mid-term and final exams.

Intensive Spanish courses are offered prior to the beginning of each term. Students may also take Spanish regular courses. An especially designed course on Prehistoric European Art (6 ECTS credits), also taught in English, is offered to the students attending the program in the spring semester.

Init Courses

Engineering Computation

Fall. 6 ECTS credits

This course addresses the science, practice, and art of computing numerical solutions to mathematically posed engineering problems. Engineering computation must be done correctly to avoid the accumulation of

computational errors that render the numerical results useless. In this course you will learn the methods you need to compute numerical solutions to engineering problems correctly (i.e. with little error) and with computational efficiency. This knowledge will enable you not only to write your own codes for powerful engineering computation but also to be able to use existing software packages more effectively.
Textbook: *Numerical Methods for Engineers. S. C. Chapra and R. P. Canale*

Strength of Materials

Fall. 6 ECTS credits

The course presents the basic concepts related to the analysis and design of structural members subjected to tension, compression, torsion and bending. Specific topics include: stress and strain, deformations and displacements, elasticity and plasticity, stresses in beams, deflections of beams, internal forces diagrams, statically indeterminate beams, composite beams, energy methods.
Textbook: *Mechanics of Materials. James M. Gere and Barry J. Goodno*

Introduction to Geotechnical Engineering

Fall. 6 ECTS credits

Origin and description (identification and state parameters) of soil and rock. Ground water: Hydrostatic condition. Steady-state subsurface fluid flow. Soil stresses: Stress components and parameters. Principle of effective stresses. Geostatic condition: stress history, overconsolidation, lateral stresses. Confined compression of soils. Consolidation and settlement. Oedometric tests. Partially saturated soils: soil suction, collapse and swelling. Soil strength and deformability: Drained and undrained strength. Soil behaviour in triaxial and shear tests.
Textbook: *Fundamentals of Geotechnical Engineering. Das, B.M.*

Fluid Mechanics

Fall. 6 ECTS credits

This course covers hydrostatics, the basic equations of incompressible fluid flow, potential flow and dynamic pressure forces, viscous flow and shear forces, steady pipe flow, turbulence, dimensional analysis, laminar and turbulence boundary layer, flows around obstacles, and open-channel flow. The course includes small-group laboratory assignments.
Textbook*: A Brief Introduction to Fluid Mechanics. Donald F. Young, Bruce R. Munson and Theodore H. Okiishi.*

Geology

Fall. 6 ECTS credits

This subject covers the main properties of rocks with an emphasis on problems and applications to engineering projects. Rocks and discontinuities are the key elements of rock mass and the subject will cover the principles of bedrock classification based on these criteria. There is also an introduction to Geomorphology and its application to engineering projects. The course includes practical activities focused mainly on geological maps but also aerial photography and identification of rock samples.
Textbook: *Geology for Engineers and Environmental Scientist, 3rd Edition. Alan E. Kehew*

Mechanical Properties of Materials

Spring. 6 ECTS credits

The aim of this course is to provide the student with the basis to understand the different models of mechanical behaviour of materials used for structural purposes. The course is divided into two sections: The first part is focused on understanding the linear-elastic, plastic and viscous behaviour of materials. The second one pays attention to the application of fracture mechanics and failure analysis in structural integrity assessments. In all cases a threefold point of view is used for the description of the phenomena: phenomenological description of the models, structural application and microstructural understanding. The course includes some laboratory practises to be conducted by the students in small groups.

***Textbook**: ASHBY M.F. y JONES D.R.H., "Engineering Materials: An introduction to microstructures, processing and design", Butterworth-Heinemann (1998).*

Engineering Economics and Management

Spring. 6 ECTS credits

At the end of this subject the student will be able:

- To rigorously formalize the decisions inherent to his technical work to justify and to defend the elections he propose
- To include in his analytical framework economic concepts as inflation, taxation, depreciation, financial planning, economic optimization …
- To analyze and discuss the selections made by others.
- To understand the economic consequences derived from his personal decisions about savings, investment, retiring...

***Textbook**: Engineering Economic Análisis. Edward W. Wheeler & Donald G. Newman.*

Coastal Engineering

Spring. 6 ECTS credits

The aim of this course is to provide the student with the knowledge for the design, construction and management of coastal works, and more specifically those devoted to coastal protection against erosion and beach nourishment and restoration. The course is divided into three main sections. The first one is focused on the understanding of coastal processes, the second is devoted to the conceptual models and formulations used in engineering designs, the third one deepen on several hot topics related with shore protection and coastal management

***Textbook:** Introduction to Coastal Engineering & Management. J.W. Kamphuis.*

Uncertainty Analysis in Engineering

Spring. 6 ECTS credits

The course provides an introduction to probability and statistics, statistical techniques, and uncertainty analysis with examples drawn from civil, environmental, industrial and related engineering disciplines. Specific topics include: data presentation, discrete probability theory, commonly used probability distributions (normal, lognormal, gamma, Weibull, Gumbel, Poisson, binomial, geometric), probability plotting papers, survey sampling & experimental design issues, parameter estimation (MLEs and moments), confidence intervals, hypothesis testing (Student t; one/two-sample/paired), some nonparametric statistical tests, simple linear regression and an introduction to multiple linear regression and model selection.

***Textbook:** Probability and Statistics for Engineering and the Sciences.* Jay L. Devore.

Environmental Engineering

Spring. 6 ECTS credits

The course provides the students with the basic knowledge to understand and solve Environmental Engineering issues. It introduces the basic biological, chemical and physical processes of relevance in the field, stressing the mass balance and transport concepts. These principles are analyzed and applied to the main areas of Environmental Engineering: air and noise pollution, solid waste management, water treatment, water quality and wastewater treatment.

***Textbook:** Introduction to Environmental Engineering. David A. Cornwell and Mackenzie L. Davis.*

Energy Systems

Spring. 6 ECTS credits

This course introduces energy systems with emphasis on design and costs. The course presents a systems approach to energy needs, covering carbon-based, nuclear, and renewable energy sources, including solar energy, small-scale hydropower, wind, bio-conversion processes, and house energy balances.

***Textbook.** Energy Systems Engineering: Evaluation and Implementation.* Francis Vanek and Louis Albright

Introduction to Business Administration

Spring. 6 ECTS credits

At the end of this course the student will be able:

- To understand basic Economy and Business Administration concepts
- To recognize the role of companies in national and world Economy and how they adapt to different economic situations
- To distinguish different areas of expertise in the field of Business Administration: Direction, Marketing, Finances, Investments, etc.
- To know basic Business Administrations techniques related to risk evaluation, growing strategies, resources optimization, marketing tools.

Textbook. *Organizational Behavior.* Stephen Robbins and Timothy Judge. *Engineering Economic Analysis.* Donald Newnan, Ted Eschenbach and Jerome Lavelle. *Economics.* Paul Samuelson and William Nordhaus.

Structural Analysis

Spring. 6 ECTS credits

The main objective of this course is to present both the conceptual analysis of structures and its computational approach based on matrix analysis and finite elements. Topics include: analysis of trusses; analysis of frames; virtual work and unit load method; basic concepts of structural stability; influence lines and introduction to the finite element method.

Textbook. *Structural Analysis.* Russell C. Hibbeler. *Matrix Analysis of Structures.* Robert E. Sennet.

Geotechnical Engineering: Foundations, excavations and tunnels

Spring. 6 ECTS credits

Site exploration: planning, borings, tes pits, in situ tests, geophysical methods. Shallow and deep foundations: design and construction. Earth retaining structures. Excavations and fills: slope stability. Ground improvement. Tunnels in rock and soft ground: geotechnical aspects of construction methods, design considerations.

Textbook: *Fundamentals of Geotechnical Engineering. Das, B.M. Practical Rock Engineering. Hoek, E. (2007)*

Hydrology

Spring 6 ECTS credits

This course studies the hydrological cycle and phenomena involved in it. It discusses methods for measuring flow in a section of a watercourse; hydrographs are studied and the methods for their determination and for their transit through stretches of rivers and reservoirs and are determined maximum flows in both the general case and in cases such as urban hydrology and drainage of roads. Finally, we study basic aspects of Hydrogeology and movement in porous media.

Textbook: *Applied Hydrology. Ven Te Chow, David R. Maidment and Larry W. Mays.*

Construction of Civil Infrastructure

Spring. 6 ECTS credits

This course offers to the student a review of the main engineering concepts related with the construction of civil infrastructure: types of civil infrastructures, machinery used in civil engineering, construction procedures and management systems in construction engineering. At the end of the course, the student will be able to allocate resources during the construction process with effectiveness and efficiency, to use interdisciplinary approach as basic mechanism of value-creating in construction engineering, to respect the built heritage and the cultural expression in construction, and to be sensitivity to problems of safety and health in construction, minimizing the risks in all the activities.

Textbooks: *"Moving the earth: the workbook of excavation" / Herbert L. Nichols, David A. Day. 6th ed. New York: Mc Graw Hill, 2010, and "Modern construction management" / Frank Harris and Ronald McCaffer with Francis Edum-Fotwe. 6th ed. Oxford: Blackwell, 2006.*

Heat Transfer

Spring. 6 ECTS credits

The main objective of this course is to present both the fundamentals of Heat Transfer and Two-Phase Flow. This course provides students with a working knowledge of conduction, convection, radiation; heat exchanger; boiling and condensation; and heat transfer measurement. The last part of this course is devoted to the theoretical foundation of multi-phase flow thermo-fluid dynamics and its application to Power Generation Systems.

Textbook: Introduction to Heat Transfer Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine