



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 unit Courses such as: Engineering Computation; Foundation Engineering; Introduction to Geotechnical Engineering; Fluid Mechanics; Mechanical Properties of Materials; Structural Modeling and Behavior; Advanced Solid Mechanics; Coastal Engineering; Engineering Economics and Management; Uncertainty Analysis in Engineering; Hydrology and Introduction to Business Administration.

Four courses are taught during the Fall Semester (late September through mid-February) and nine 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. A especially designed course on Prehistoric European Art (6 ECTS credits), also taught in English, is offered to the students attending the program.



Unit 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 Not offered in 2011-2012

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. Oedometer 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.

Mechanical Properties of Materials

Spring. 6 ECTS credits

The course presents the basis to understand the mechanical behaviour of materials used for structural purposes, the different elastic, plastic and viscous models. It also defines the application of fracture mechanics and failure analysis to be used in structural integrity assessments. Finally, it includes the experimental work that supports the previous areas.

Textbook. *Mechanical Behaviour of Materials*. Gutierrez-Solana, F. and Alvarez, J. A.

Advanced Solid Mechanics

Fall. 6 ECTS credits

The course presents the basic theory of stress and strain and its application to advanced topics in the field of solid mechanics. Specific topics include: theory of stress and strain; stress-strain-temperature relations; torsion of noncircular bar and hollow thin-wall members; bending and torsion of open thin-wall members; stability analysis for columns and beam-columns; nonlinear material response and yield criteria; plastic analysis of beams and frames.

Textbook. *Advanced Mechanics of Materials*. Arthur P. Boresi and Richard J. Schmidt

Structural Modeling and Behavior

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 two and three-dimensional trusses; analysis of frames; grids, cables and arches; virtual work and unit load method; basic concepts of structural stability; introduction to the finite element method. The course also introduces the application of finite element software.

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

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.

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 Analysis*. Edward W. Wheeler & Donald G. Newman.

Hydrology

Spring. 6 ECTS credits

Heat Transfer and Two-Phase Flow

Spring. 6 ECTS credits

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, log-normal, 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 non-parametric 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.

Foundation Engineering

Spring. 6 ECTS credits

Ground exploration: borings, sampling, in situ tests, geophysical exploration. Elastic stress distribution in soils and rocks. Limit analysis of geotechnical problems. Shallow foundations: Bearing capacity, settlements. Deep foundations: types of piles, bearing capacity. Earth retaining structures: earth pressures, active, passive and at-rest cases. Design of rigid walls. Diaphragm walls and other flexible structures. Slope stability: types of slope failures in soils and rocks. Stability analysis. Corrective measures.

Textbook. *Fundamentals of Geotechnical Engineering*. Das, B.M.

Environmental Engineering

Spring. 6 ECTS credits Not offered in 2011-2012

The course introduces the students to the basic chemical and physical processes of relevance in environmental engineering. Mass and energy balance and transport concepts are introduced and stressed. These principles are applied as a means of understanding and solving environmental engineering issues, related to water, air pollution and solid waste.

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

Energy Systems

Spring. 6 ECTS credits Not offered in 2011-2012

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.