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Study Abroad
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Faculty: Science and Technology and Engineering.

Course: **Numerical Methods**

Programme: Study Abroad in Engineering

Semester: 1 - Fall

ECTS credits: 6

Duration: 45 hours

Language of instruction: English

Instructor: Rafel Martí Serra

Course Description

The aim of this Course is to understand the numerical methods that may be used once analytic methods are not enough. The course includes solving non-linear equations, interpolation, numerical differentiation and integration, and differential equations

Prerequisites

None

Attendance and punctuality policies

Attendance is mandatory for all classes. Any presentation or activity missed due to student absences can only be rescheduled in cases of certified medical or family emergencies. If a student misses more than three classes in any course half a letter grade will be deducted from the final grade for each additional absence. Seven absences in 6 ECTS courses or four absences in 3 ECTS courses will result in a Fail grade. Notice that there is a minimum of 80% attendance.

Students will be marked ABSENT from any class if they arrive more than 20 minutes late. Students will not be permitted to enter the class unless the professor specifically accepts it. Even if the instructor allows students to join the class, they will still be marked as absent for that lesson.

Absences can be justified in the following cases: Death of a first-degree relative, serious illness of the student/ first-degree relative or obligation to attend legal affairs. In all these cases a document or receipt must be sent via e-mail to studyabroad@uvic.cat adding your professor in copy. Important! In case of injury/ illness of the student, a medical document issued in Vic* needs to be provided.

*Medical documents accepted: physical doctor's notes which contain the hospital's stamp and signature in handwriting OR digital doctor's notes which contain the doctor's valid digital signature (a digital signature is valid when it shows the authentication of the person who signs and prevents the pdf to be modified after being signed).

Learning outcomes

By the end of the course, students should be able to use numerical methods both by hand and with a computer and apply them successfully to any problem related to the subject.

Method of presentation

- Lectures and discussions: Lectures with appropriate visual support provide the theoretical content of the sessions. Class discussions facilitate the students' ability to connect reading and lectures, analyzing or applying concepts.
- Class participation: Students are expected to participate in group activities and in the discussions based on the course readings and cases proposed.
- Home exercises: Students are expected to solve several exercises about each chapter during the semester.

Required work and assessment methods

Cases, reading and exercises. Preparation and development related to exercises will be highly valuable for the success of the course both at individual and group level.
Participation Individual active participation in discussions and team work. The positive and proactive attitude of the student will be encouraged and valued by instructors throughout the course.

In order to pass the course, it is compulsory to have completed all the exercises proposed by the teacher. These exercises will count for 60% of the final qualification. The remaining 40% will be the average of the exams taken during the course. The final exam of the subject will be held on December 19th.

Activities weight. Ordinary evaluation.

	Practice U2	Practice U3	Practice U4	Practice U5	Exam
%	15	15	15	15	40

Students who do not pass the course will be able to make it up with a final exam of the whole course syllabus after the Christmas holidays. In this case, the final mark will be a 5.

Contents

Unit One: The error (1 week)

Unit Two: Solutions of Equations in One Variable (3 weeks approx.)

- The Bisection Method.
- Fixed-Point Iteration.
- Newton's Method.

Unit Three: Interpolation and Polynomial Approximation (3 weeks approx.)

- Interpolation. Lagrange Polynomials.
- Divided Differences.
- Hermite Interpolation.
- Cubic Spline Interpolation.

Unit Four: Numerical Differentiation and Integration (4 weeks approx.)

- Numerical Differentiation.
- Numerical Integration: the Trapezoidal Rule.
- Numerical Integration: Simpson's Rule.
- Gaussian Quadrature.

Unit Five: Initial-Value Problems for Ordinary Differential Equations (4 weeks approx.)

- Euler's Method. Higher-Order Taylor Methods.
- Runge-Kutta Methods.
- Systems of Differential Equations. Higher-Order Equations.

Recommended reading

Basic: R.L. Burden, J.D. Faires: Numerical Analysis (9th Ed.). Brooks/Cole.
Complementary: J.F. Epperson: An Introduction to Numerical Methods and Analysis (2nd Ed.). Wiley.
W. Gautschi: Numerical Analysis (2nd Ed.). Birkhäuser.