UAB
Universitat Autònoma de Barcelona

Applied Modelling & Simulation

2026/2027

Code: 43480
Credits: 6

Degree programme	Type	Course
Modelling for Science and Engineering	OP	1

Contact lecturer

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Teaching staff

Abraham De la Rosa Ibarra

Group languages

You can consult this information at the end of the document.

Prerequisites

User knowledge of computer systems and (recommended) some knowledge of a programming language but not essential.

Objectives

The present course aims to:

- Introduce students to the modelling and simulation techniques used in multidisciplinary areas.
- Apply the appropriate methodology for developing models in multidisciplinary areas.
- Evaluate modelling and simulation tools available for different areas.
- Model and simulate structures of different types.

Learning outcomes

- CA21 (Apply computational tools to solve unprecedented problems in the field of engineering.) Apply computational tools to solve unprecedented problems in the field of engineering.
- CA22 (Communicate the results obtained from engineering modelling projects to an expert audience.) Communicate the results obtained from engineering modelling projects to an expert audience.
- CA23 (Incorporate sustainability criteria in the modelling applied to Engineering.) Incorporate sustainability criteria in the modelling applied to Engineering.
- KA17 (Identify the appropriate programming environments in engineering modelling.) Identify the appropriate programming environments in engineering modelling.
- KA18 (Identify the most common computing and resource management architectures to solve models and to simulate structures in the field of engineering.) Identify the most common computing and resource management architectures to solve models and to simulate structures in the field of

engineering.
- SA21 (Use specific software to solve modelling problems for engineering.) Use specific software to solve modelling problems for engineering.
- SA22 (Apply specific mathematical models to analyse complex physical problems.) Apply specific mathematical models to analyse complex physical problems.
- SA23 (Interpret the results and predictions obtained from applying a mathematical model to problem-solving in the field of engineering.) Interpret the results and predictions obtained from applying a mathematical model to problem-solving in the field of engineering.

Contents

Module 1: Applications of Complex Physical Models

- Forest fire spread models: basic and Rothermel model, global models
- Input uncertainty: Data Driven Systems (Genetic Algorithms, Statistical Systems)
- Multi-model prediction system (Numerical Weather Prediction, Wind Field model, Fuels models...)
- Numerical weather forecast models: Numerical Weather Prediction (NWP)
- Basic concepts of Atmospheric Modeling. NWP models and computational power

Module 2: Modelling in engineering

- Tools for structural modelling
- Structures design
- Structural Simulation
- 3D Printed

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Theoretical Lectures	12	0.48	
Technical documentation study and preparation	45	1.8	
Individual (personal work)	20	0.8	
Collaborative work	40	1.6	
Practical sessions	26	1.04	

The course will be developed in theoretical classes, practical excercises and seminars.

It is recommended that students attend all classes of the subject with a laptop and (minimum) Windows 10.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Structural simulation	40%	3	0.12	CA21, CA22, CA23, KA17, KA18, SA21,

				SA22, SA23
Environmental modelling and simulation: Case study	60%	4	0.16	CA21, CA22, CA23, KA17, KA18, SA21, SA22, SA23

The evaluation will be made by developing and presenting the proposed case studies using the tools presented in the lecture sessions. Group work and interaction will also be assessed.

In the case that the student has an evaluation of less than 5 points in some sections of the assessment (except the Lab), the student will have to do an additional (in person) test on the particular section.

Academic Integrity

If the student use someone else's work (code, figures, research publications, etc.) to produce any work for this course, the student must:

1. Indicate how this work was used,
2. Acknowledge this work in a bibliography section.

Violation of these policies will be considered a breach of academic integrity, and the student will be subject to penalties outlined by the MsC studies coordination at the Faculty of Sciences.The student is subject to the rights and responsibilities that includes an academic (grade) penalty administered by the professor and/or disciplinary action through the UAB judicial process by plagiarism responsabilitities.

Use of AI

In this subject, the use of Artificial Intelligence (AI) technologies is allowed as an integral part of the development of the work, as long as the final result reflects a significant contribution of the student in the analysis and personal reflection. The student will have to clearly identify which parts have been generated with this technology, specify the tools used, and include a critical reflection on how these have influenced the process and the final result of the activity. The non-transparency of the use of AI will be considered a lack of academic honesty and may lead to a penalty in the grade of the activity, or greater sanctions in serious cases.

Bibliography

- Solidedge user's guide: https://solidedge.siemens.com/es/solutions/users/students/
- WRF user's guide: https://www2.mmm.ucar.edu/wrf/users/docs/user_guide_v4/contents.html
- WRF-Chem user's guide: https://ruc.noaa.gov/wrf/wrf-chem/
- FARSITE user's guide: https://www.firelab.org/project/flammap
- WindNinja user's guide: https://www.firelab.org/project/windninja
- M. P. Groover. Fundamentals of Modern Manufacturing, Materials, Processes, and Systems. Prentice Hall. 1996
- Karl T. Ulrich and Steven D. Eppinger. Product Design and Development. Third Edition, McGraw-Hill, 2004
- Bernard P. Zeigler. Theory of Modeling and Simulation. Academic Press. 2000
- Sheldon Ros. Simulation. Academic Press. 2012.
- Angela B. Shiflet, George W. Shiflet (Author). Introduction to Computational Science: Modeling and Simulation for the Sciences. Princeton University Press.2014.

Software

SolidEdge

WRF

FARSITE

WindNinja

VirtualBox

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TEm) Theory (master)	1	English	second semester	afternoon