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# Technological Institute for Industrial Mathematics

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## TRAINING COURSE: MTC-1: MULTIPHYSICS MODELLING

Welcome to **MTC-1: MULTIPHYSICS MODELLING**, a course offered by **ITMATI** in collaboration with the **University of a Coruña** and **University of Santiago de Compostela**.

Mathematical models describe real world phenomena using the language of mathematics. Multiphysics models deal with multiple simultaneous physical phenomena, which include, but are not limited to, coupling among thermo-mechanical, acoustic or fluid problems. Knowledge obtained through these models can be applied in many industrial fields and help us in the decision making process.

**MTC-1: MULTIPHYSICS MODELLING will focus** on the statement and analysis of the main mathematical models, such as thermo-mechanical, fluid-structure interaction and acoustics models, which will be deduced from the principles of the continuum mechanics, and the coupling phenomena between them.

This **training course** has arisen within the **Innovative Training Network ROMSOC** (Reduced Order Modelling, Simulation and Optimization of Coupled systems), belonging to **H2020-MSCA-ITN-EID** (European Industrial Doctorates).
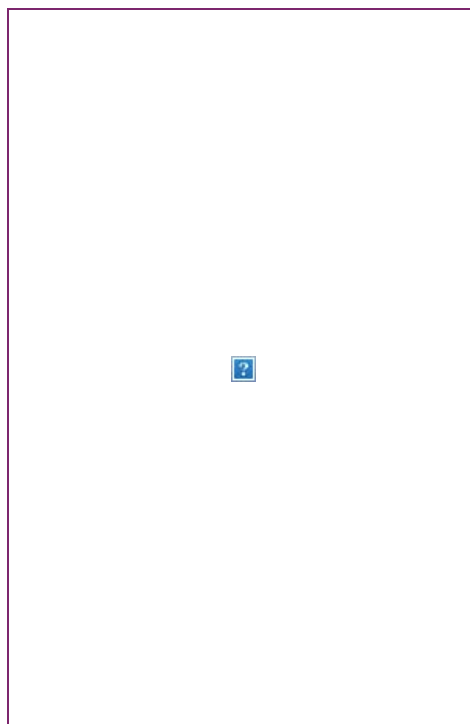
**Location:** Faculty of Mathematics- University of Santiago de Compostela, Spain

**Dates:** 25 June 2018 – 6 July 2018

**Who is this training course for:** Our intended audience are Master and PhD students in Engineering and Applied Science, interested in multiphysics modelling and numerical simulation.

**Length:** 2 weeks

| Total workload | 200h |
|---|---|
| Teaching hours/lecture | 40 |
| Self-Study Hours | 37 |
| Exam | 3 |
| Case Study/Practical mark | 120 |

**Evaluation:**

1 Test (Multiple-choice questions)

2 Case Studies/Practical mark: solve 2 problems (as an individual work) from two chosen modules. Designed to help you practice and apply the skills you learn.

**Tuition fee:** The tuition fee is € 550 per student, except for PhD student from UDC, USC, UVIGO for which the registration will be free.

**Credits:** 8 ECTS

## AGENDA

- **08/04/2019** 147 ESGI (European Study Group with Industry)
- **08/07/2019** 3rd International Conference on Computational Finance (ICCF2019)
- **15/07/2019** ICIAM 2019: International Congress on Industrial and Applied Mathematics
- **22/07/2019** CTMI 2019: I Conference on Transfer between Mathematics & Industry

**Certificate:** The **Phd students** will earn an **Official Certificate** issued by the **International Center for Doctoral and Advanced Studies** of the **University of Santiago de Compostela.** For those who are not unrolled in a doctoral program, a **Certificate** from ITMATI will be issued.

**Language:** English

**Class Shedule:**
First week:  9:00-14:00
Second week: 9:00-14:00

**Course Structure:** The training course is divided into three main modules.


### Module 1: Continuum Thermomechanics

The First Module, Continuum Thermomechanics, is focused on the study of some mathematical models in solid mechanics, referred to static and dynamic problems. Elastic, isotropic and anisotropic materials, as well as the thermal effects will be considered.  Simplifications due to the geometry of the piece, the volume forces, the boundary conditions, or the existence of symmetries will be also introduced. In addition, an introduction to more general behaviour laws, and to the formulation of non-linear boundary conditions will also be considered. The numerical simulation will be performed using COMSOL Multiphysics software package.

**Teaching hours/lecture:** 3h +13.5 h


### Module 2: Fluids and fluid-structure interaction

The second module provides a presentation of the main models in fluid mechanics, including those regarding coupling with structures. After a presentation of a general framework and the discussion of some relevant non-dimensional numbers, the main limit models (for newtonian fluids) are derived. Some of these models will then be discussed. In particular, the module will cover the study of potential flows, laminar isothermal flows, turbulent isothermal flows, heat transfer problems and fluid-structure models. Some of these models will be solved using a CFD software.

**Teaching hours/lecture:** 10 h


### Module 3: Wave Propagation Modeling in Complex Systems

The third module is focused on the derivation and the analysis of mathematical models of acoustic and structural vibrations of elastic solids and porous media. Coupling problems involving fluid-structure interaction and damping materials will also be addressed.

**Teaching hours/lecture:** 13.5 h


This course allows students to take only **one module** or **part of the modules**. Access preference will be given to those students who take the full course. Those students interested in taking part of the modules, after the registration, should send an e-mail to: itmati@itmati.com


## MTC-1 Training Course PROGRAM (CLICK HERE)

## REGISTRATION FORM (CLICK HERE)

**Professors:**



Andrés Prieto Aneiros, Associate professor at the Department of Mathematics,

University of A Coruña (UDC), and Technological Institute of Industrial Mathematics (ITMATI)



Luis Hervella Nieto, Professor at the Department of Mathematics, University of A Coruña (UDC)



Iñigo Arregui Álvarez, Professor at the Department of Mathematics, University of A Coruña (UDC)



Patricia Barral Rodiño, Professor at the Department of Applied Mathematics, University of Santiago de Compostela (USC), and Technological Institute of Industrial Mathematics (ITMATI)



Peregrina Quintela Estévez, Full professor, Department of Applied Mathematics, University of Santiago de Compostela (USC), and Technological Institute of Industrial Mathematics (ITMATI)

Fernando Varas Mérida, Professor at the Department of Applied Mathematics, Polytechnic University of Madrid(UPM)



Jose Luis Ferrin Gonzalez, Professor at the Department of Applied Mathematics, University of Santiago de Compostela (USC), and Technological Institute of Industrial Mathematics (ITMATI)

All teachers are professors in the Phd. Program: *Mathematical Modelling and Numerical Simulation in Engineering and Applied Science*, which is an interuniversity PhD program offered by the Universities of A Coruña, Santiago de Compostela and Vigo.

The members of the Scientific Committee are:

Prieto Aneiros, Andrés. Associate Professor in the Department of Mathematics of the Faculty of Computer Science. University of A Coruña. Affiliated researcher to ITMATI.

Quintela Estévez, Peregrina. Full professor, Department of Applied Mathematics, University of Santiago de Compostela (USC), and Technological Institute of Industrial Mathematics (ITMATI)

**Access and accommodation:**

Should you require accommodation, the organization provides a residence hall at preferential rates for the 139 ESGI.

**Residence Hall Monte da Condesa**
Prices per night are:
- Single Room: 25€+VAT
- Double Room: 42€+VAT
- Single Room (student): 15€+VAT
- Double Room (student): 25€+VAT

To check availabilty please contact ITMATI through the e-mail itmati@itmati.com with the subject **"MTC-1 | RU Monte da Condesa"**

**How to reach us:**

Please click here to see the **"Access Guide-MTC-1"** with information about the access to the Faculty of Mathematics- University of Santiago de Compostela, where the training course will take place and the access to the Monte da Condesa Residence Hall from the Santiago Airport.

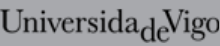**Fecha:** Mon, 2018-06-25 09:00 - Fri, 2018-07-06 12:00
**Place:** Faculty of Mathematics, USC
**Organizer:** ITMATI, UDC, USC

**CONTACTO**
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