جامعة مولاي إسماعيل
UNIVERSITÉ MOULAY ISMAÏL

ENSAM
المدرسة الوطنية العليا للفنون و المهن
ÉCOLE NATIONALE SUPÉRIEURE D'ARTS ET MÉTIERS

Master M2I
Mathematical Modeling in Engineering
2017/2018

www.ensam-umi.ac.ma

Goals of the course : Many industrial problems which are dealt with in engineering departments, in research and development (R&D) laboratories, and in IT services companies, are described by partial derivative equations (PDE) which constitute theoretical models of these problems. The latter cover various fields ranging from mechanics, energy, environment, geology and biology to stock exchange transactions. Understanding these phenomena, whether simple or complex, undeniably necessitate an in-depth knowledge of these equations' and models' solutions. The equations are the design engineer's working instrument and the experimental engineer's guiding beacon.

Searching for solutions to these equations and studying their characteristics and properties is a primary area of interest to the PDE disciplinary field. However, although this field can inform us about the existence of admissible solutions to these problems, it does not provide the means to calculate and implement them, given the complexity of the problems. Thanks to scientific calculation, we are able to implement approximate, digitally processed, models that allow us to approach a solution as much as our calculation means allow.

Tailoring instruments to research approximate solutions constitutes in itself a rich domain in applied mathematics that uses specific tools. Approximating without misrepresenting and serving without complicating is the motto of the two-year M2I Master. Each year aims to achieve a specific objective. The first year is intended to complement and reinforce the initial training of the student holding a Bachelor's degree in mathematics (or an equivalent qualification). It strengthens the student's training in PDE, numerical analysis, scientific calculation, modeling, probability and statistics, and IT. This year is the foundation of the future training. The second year of the Master provides a window to the world of research in mathematical engineering and in modeling. It aims to train mathematical engineers, teachers, and researchers in modeling, numerical analysis and scientific calculation.

Admissions Procedure:

- **Required qualification :** licence d'études fondamentales (LEF), licence en sciences et techniques (LST) en mathématiques ou en mathématiques et informatique (or an equivalent qualification).
- **Specific education prerequisites :** linear algebra, multivariate calculus, topology, differential calculus, measure and integration, numerical analysis, algorithmics, and notions in programming.
- **Selection procedure :** shortlisted candidates will be invited to sit a selection examination (written tests in mathematics, programming and English).
- **Number of places** : 30 students, including 5 foreign students. Applications will have to be submitted online, on the **ENSAM's** website : **www.ensam-umi.ac.ma.**

Master 1

Semestre 1

1. Distribution
2. Applied functional analysis
3. Modeling in continuum mechanics and analysis
4. Integration, probability and statistics
5. Scientific calculation and programming with SCILAB
6. English language

Semestre 2

1. Optimization
2. Elliptic and linear and nonlinear parabolic PDE
3. Analysis and implementation of finite difference and finite volume methods
4. Analysis and implementation of the finite element method
5. Parallel computing and domain decomposition
6. GNU/Linux system and programming in Python language

Master 2

Semestre 1

1. Analysis and approximation of conservation laws' systems and applied inverse problems
2. Modeling in porous media and radial functions methods
3. Asymptotic analysis and nonlinear structure analysis
4. Computing in hydraulics (M. Seaid, Durham University, UK)
5. Stochastic methods for PDE (M. Zahri, Taibah University, KSA)
6. Electives:
   a. Spectral analysis and functional equations
   b. Distributed computing infrastructure and big data for scientific calculation
   c. Variational calculus, methods and applications

Semestre 2

Final project

Career Prospects : Given the nature of the training, which combines theoretical learning in applied mathematics with a practical know-how in the implementation of scientific calculation, graduates will be able to work in engineering departments, R&D companies and IT services companies as a development engineer. They can join the world of academia. They will be messengers of a new vision of mathematics based on new technologies of scientific calculation. They can work in university laboratories to prepare a doctoral thesis in Moroccan universities, with the possibility of a co-tutorship with our international partners. They can benefit from support by the AUF, l'Institut Français and the MOUNAF's "Inter-Afrique" program. Graduates will be capable of working on issues requiring numerical modeling in different disciplines. They can contribute with a new practical know-how based on new methods and with a critical and analytical view on the methods used.

International Relations : Durham University (UK), Taibah University (KSA), École centrale de Nantes (France).

Support : CNRS (FINCOM Program), AUF (Transfers' and Scholarships' Programs), and the Inter-Afrique MOUNAF Program.

Certification : Trainings leading to a certification will be organized in parallel of the master's program, in scientific calculation, IT and continuum mechanics.

جامعة مولاي إسماعيل
UNIVERSITÉ MOULAY ISMAÏL

Centre National pour la Recherche Scientifique et Technique

MOUNAF
intra-african mobility project

ROYAUME DU MAROC
Ministère de l'enseignement supérieur de la recherche scientifique et de la Formation des Cadrees

Responsable de la filière : Pr. Mustapha GHILANI, m.ghilani@ensam.umi.ac.ma
Adresse : B.P. 15290 EL Mansour Meknès 50500, TEL: 05 35 46 71 60/62, Fax : 05 35 46 71 63/64, www.ensam-umi.ac.ma