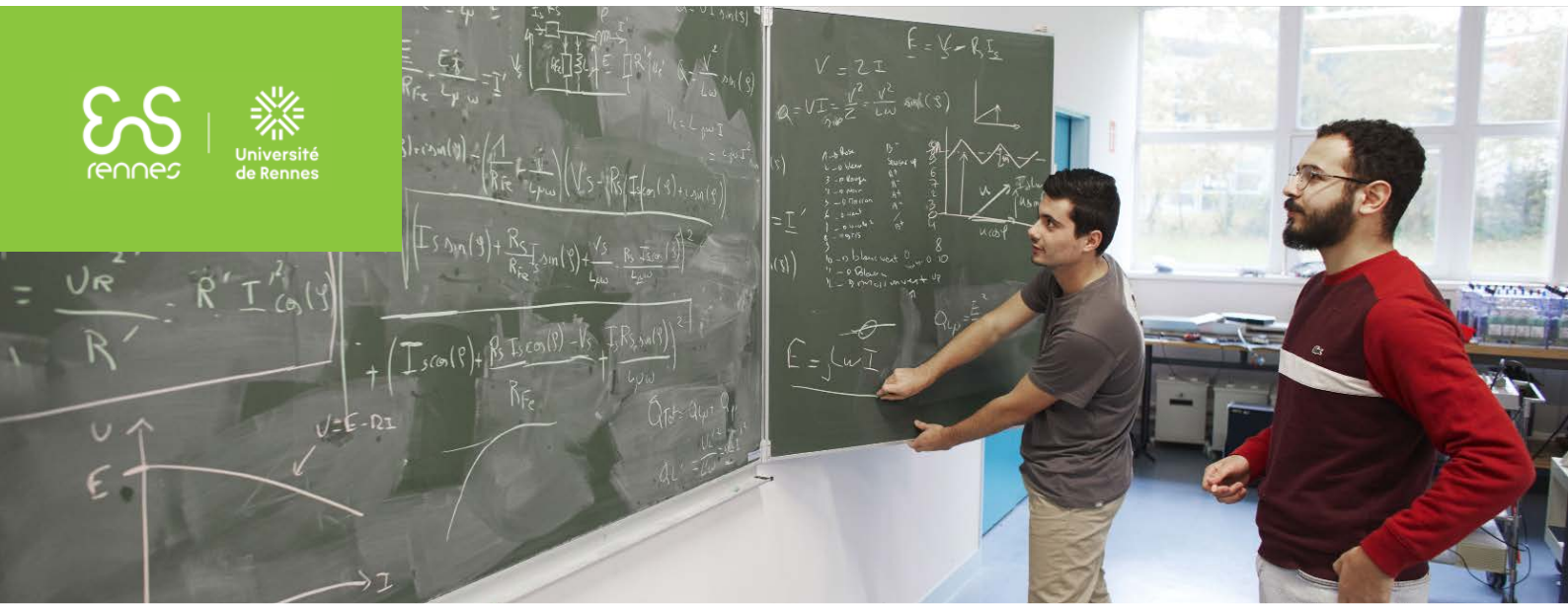
École normale supérieure de Rennes

# Mechatronics Department



The Mechatronics department's mission is to train scientists, through and for research, in the field of engineering sciences, in order to:

- **produce** new knowledge, develop/imagine new concepts, models and methods, validation protocols and tools in laboratories and institutes, research and R&D centers;
- **transmit** this knowledge to students, future engineers and technicians in universities and schools;
- **provide** expert appraisal of industrial projects, development plans or public policies.

The department offers a unique 4-year training program for careers in research, innovation and teaching. It is based on the ENS Rennes Master's degree. It emphasizes a core of disciplinary skills in mechatronics, as well as cross-disciplinary skills in research, multidisciplinarity, teaching and international relations.

By its very definition, mechatronics is a multi-disciplinary field, with a wide range of teaching options:

- a solid grasp of the physical sciences and associated scientific disciplines ;
- good knowledge of cutting-edge technologies;
- hands-on experience of integrated design approaches.

## Recruitment

The department offers two selective recruitment routes with two statuses:

- 1st year admissions via competitive selection exams (PSI, PT, TSI and ATS banks) with the status of "normalien-ne fonctionnaire-stagiaire" (remuneration of around €1,500 gross per month and ten-year commitment) or parallel admissions in 1st year with a selection based on a portfolio with the status of "normalien-ne étudiant-e";
- Admission in 2nd year by competitive examination in 2nd year (at M1 level), with the status of "normalien-ne fonctionnaire-stagiaire";
- Parallel admissions in 3rd year (M2 teaching course) with selection based on portfolio.

Each year, 3 allocations normaliennes are awarded to students admitted to the 1st year of the Mechatronics department, on the basis of their academic excellence and social criteria, providing a guaranteed income of €1,000 per month for the entire duration of their studies. It is possible to apply for parallel admissions in addition to the competitive entrance exam.

## Job opportunities

By studying mechatronics, you'll be able to master the fundamentals of the discipline and enter specific doctoral programs. You'll be free to choose your research master's degree in the engineering sciences, and more specifically in mechanics, electronics or applied computing, opening up a wide range of career opportunities:

- in research and innovation: with an internationally-recognized doctorate, you can pursue a career as a teacher-researcher or researcher in France or abroad, in major public research organizations or in corporate R&D;
- teaching: with the agrégation, you'll teach in preparatory classes for the grandes écoles, engineering schools or other grandes écoles, IUTs or universities;
- others: several government organizations offer recruitment on the basis of qualifications.

## More information

To contact the students, who will be happy to answer your questions:

concoursMecatro@listes.ens-rennes.fr

## CONTACTS


**Department director:**
Pr. Hamid Ben Ahmed

**Assistant:**
Marielle Tanter
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# 1st year (double license)

- L3 Electronics, Electrical Energy, Automation (EEEA)
- L3 Engineering Sciences (SPI)
- End-of-year projects and internship (2 to 3 months)

## Semestre 1

### Common part SPI & EEEA

SCIF1a (5 ECTS)
- Applied mathematics
- Electromagnetism
- Photonics, Optics, Optoelectronics

ROBO1a (4 ECTS)
- General Robotics
- Serial Robotics

PROJ1a (5 ECTS)
- Mechatronic system analysis
- Report writing assistance
- Documentary research assistance
- Electrical certification

ONUM1a (4 ECTS)
- Digital tools :
  - Automatic
  - State diagram
  - Mechanics
  - Material resistance
  - Electricity
- Actuator prototyping

PEDA1a (2 ECTS)
- Science didactics

LANG1b
- English

SEM1a
- Research seminars

### Spécialités SPI & EEEA

ELEC1a (5 ECTS)
- Analog electronics

ENER1a (5 ECTS)
- General Electricity
- Electrotechnical materials and components
- Electromechanical conversion

MEMA1a (5 ECTS)
- deformable solid mechanics (RDM)
- rigid solid mechanics (dynamic)

COFA1a (5 ECTS)
- From idea to product

## Semestre 2

### Common part SPI & EEEA

INFO1b (3 ECTS)
- Programming
- General computer skills

ROBO1b (4 ECTS)
- Sensors
- Axis control, machine state
- Parallel robotics

ECOC1b (3 ECTS)
- Ecodesign

PROJ1b (4 ECTS)
- Mini project + project

COAC1b (3 ECTS)
- Opening course of your choice (activity of your choice)

LANG1b (3 ECTS)
- English
- Courses take place all year round, but grades are counted in semester 2

SEMI1b
- Research seminars

STAG1b (8 ECTS)
- Internship

MALE1a (2 ECTS)
- Introduction of machine learning

### Spécialités SPI & EEEA

ELEC1b (5 ECTS)
- Digital signals
- Communication networks

ENER1b (5 ECTS)
- Static conversion
- PROTO1

MEMA1b (5 ECTS)
- Continuum Mechanics
- Mechanics of Materials

COFA1b (5 ECTS)
- Design
- Technology
- Forming

# 2nd year (M1 ISC)

- M1 Complex Systems Engineering (ISC)
- Projects and end-of-year internship (2 to 3 months)

## Semester 1

SCIF2a (4 ECTS)
- Applied mathematics
- Thermo-transport

ROBO2a (2 ECTS)
- Sampled Systems

PROJ2a (3 ECTS)
- Research project
- Research Seminars

ELEC2a (4 ECTS)
- Analog Electronics
- Digital modulations

ENER2a (4 ECTS)
- Inverters
- Systems and Machines

MEMA2a (4 ECTS)
- Plasticity and Viscoplasticity
- Dynamics of Slender Structures

COFA2a (4 ECTS)
- Forming
- Quality

INFO2a (2 ECTS)
- Algorithms and Data Structures

PEDA2a (3 ECTS)
- Didactics

LANG2a
- English

SEMI2a
- Research seminar

COCT2a (COAC2a) (3 ECTS)
- Elective course on a transition theme

## Semester 2

ONUM2b (3 ECTS)
- Multiphysics simulation (EF)
- Multiphysics simulation (acausal)

ROBO2b (3 ECTS)
- State feedback
- Robust control
- vision
- Dynamic control

PROJ2b (3 ECTS)
- Didactic project

ELEC2b (4 ECTS)
- Architecture and networks
- Digital systems

ENER2b (4 ECTS)
- Energy Conversion

MEMA2b (4 ECTS)
- Fluid Mechanics
- Microfluidics

COFA2b (4 ECTS)
- Design
- Technology

LANG2b (3 ECTS)
- English

STAG2b (2 ECTS)
- Internship

SEMI2b
- Seminars of transition

TRAN2b (2 ECTS)
- Resources and renewable energies

COCT2b (COAC2b) (3 ECTS)
- Elective course on a transition theme

# Mechatronics Department

## 3rd year

- M2 Complex Systems Engineering (ISC) teaching : preparation for one of the 3 options for the agrégation externe de sciences industrielles de l'ingénieur SII (electrical engineering, computer engineering or mechanical engineering)
- or Research at Interfaces
- or Research and International

### M2 Complex Systems Engineering (ISC) teaching (SII agrégations)

### Semester 1

#### Common part

TMEM3a : Common core in mechanics and materials (4 ECTS)
- General mechanics
- Resistance of materials
- Fluid mechanics
- Choice of materials and processes
- Thermodynamics and thermodynamic machines

TENE3a: Common core in energy conversion (4 ECTS)
- Static conversion 3a
- Electromechanical conversion 3a

TELI3a: Common core in electronics and computer science (4 ECTS)
- Algorithms and data structure
- Website programming
- Architecture
- Databases
- Operating systems
- C++
- Networks

TROB3a: Common core in robotics (4 ECTS)
- State formalism
- Continuous linear systems
- Sampled linear systems
- Discrete-event systems
- TP auto et soutenances

#### Electrical Engineering Specialty

ENER3a : Energy Conversion (5 ECTS)
- General electricity
- Static conversion

ELEC3a : Electronics (5 ECTS)
- Digital signals
- Amplification, filtering, analog transmission

#### Computer Engineering Specialty

INFO3a : Computer Science (5 ECTS)
- Operating Systems
- Image processing
- Algorithms and proofs
- Software engineering

#### Mechanical Engineering Specialty

MEMA3a : Mechanics and Materials (5 ECTS)
- Energy approach
- Materials
- Fluid mechanics
- General mechanics
- RDM and MMC
- Thermodynamics

COFA3a : Design and Manufacturing (5 ECTS)
- Design and industrialization
- Polymer and composite shaping
- Foundry processes
- Power transmission by gears
- GPS specifications

#### Didactic research option

REDI3a : Didactic research (4 ECTS)
- Construction of teaching sequences
- Research dissertation preparation
- Training practice and engineering

#### Agrégation SII option

AGRG3a : Agrégation (4 ECTS)
- Construction of teaching sequences
- Agrégation exam training
- Industrial case study

#### Non-master (ENS diploma)

SEMI3a: Seminars

TINGa: Transitions engineering
- Functional analysis
- Mechanical modeling / simulation
- Energy efficiency
- LCA and eco-design
- Building thermics
- Civil engineering culture

## Semester 2

### Electrical Engineering Specialty

ENER3b : Energy conversion (9 ECTS)

- Electromechanical conversion
- Electrical System Control

ELEC3b : Electronics (9 ECTS)

- Phase-locked loops and modulation
- Microwave frequencies

### Computer Engineering Specialization

INFO3b : Computer Science (9 ECTS)

- Embedded Systems and Graphical Interfaces
- Databases
- Parallel computing
- Software engineering
- Networks

ELEC3b : Electronics (9 ECTS)

- Phase-locked loops and modulation

### Mechanical Engineering Specialization

MEMA3b : Mechanics and Materials (9 ECTS)

- continuum mechanics
- Fluid mechanics
- Resistance of materials
- Analysis of dynamic behavior

COFA3b : Design and Manufacturing (9 ECTS)

- Forming by material removal and deformation
- Production management and maintenance
- Design for manufacturing
- Specifications, quality control
- Technology: bearings, hydraulics

### Didactic research option

REDI3b : Didactic research (12 ECTS)

- Preparation of research dissertation
- Application internship
- Training practice and engineering

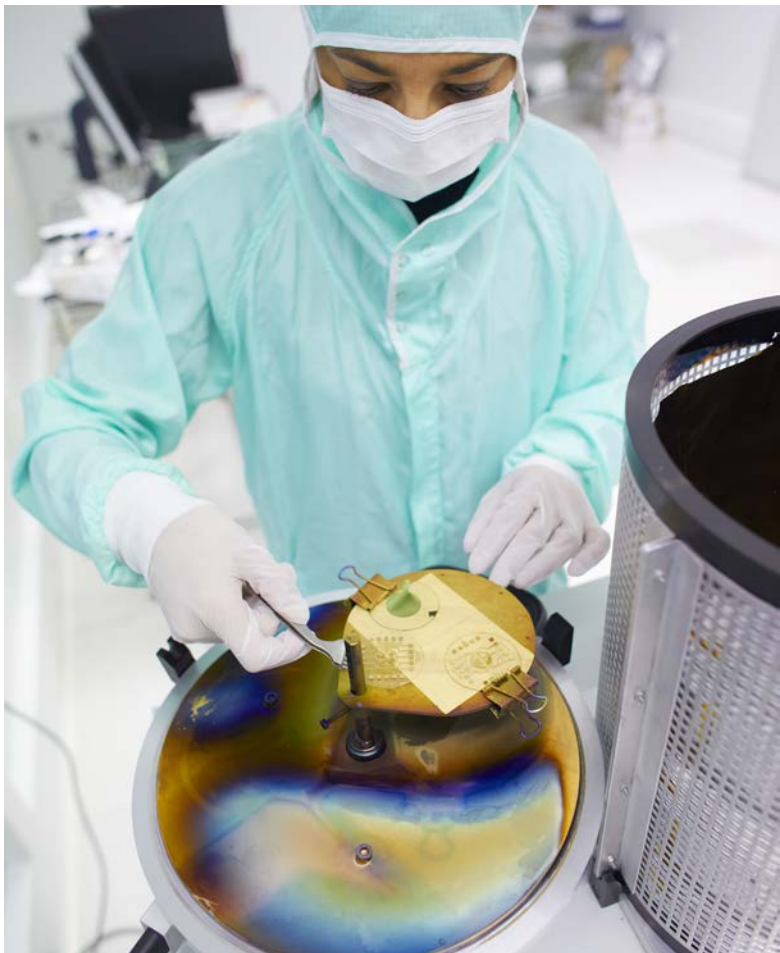
### Agrégation SII option

AGRG3a : Agrégation (12 ECTS)

- Practical observation internship
- Sciences of orality
- conference on laicity
- Preparation of practical sequences
- Agrégation exam training
- Admission tests
- Industrial study case

### Non-master (ENS diploma)

SEMI3a : Seminars



## 4th year

- M2 Complex Systems Engineering (ISC) or other M2 (in France or other countries)
- Research internship (6 months)