INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES ROUEN NORMANDIE

# ENGINEERING COURSES TAUGHT IN ENGLISH AT
## INSA ROUEN NORMANDIE

**FOR EXCHANGE STUDENTS**

# INTRODUCTION

INSA Rouen Normandie holds a very strong position within the French higher education system of engineering schools. Our missions revolve around four poles of expertise associated with an interdisciplinary theme: risk management.

The INSA curriculum is a 5-year program that leads to the **"Diplôme d'Ingenieur"** which is equivalent to a Master of Science. The first two years are made up of a common core for all engineering students to ensure strong fundamental knowledge. At the end of the second year, students choose a department in which to specialize for the remaining three years.


**Humanities and Social Sciences**
Humanities and Social Sciences represent 20% of the curriculum at INSA Rouen Normandie. They include business Training [Management & Economics, Enterpreneurship, Communication & Interpersonal Skills], Foreign Languages & Culture, and Physical Education. Among elective courses, students can take artistic classes [Drama, Choir and Music] taught by professionals.

Find information about the "Welcome to France" here

# SELECTING COURSES

Exchange students can select courses from one of the seven specialized departments. If the department schedule allows it, they can attend courses in other departments.

Lastly, there are research opportunities for exchange students wishing to gain hands-on experience. Students can partake in research part-time or full-time.

**ADVICE:** Get in contact with the academic coordinator for exchange students of your department of interest before submitting your online application. He or she can provide you with the most up-to-date information regarding course availability and guide you according to your academic background and interests.

# INSA, a French engineering school at a glance

| Year of study | Semester |
|---|---|
| 1st year | Semester 1 (Fall)<br>Semester 2 (Spring) |
| 2nd year | Semester 3 (Fall)<br>Semester 4 (Spring) |
| 3rd year | Semester 5 (Fall)<br>Semester 6 (Spring) + Technician internship |
| 4th year | Semester 7 (Fall)<br>Semester 8 (Spring) + Specialty internship |
| 5th year | Semester 9 (Fall)<br>Semester 10 (Spring) + Engineer internship |

Bachelor level

Master level

Diplôme d'Ingénieur
Engineering degree

***Fall semester:*** *September- January*
***Spring semester:*** *February - June*

# 7 departments from which to choose

| | |
|---|---|
| **Computer Science and Information Technology**<br>*Informatique et Technologies de l'Information* | **ITI** |
| **Mechanical Engineering**<br>*Mécanique* | **MECA** |
| **Industrial Risk Management and Process Engineering**<br>*Génie des procédés et gestion des risques* | **GPGR** |
| **Energy engineering**<br>*Génie énéergétique (parcours EP)* | **GE** |
| **Chemistry and chemical engineering**<br>*Chimie Fine et Ingénierie* | **CGC** |
| **Mathematical and Software Engineering**<br>*Génie mathématique* | **GM** |
| **Civil and Urban Engineering**<br>*Génie civil et constructions durables* | **GCU** |

# Research opportunities in labs

- **COBRA**: Organic and Bio-Organic Chemistry – Reactivity and Analysis
- **CORIA**: Inter-professional Research Complex in Aerothermal Chemistry
- **GPM**: Group for Physics of Materials
- **LITIS**: IT Laboratory, Information Processing and Systems
- **LMI**: INSA Mathematics
- **LMN**: Normandy Mechanics Laboratory
- **LSPC**: Laboratory for Chemical Process Safety
- **PBS**: Polymer and Bio-polymer Surfaces

Access the laboratories websites here

# GRADING SYSTEM AT INSA ROUEN

INSA ROUEN NORMANDIE (F FROUEN06) uses the 20 point scale used in the French grading system. A grade of 20 represents the highest grade, while 0 is the lowest. In reality it is rare to see grades below 8 or above 16. Marks of 20, 19 and 18 are very rarely given. Students must obtain an overall average of 10 or above in each thematically-grouped block (called "UE") of courses, (called "ECs"), in order to pass from one year of study to the next. This rule does not apply to exchange students who can choose courses from different UEs, each course being graded separately.

| INSA ROUEN Marks/20 | Interpretation used by INSA Rouen | Equivalences with ECTS grades |
|---|---|---|
| 19-20 | EXCELLENT – outstanding level | A+ (excellent) |
| 17-18 | VERY GOOD – well above average | A (very good) |
| 15 - 16 | GOOD – generally sound work with very few shortcomings | B+ (good) |
| 13- 14 | SATISFACTORY – generally sound work with a few shortcomings | B (satisfactory) |
| 11-12 | SUFFICIENT- fair but with significant shortcomings | C (sufficient) |
| 10 | PASSING – performance meets the minimum criteria | D (passing) |
| < 10 | FAIL – further work required before credit can be awarded | F (fail) |

ECTS credits:

1 full academic year = 60 credits 1 semester = 30 credits

Studies at INSA Rouen Normandie

| Sem 1 | Sem 2 | Sem 3 | Sem 4 | Sem 5 | Sem 6 | Sem 7 | Sem 8 | Sem 9 | Sem 10 |
|---|---|---|---|---|---|---|---|---|---|
| 1st Year | | 2nd Year | | 3rd Year | | 4th Year | | 5th Year | |
| 180 ECTS | | | | | | 120 ECTS | | | |
| Bachelor's degree (EQF Level 6) | | | | | | Master's degree (EQF Level 7) | | | |
| "Diplôme d'Ingénieur" = 300 ECTS | | | | | | | | | |

# COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

The ITI engineer is a computer engineer with expertise in information systems. Software development, networks, decision support techniques (machine learning, data mining), perception systems (signal or image acquisition and processing) as well as mastering large IT projects (management, quality) are examples of skills acquired in this training.

| | 3RD YEAR |
|---|---|
| ***FALL – S5*** | |
| ITI31-ELEC: **Electronics for embedded systems**<br>This course introduces the basic notions of analog and digital electronics to 3rd year engineering students. The objective is to enable them to understand the role of electronic components in the design of calculators, microprocessors, computers. How electricity and semiconductors enable complex calculations or represent binary states. Students should be able to design electronic systems from existing components (sensors and actuators) based on predefined specifications by the end of this course. | 4 ECTS |

| | 4TH YEAR |
|---|---|
| ***FALL – S7*** | |
| ITI41-OPTIMIZATION 2: **Numerical Optimization**<br>The objective of this course is to acquire a basic knowledge in numerical optimization. | 2,5 ECTS |
| ITI41-ML: **Machine Learning**<br>The course introduces machine learning methods and applications. The main objectives are:<br>• Know how to perform exploratory analysis, visualization and description of data<br>• Know how to identify different categories of statistical learning problems<br>• Know how to use optimization algorithms and software tools to solve these statistical learning and data processing problems<br>• Know how to evaluate learning algorithms and select the appropriate model | 4,5 ECTS |
| ITI41-TW2: **Web Technologies II**<br>This course is dedicated to advanced full stack web development, including dynamic web programming in JavaScript for both server and client sides (Node.js, Express.js, Vue.js), as well as event-driven and asynchronous programming. | 2,5 ECTS |
| ***SPRING – S8*** | |
| ITI42-BGD: **Big Data**<br>The objectives of this course are: 1) Understand the issues and problems associated with storing and processing massive data 2) Understand the limitations of traditional (relational) database management systems and the solutions suited to data-intensive distributed systems 3) Learn how the MapReduce algorithm works 4) Learn to use the Apache Hadoop ecosystem 5) Learn how to manage streaming data with Spark 6) Learn about distributed computing with Spark 7) Discover NoSQL technologies (using MongoDB) | 4,5 ECTS |
| ITI42-RL: **Representation Learning**<br>The purpose of this lecture is to familiarize the student with learning and data mining methods on huge amount of data. The main objectives are:<br>• Learn about nonlinear approaches based on statistical learning theory.<br>• Be familiar with state-of-the-art research.<br>• Implement these approaches using Python machine learning libraries (SciKitLearn, Keras, etc.). | 4,5 ECTS |

| | 5TH YEAR |
|---|---|
| ***FALL—S9*** | |
| ITI51-MLA: **Advanced Machine Learning**<br>The objectives of this course are to: 1) discover an overview of recent statistical learning methods 2) Master the learning of dictionaries for signal and image representation (denoising) 3) Learn about matrix factorization (e.g. recommendation systems). | 4,5 ECTS |
| ITI51-IHME: **Evolved Human Machine Interactions**<br>The objectives of this course are to: 1) exploit data collected from human-computer and human-computer-human interaction to develop applications that can adapt according to users and context; 2) illustrate the concepts of a proactive behavior and/or adapted information that would propose an advanced HMI; 3) exemplify these concepts in existing applications. An introduction to research (bibliographic synthesis, modeling a scientific problem, etc.) is also included in the course content. | 4,5 ECTS |
| ITI51-DLA: **Advanced Deep Learning**<br>The objectives of this course are to: 1) discover recent and SOTA deep learning architectures 2) discover (and overcome) potential pitfalls (fairness, privacy and robustness) of deep learning models 3) apply SOTA models on real applications. | 4,5 ECTS |

**FRENCH AS A FOREIGN LANGUAGE (FLE)**

FLE courses are available for international students throughout the academic year. 1,5 ECTS

**INDUSTRIAL PROJECTS**

ITI42-PIC: **4th year Industrial Project (Fall semester only)** 14 ECTS
Software production in collaboration with a company a team of 5 to 9 students working professionally with a company.

ASI51-PIC: **5th year Industrial Project (Spring semester only)** 14 ECTS
Software production in collaboration with a company a team of 5 to 9 students working professionally with a company.

**RESEARCH AND DEVELOPMENT PROJECT**

Students can conduct research alongside an experienced professor who will act as a mentor. Research topics are developed by the professor in the fields of Information Systems, Data Engineering or Vision oriented Embedded Systems.

15 ECTS PT
30 ECTS FT

**> ASSOCIATED LABS**

**LITIS**

https://www.insa-rouen.fr/recherche/laboratoires/litis

*PT: Part-time*
*FT: Full-time*



iti@insa-rouen.fr

Find more information about the department on Youtube here

# MECHANICAL ENGINEERING

The Mechanical Engineer is involved at all levels of the industrial process: general or detailed design, choice of materials, implementation, manufacturing, maintenance. He masters modeling, optimization as well as product development or new materials.



| | 5TH YEAR |
|---|---|
| ***FALL – S9*** | |
| M51- FIA: **Reliability Engineering**<br>The purpose is to introduce the main aspects of the reliability applied to the problems of mechanics of materials or structures. Notion of failure and safety scenario and probability of failure. | 3 ECTS |
| MECA51-ROAD : **ROAD** | 1 ECTS |
| MECA51-MLEARN: **Machine Learning**<br>The basis of data-driven techniques applied to mechanics is discussed, along with the programming of various neural network architectures. | 1 ECTS |
| MECA51-LBM: **Lattice Boltzmann Method**<br>Learn the fundamentals and the practice of the Lattice Boltzmann Method for simulating flows in complex geometries. | 2 ECTS |
| MECA51-PROPUL: **Propulsion Systems**<br>The course gives a theoretical basis for the operation of a turbo machine (centrifugal pump, compressors, turbines), essentially from the point of view of fluid mechanics. | 1 ECTS |
| MECA51-WIND: **Wind**<br>Modeling turbulence in the near wall region. Aerodynamics of helicopter rotors. | 2 ECTS |
| M21-IC-CBI: **Bio-inspired conception**<br>Introduce fundamental concepts of Bio-Inspired Mechanical Design, an approach that seeks solutions to human challenges within the natural world. Methods and solutions from structural mechanics and materials will be studied. | 3 ECTS |
| MECA51-AGD: **Advanced Gas-Dynamics**<br>The objective of this course is an introduction to the measurement techniques used to develop, characterize and control aeronautical propulsion systems. | 1 ECTS |
| MECA51-FSI: **Fluid-Structure Interaction**<br>The objective of this course is the study of compressible flows and sizing of wings in supersonic and hypersonic flow (2D). | 1 ECTS |
| MECA51-MODEL: **Turbulent reacting flow modeling**<br>The concepts and modeling tools used in industry for virtual prototyping of liquid and gaseous turbulent reacting flows are discussed. | 2 ECTS |
| MECA51-TURBUL: **Turbulence Modeling**<br>The fundamentals of Reynolds Averaged Navier Stokes (RANS) and Large Eddy Simulation (LES) are presented given their application for the optimization and the design of complex flow systems. | 1 ECTS |
| M51- AERO-0: **Aeronautics**<br>The objective of this race is to light up the context in which aeronautical propulsion system technologies develop and evolve. | 1,5 ECTS |
| M51- AERO-A: **Aeroacoustics**<br>The objective of this course is the introduction to linear acoustics as well as aeroacoustics for flows with low Mach numbers. | 1,5 ECTS |
| MECA51-HOCFD: **High-Order for fluid flows**<br>The most advanced discretization techniques and algorithms are presented to simulate flow in complex geometries with high-order accuracy. | 2 ECTS |

| | |
|---|---|
| PROJECT: **Structure or Reliability**<br>This project presents 20 percent of the whole semester's workload (30 ECTS). | 9 ECTS |
| PROJECT: **I2P - Materials**<br>This project presents 30 percent of the whole semester's workload (30 ECTS). | 9 ECTS |
| PROJECT: **AERO**<br>This project presents 20 percent of the whole semester's workload (30 ECTS). | 9 ECTS |

**FRENCH AS A FOREIGN LANGUAGE (FLE)**

| | |
|---|---|
| FLE courses are available for international students throughout the academic year. | 2 ECTS |

**RESEARCH AND DEVELOPMENT PROJECT**

| | |
|---|---|
| Students can conduct research alongside an experienced professor who will act as a mentor. Research topics are developed by the professor in modeling, optimization, product and new materials development. | 15 ECTS PT<br>30 ECTS FT |

| Specific tracks | Abbreviations |
|---|---|
| Engineering-Product-Process | I2P |
| Aerospace | AERO |
| Structures in their environment | Structure |
| Materials | Materials |
| Reliability | Reliability |

**> ASSOCIATED LABS**

**CORIA**
http://www.coria.fr/
**GPM**
http://gpm.univ-rouen.fr/
**LMN**
http://lmn.insa-rouen.fr/



meca@insa-rouen.fr

Find more information about the department on Youtube here

# CHEMISTRY AND CHEMICAL ENGINEERING

Chemical engineers are general engineers with expertise in fine chemistry, chemical process engineering and polymer materials. Health, safety at work and the environment are at the heart of their concerns.



| | 4TH YEAR |
|---|---|
| ***SPRING – S8*** | |
| CGC42-OCS: **Observation and control of systems**<br>Introduction to process automation. Automatic control and observation of a process, without human intervention. | 3 ECTS |
| CGC42-HSA: **Heterochemistry and Asymmetric Synthesis**<br>Organic chemistry course on properties and synthesis of compounds comprising Phosphorus, Sulfur and Silicon atoms (Wittig, Staudinger, Mitsunobu, Swern, Peterson...). The second part is dedicated to enantioselective synthesis bases. | 3 ECTS |
| CGC42-HOM: **Heterocycles and Organometallics**<br>Organic chemistry course on heterocycles chemistry, organometalics and transition metal catalysis. | 3 ECTS |
| CGC42-ANASOL: **Anasol**<br>Main solid analysis techniques | 2,5 ECTS |
| CGC42-CORR: **Corrosion**<br>Different corrosion mechanisms and means of struggle against corrosion | 2,5 ECTS |
| CFI42-ORGA+: Advanced Organic Chemistry<br>Advanced asymmetric synthesis, retrosynthesis, protecting group… | 2,5 ECTS |

**FRENCH AS A FOREIGN LANGUAGE (FLE)**

FLE courses are available for international students throughout the academic year. 2 ECTS

**RESEARCH AND DEVELOPMENT PROJECT**

Students can conduct research alongside an experienced professor who will act as a mentor. Research topics are developed by the professor in organic chemistry, polymers & materials and chemical engineering. 15 ECTS PT / 30 ECTS FT

*PT: Part-time*
*FT: Full-time*

**> ASSOCIATED LABS**

**COBRA**
http://www.lab-cobra.fr/
**PBS**
http://pbs.univ-rouen.fr/
**LSPC**
http://lspc.insa-rouen.fr/

cfi@insa-rouen.fr

Find more information about the department on Youtube here

CGC

# ENERGY ENGINEERING

The Energy Engineer is at the heart of current environmental issues. She or he has increased skills in the fields of energy management, control and renewal as well as in the development of terrestrial, aeronautical and space propulsion systems.

| | 4TH YEAR |
|---|---|
| ***FALL – S7*** | |
| EP41-COMB: **Combustion 2**<br>The objectives of the course are to (i) Understand the local governing equations used in combustion; (ii) Connect "chemistry" with "fluid mechanic", (iii) Understand the meaning of chemical equilibrium and implications, (iv) Know the basics of chemistry processes applied to combustion, (v) Have a comprehensive description of the flame structure, and (vi) Study basic practical cases retrieved in combustion technology (PSR, 1D flame). | 2,5 ECTS |
| EP41-TPTH: **Practical works on heat transfer, fluid mechanics, thermodynamic**<br>The students have to work on practical installations and to apply the theories learned in the courses. | 4,5 ECTS |
| EP41-DDRS: **Project on Sustainable Development**<br>Research project on a specific subject dedicated to an open question linked to sustainable development. Oral presentation and report. | 2,5 ECTS |
| EP41-SNE: **Numerical simulation of flows**<br>The objective of this course is to help the future engineers on how to rationally use a computer software dedicated to fluid dynamics related problems. This type of numerical tools is currently very useful in the design and the analysis of complex fluid flows. In the framework of this course, the open-source software, OpenFoam, is used to illustrate the capability of the current CFD. Some selected test cases are simulated to assess the accuracy and the robustness of the code. The objective is to be familiar with a conceptual tool in fluid dynamics. | 3 ECTS |
| EP41-DYNGAZ: **Introduction to fluid dynamics in compressible flow**<br>The objective of the course is to acquire the compressible fluid mechanics bases. | 2 ECTS |
| EP41-TURB : **Turbulence**<br>Introduction to the concepts of turbulence. | 2,5 ECTS |
| EP41-2PHAS : **Two-phase flow – Fundamentals**<br>Learn and understand the essential notions related to two-phase flows. Learn and understand the link between the local (and exact) balance equations and the one-dimensional models for two-phase flows. Know how to calculate the pressure drop in conduits for two phase flows. Be able to predict a two-phase flow configuration in conduits from flow regime maps. | 2 ECTS |
| ***SPRING – S8*** | |
| EP42-TMACH2: **Turbomachinery**<br>Design and efficiency of axial/centrifugal turbomachinery | 2,5 ECTS |
| EP42-2PHAS2: **Two-phase flow - Applications**<br>Learn and understand the usual industrial applications of two-phase flows. Be able to model a two-phase flow with a phase transition. Be able to model a two-phase flow including a solid phase (potentially mobile). Investigation of three applications: boiling, condensation and fluidized beds. Investigation of three applications: boiling, condensation and fluidized beds. | 2 ECTS |
| EP42-VIB: **Vibration**<br>Study of systems with one degree of freedom (DOF), Study of systems with n DOF, Analytical dynamics of discrete systems: Lagrange equations, Kinetic and potential energies of a simple continuous system, Simplified study of a bending rotor | 2,5 ECTS |

| | 5TH YEAR |
|---|---|
| ***FALL – S9*** | |
| EP51-ED-SNEA and EP51-ED-PROJET-SNEA: **Numerical modelling and flow simulations**<br>Introduction and extensive use of CFD tools (Openfoam) for flow simulations. Course and project.<br>*Track: RE* | 3 ECTS |
| EP51-ED-ENB and EP51-ED-ENB-PROJET : **Building Energy**<br>Establish heating requirement for every single room, calculate energy consumption for heating, cooling, lighting and hot water providing, check conformity to French Thermal Regulation. Courses and project.<br>*Track: RE* | 3 ECTS |
| EP51-SP-ATOM: **Atomization and spray**<br>To introduce the main physical concepts in atomization. Definition of the basic tools to treat a problem related to the atomization.<br>*Track: PS* | 1,5 ECTS |
| EP51-SP-AERO: **Aerodynamics**<br>This course extends fluid mechanic concepts to the aerodynamic performance of wings and bodies in subsonic and incompressible regime. The course has three components: (i) fundamentals of viscous and non-viscous flows, including forces and moments and laminar/turbulent boundary-layer results for the prediction of the flow separation on profiles; (ii) non-viscous flows, including 2D potential flows; (iii) aerodynamics of 2D airfoils, including thin airfoil theory.<br>*Track: PS* | 2 ECTS |
| EP51-SP-NVH: **Noise, Vibration and Acoustics**<br>To understand the main phenomena in general acoustics. To be able to calculate the main parameters used in acoustics.<br>*Track: PS* | 1,5 ECTS |
| EP51-SP-TURBA: **Advanced modeling of turbulence**<br>Advanced modeling of turbulence<br>*Track: PS* | 2 ECTS |
| EP51-SP-SNEA: **Advanced Numerical Simulation of Complex Flows**<br>To understand in deep the turbulence models and the numerical methods to solve complex flows. Course and practicals on YALE2.0 code.<br>*Track: PS* | 3 ECTS |
| EP51-SP-COMBT: **Turbulent Combustion**<br>Detailed study of transport equations in reactive flows and corresponding turbulent combustion models. Application of YALES2.0 LES code to solve these equations for basic cases.<br>*Track: PS* | 2,5 ECTS |
| EP51-SP-TP: **Practical work (engine, Optical diagnostics)**<br>Application of optical diagnostics for turbulent and reactive flows: PIV, LII, PLIF. The course includes laboratory exercises that are divided in two parts: 1) Optical exercises where the three laser diagnostics are discovered. 2) Exercises for common engine technologies (car engine, cogeneration, annular combustor), which have been taught in previous courses in the EP department."<br>*Track: PS* | 4 ECTS |
| **FRENCH AS A FOREIGN LANGUAGE (FLE)** | |
| FLE courses are available for international students throughout the academic year. | 2 ECTS |
| **EP41 – PIE INDUSTRIAL PROJECT** | |
| Project with an industrial partner. | 12 ECTS |
| **RESEARCH AND DEVELOPMENT PROJECT** | |
| Students can conduct research alongside an experienced professor who will act as a mentor. | 15 ECTS PT<br>30 ECTS FT |

*PT: Part-time*
*FT: Full-time*

| Specific tracks | Abbreviations |
|---|---|
| Renewable Energy | RE |
| Propulsion Systems | PS |

**> ASSOCIATED LABS**
**CORIA**
http://www.coria.fr/
**GPM**
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# INDUSTRIAL RISKS AND PROCESS ENGINEERING

The IRM engineer intervenes at all levels of the industrial risk problem. Its role is to ensure the integration of the various aspects of security either internally as a security manager, or externally as an expert belonging to supervisory authorities, insurance companies or consulting firms.



| 3RD YEAR | |
|---|---|
| ***FALL – S5*** | |
| MRIE32-RAC: **Radiation Combustion**<br>Basic knowledge necessary for the understanding of the phenomena of combustion and the thermal radiation necessary for the quantification of the effects of fires and explosions. | 3 ECTS |

| 4TH YEAR | |
|---|---|
| ***FALL – S7*** | |
| MRIE42 : **Reliability**<br>Modeling systems<br>• Functional Analysis: Failure Mode, Effect and Criticality Analysis (FMECA), Failure Tree<br>• Analysis, Event Tree, Reliability Block Diagram, State Graph and Markov Graph.<br>• Functional analysis of the networks<br>• Combinatorial Logic Analysis of states (operations, failures, gradients, ...)<br>• Fault data, statistical data processing and databases (SdF, Reliability, Maintenance) Probabilistic Analysis of Safety and Functioning of Systems (probability, distributions, ...)<br>• Probabilistic Analysis of the Reliability of Structures<br>• Simulation by the Monte Carlo Method<br>• Maintenance Oriented Reliability | 6 ECTS |

| 5TH YEAR | |
|---|---|
| ***FALL- S9*** | |
| MRIE51-REX: **Experiences Feedback**<br>Feedback, investigation after accidents, technical factors to organizational and human factors in industrial safety and nuclear safety | 3 ECTS |
| MRIE51-SRC: **Chemical Reactor Stability**<br>The objective of this study is to develop a general method to determine thermal runaway boundaries for refining and petrochemical processes which may potentially undergo reaction thermal runaways. | 3 ECTS |
| MRIE51-EQR: **Quantitative Risk Assessment**<br>Introduce students to a Quantitative Risk Assessment (QRA), a quantified risk assessment method used in international oil and gas projects. | 3 ECTS |
| MRIE51-PTA: **Advanced Unit Operations and Pollution Treatments**<br>Gas pollution treatment and processes. Absorption- Absorption with chemical reaction | 3 ECTS |
| MRIE-PRORECH: Research Project<br>Immersion Project with LSPC and CORIA Research Teams | 9 ECTS |
| MASTER-M2-EFE-GP-CER: **Chemical Engineering Reaction**<br>In the first part, we will study the different method to measure the non-ideality of a chemical reactor and then, how to predict the conversion in such reactor. In the second part, we will study the transient state in continuous reactor. | 3 ECTS |
| MRIE51-MFC: **Turbulent Flows**<br>This course Introduce basic properties of turbulence: Random vortical fluctuating structures over a large range of length- and time-scales. Introduce the importance of turbulent mixing and transport of momentum in practical flows. Expose the students to theoretical, numerical and experimental techniques used to describe and quantify the effects of turbulence. | 3 ECTS |

**FRENCH AS A FOREIGN LANGUAGE (FLE)**

FLE courses are available for international students throughout the academic year. 2 ECTS

**RESEARCH AND DEVELOPMENT PROJECT**

Students can conduct research alongside an experienced professor who will act as a mentor. 15 ECTS PT
Research topics are developed by the professor in organic chemistry, polymers & materials and chemical engineering. 30 ECTS FT

*PT: Part-time*
*FT: Full-time*

**> ASSOCIATED LABS**

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**LSPC**
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Find more information about the department on Youtube here

# MATHEMATICAL AND SOFTWARE ENGINEERING

The Mathematical Engineer is distinguished by his analytical and conceptual approach to problems. He or she can quickly learn new ideas and techniques to apply them in practice. He or she must master the different techniques related to Mathematics and Computer Science which are his main tools.



| | 5TH YEAR |
|---|---|
| ***FALL- S9*** | |
| **Modeling and Numerical Simulation**<br>This course covers several important aspects of mathematical modeling and numerical simulations for various applications.<br>- Perturbations and inverse problems<br>- Numerical methods for front propagation<br>- Advanced numerical methods for the wave equation<br>- Mathematical Modelling and numerical simulation: theory and applications to image processing, energy and coastal morphodynamics<br>- - Variational methods for image processing | 8 ECTS |
| **Optimization for Operations Research and Data Science**<br>This course covers several important aspects of optimization, from exact methods with mathematical programming to approximate methods with or without performance warranty. Applications to operations research or data science include practical homework and computing.<br>- Large Scale Optimization: main results in general optimization and some advanced technics like decomposition methods<br>- Network Design: solving optimization problems including a network or a graph model<br>- Complexity and Approximate Algorithms: NP-complete problems, design of approximate methods with some proof on the performance ratio, some results on complexity for parallel algorithm.<br>- Metaheuristics: approximate methods for combinatorial optimization problems.<br>- logic programming and constraint programming | 8 ECTS |
| **Stochastic control and Finance**<br>Basic and advanced methods for modeling and solving problems in mathematical finance.<br>- Optimal Control and applications<br>- Stochastic control and applications to finance<br>- Stochastic Calculus and Finance | 8 ECTS |
| **Advanced concepts in artificial intelligence**<br>- Explainable AI<br>- Virtual and Augmented Reality | 5 ECTS |
| **Machine Leaning and Data Approximation Applied to Image Processing and Big Data**<br>During this course, we focus on applications of machine learning to image processing. More precisely, we will study of Adaboost method, often used in image processing, which has the distinction of using ML. The importance of the definition of descriptor vectors will be underlined, where is the necessary and sufficient information to deduce the underlying model by learning will be treated. Convergence, genericity, parades to over-learning are also studied. We will then introduce the use of machine learning applied to data science (big data), and we will study artificial neural networks (ANN) method. | 1 ECTS |

GM

**PROFESSIONAL OR RESEARCH PROJECT**
The course is made up of a mid-term presentation and a final defense. The topics are to be discussed with the professors of the department and can have a non-negligible research component, either in mathematics or in computer science, according to the skills the exchange student wants to develop. — 15 ECTS PT

**FRENCH AS A FOREIGN LANGUAGE (FFL)**
FLE courses are available for international students throughout the academic year. — 2 ECTS

*PT: Part-time*
*FT: Full-time*

**> ASSOCIATED LABS**
**LITIS**
http://www.litislab.fr/
**LMI**
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Find more information about the department on Youtube here

# CIVIL AND URBAN ENGINEERING

The GCCD specialty prepares engineers capable of leading the design, implementation, operation, management and renovation of construction works and infrastructure. They gain expertise in many fields such as Sustainable Construction, Environment, and Building Security and Risk Analysis.



## Rouen Campus

| | 5TH YEAR |
|---|---|
| ***FALL - S9*** | |
| EP51 ED-ENB: **Building Energy**<br>Establish heating requirement for every single room, calculate energy consumption for heating, cooling, lighting and hot water providing, check conformity to French Thermal Regulation. | 5 ECTS |
| M51-CBI: **Bio-Inspired Mechanical Design**<br>Introduce fundamental concepts of Bio-Inspired Mechanical Design, an approach that seeks solutions to human challenges within the natural world. Methods and solutions from structural mechanics and materials will be studied. | 4 ECTS |
| MRIE51-REX**: Experience Feedback**<br>Feedback, investigation after accidents, technical factors to organizational and human factors in industrial safety and nuclear safety. | 3 ECTS |
| MECA51-DYNA**: Digital Modeling and Simulation in Structural Dynamics**<br>Theoretical and numerical tools that allow the modeling of a linear elastodynamic structure during its interaction with the environment, taking into account material or geometric hazards. | 4 ECTS |
| MECA51-DYNAE: **Experimental dynamics, model validation and verification**<br>Learning theoretical, numerical and experimental tools that allow the measurement of the dynamic properties of a structure and the validation of numerical models. | 4 ECTS |
| GC51-ISIS-STRUC: **Structural Reliability**<br>Fundamental theory of structural reliability, risk assessment, uncertainty quantification and propagation, First order and second order reliability methods, Monte Carlo simulations, finite element and reliability coupling. | 4 ECTS |
| GC51-ISIS-GEOT: **Geotechnical risks**<br>Decision making in engineering design considering geotechnical risk. | 2 ECTS |
| **FRENCH AS A FOREIGN LANGUAGE (FLE)**<br>FLE courses are available for international students throughout the academic year. | 2 ECTS |
| **RESEARCH AND DEVELOPMENT PROJECT**<br>Students can conduct research alongside an experienced professor who will act as a mentor. | 15 ECT PT<br>30 ECTS FT |

**> ASSOCIATED LABS**

**CORIA**
http://www.coria.fr/

**PBS**
http://pbs.univ-rouen.fr/

**LSPC**
http://lspc.insa-rouen.fr/

*PT: Part-time*
*FT: Full-time*

## Le Havre Campus

| | 5TH YEAR |
|---|---|
| ***SPRING – S10*** | |
| Mechanical design and aerodynamics *Track: Wind Energy* | 2 ECTS |
| Blade design & composite materials *Track: Wind Energy* | 2 ECTS |
| Project management for the creation of wind farms *Track: Wind Energy* | 2 ECTS |
| Numerical aspects related to wind turbines *Track: Wind Energy* | 2 ECTS |
| Project of wind energy *Track: Wind Energy* | 2 ECTS |
| Marine renewable energy (Wave, Current and Tidal) *Track: Marine Energy* | 2 ECTS |
| Offshore wind energy *Track: Marine Energy* | 2 ECTS |
| Offshore structures *Track: Marine Energy* | 2 ECTS |
| Environmental impact of marine renewable energy *Track: Marine Energy* | 2 ECTS |
| Project of marine energy *Track: Marine Energy* | 2 ECTS |
| Photovoltaic solar energy *Track: Solar and earth energy* | 2 ECTS |
| Thermal solar energy *Track: Solar and earth energy* | 2 ECTS |
| Geothermal energy and positive energy buildings *Track: Solar and earth energy* | 2 ECTS |
| Biomass and waste energy *Track: Solar and earth energy* | 2 ECTS |
| Projects of solar and earth energy *Track: Solar and earth energy* | 2 ECTS |
| Civil engineering: generalities and costing *Track: Civil engineering* | 2 ECTS |
| Onshore foundation for renewable energy *Track: Civil engineering* | 2 ECTS |
| Management of civil works for renewable energy projects *Track: Civil engineering* | 2 ECTS |
| Fundamentals of electrotechnics and energy converters *Track: Humanities and electrotechnics* | 2 ECTS |
| Grid integration, intermittency, and energy storage *Track: Humanities and electrotechnics* | 2 ECTS |
| Energy savings and legal aspects, project management *Track: Humanities and electrotechnics* | 2 ECTS |
| Global warming, world energy situation and geopolitical aspects *Track: Humanities and electrotechnics* | 2 ECTS |

**FRENCH AS A FOREIGN LANGUAGE (FLE)**

FLE courses are available for international students throughout the academic year. 2 ECTS

**RESEARCH AND DEVELOPMENT PROJECT**

Students can conduct research alongside an experienced professor who will act as a mentor. 15 ECTS PT

*PT: Part-time*
*FT: Full-time*

gccd@insa-rouen.fr

Find more information about the department on Youtube here