FOURTH YEAR INSA TOULOUSE

Autumn semester

MECHANICAL ENGINEERING COURSES

Design of structures	7 credits	79h
Manufacturing	6 credits	64h
Mechanical power transmission	9 credits	133h
Improving autonomy and building a professional project	4 credits	39h
Improve your management abilities	4 credits	45h

SYSTEM ENGINEERING COURSES

Control Systems	4 credits	39,25h
Power systems and instrumentation	7 credits	85,5h
Multiphysic modeling	6 credits	72,75h
Improving autonomy and building a professional project	4 credits	39h
Modelling and Optimization	5 credits	60h
Improve your management abilities	4 credits	45h

Spring semester

MECHANICAL ENGINEERING COURSES

Advanced heat transferts and fluid flow	5 credits	65h
Advanced mechanical modelling	7 credits	99h
Multidisciplinary industrial project	6 credits	86h
Research projects and Sports	6 credits	37h
Communicating with in organizations	6 credits	75h

SYSTEM ENGINEERING COURSES

Tutored projects	4 credits	60h
Systems Engineering processes	5 credits	76h
Dynamics of structures and control	4 credits	54h
Object oriented and real time programming	3 credits	55h
Mechatronic project	4 credits	60h
QSE and Sport	4 credits	48,75h
Communication with in organizations	6 credits	

Design of structures

Level
BAC +3

ECTS
7 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
79h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

Program (detailed contents):

Finite element module :

The student learns various phases of a finite element analysis using a modern software: geometrical modeling of structures, meshing, applying the boundary conditions, solving, postprocessing and analyzing the results from a critical point of view. Student gets to know various features built-in the software related to: meshing technique working firstly on the single part and later on part assembly, using specific finite elements and particular algorithms devoted to linear and nonlinear problems (contact, plasticity), error estimation...

Course is divided into two parts. The first part considers training (with significant help of the teacher) oriented towards understanding and familiarizing with the user interface of the software and the capabilities of the computer code. This computer code serves as a tool to support the training and test the concepts known from the previous courses such as Finite elements, Continuum mechanics and Resistance of materials. During the second part, the student must conduct the analysis of a real-life problem, with a partial autonomy, in the form of a project.

Reliability and Design of experiments module :

The contents are divided in two parts. The first part presents the role and objective of RAMS (Reliability, Avaibility, Maintainability, Safety) analysis. The design of experiments part presents the Taguchy method.

Mechanics of vibrations module :

Firstly the teaching focuses on discrete models with localized parameters (mass-spring model). The analysis and understanding of the basic one-degree-of-freedom oscillator is followed by an extension to multi-degree-of-freedom models. Time domain resolution by direct resolution of differential equations or frequency domain resolution by use of Frequency Response Functions are discussed in the different cases. A second part of the teaching focuses on the vibrations of continuous models (beams, plates, etc.).

Bibliographic work module :

Initiation to bibliographic search tools. Awareness to the concept of "industrial property".

Organization:

Finite element module :

9 seances of 3h, 5x3h of mixed lecture and practical work, 4x3h project

Reliability:

Design of experiments:

4h of lectures, 4 tutorials and 1 labwork of 4h.

Mechanics of vibrations module :

10x1,25h Lecture + 9x1,25h practical

Objectives

Finite element module :

* Perform finite element analysis using a commercial finite element code (Abaqus for example) following the presented principles and good practice.
* Identify the features offered by these numerical tools and the associated potentialities.
* Create relevant models related to the target objectives.
* Analyse and postprocess the obtained results.
* Analyze the impact of the modeling assumptions.
* Assess the risks inherent to the wrong interpretation of the results.

Reliability and Design of experiments module :

* Apply to practical case analyses the basics of reliability
* Build a design of experiments for the modeling of a physical system from numerical or experimental data.

Mechanics of vibrations module :

* Develop a linear dynamic model of a mechanical structure: a lumped parameters model for a discrete elements structure, or a distributed parameters model for a continuous structure.
* Determine the vibrations of these structures undergoing transient or permanent excitation.

Bibliographic work module :

* Carry out a literature review and establish a state of the art on a research topic that will be developed in I4GMPJ81 formation unit.

This state of the art will present :

* past history (previous studies, de facto situation, necessity of research)
* the main results of these past studies
* The elements that could guide future work in UF I4GMPJ81.

Pre-requisites

Finite element module :

Computer aided design (CAD)

Finite element concepts.

Mechanics of vibrations module :

Basics in solid mechanics, strength of material, dynamic systems.

Useful info

Contacts

Education manager
EDUARD MARENIC

Place

Toulouse

Manufacturing

Level
BAC +3

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
64h

Presentation

Description

Theory of cutting

Cutting tools

Optimization of cutting conditions

High speed machining

Chatter

Shaping of plastics and composites

Production management : Types of manufacturing, inventory management, lean manufacturing and associated tools.

Casting : Presentation of the processes of shaping of crudes / mechanical parts by plastic deformation, with technologies and associated calculations. The processes discussed are mainly forging, stamping, folding and stamping.

Presentation of Additive Manufacturing processes and intervention of specialized industrialists.

Method of implementing a 3D printing process.

Organization:

The teaching sessions are divided down into Courses, Lectures and Practical work.

6 x 1h15 of course in HSM + 6 x 1h15 of lectures

3 x 1h15 of course in Production Management course + 3 x 1h15 of lectures

2 x 1h15 of course in plastic deformation course + 4 x 1h15 of lectures

4 x 1h15 of course in casting course + 3 x 2h5 of lectures

5 x 1h15 of course in Additive Manufacturing +3 x 1h15 of lectures

3h of practical work on the implementation of means of Additive Manufacturing

9h of practical work on plastic injection, cutting forces and HSM

Objectives

The student will be able to :

- Define the influencing parameter on cutting material,

optimize a machining operation in HSM.

- Define a Production Management Approach.

- Design parts by casting.

- Define the advantages and limitations of additive manufacturing processes.

- Design and produce plastic parts using an additive manufacturing process.

- Know the different ways to get rough part and their costs and performance, define a range of rough part and design the necessary tools.

Pre-requisites

CAM manufacturing technology

Tolerance Manufacturing analysis

Mechanical characteristics of materials

Resistance of materials : elasticity

Digital production chain : CAD, CAM, Post-processing, use of means of production, control

Knowledge check

Written exam in the different subjects.

Useful info

Contacts

Education manager
SEBASTIEN SEGUY
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Place

Toulouse

Mechanical power transmission

Level
BAC +3

ECTS
9 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
133h

Presentation

Description

Part I - CAD

- best use of CAD software (organising the data; top-bottom modeling via skeletons)

- practice with 3DX

Part II - Gears

- planetary gears

- detailed geometry of involute gears

- gear sizing using ISO6336

Part III - Project work

Groups of 2 or 3 students

Using the following specifications:

. use context, geometrical constraints

. input and output data

. expected service life

Each team has to produce:

. a thorough sizing synthesis document (gears, bearings, shafts, clampings)

. a drawing of the mechanism

. a CAD model of the mechanism

Objectives

At the end of this module, the student will be able to analyse technical requirements related to the design of a gear reducer, create a design with the associated sizing calculations, present their solution by means of both a draft and a CAD model.

Pre-requisites

Fundamentals of mechanical design:

- basics of manufacturing (welding, machining)

- common clamping technology (key, splines, screws, etc.)

- pivot joints (rolling bearings joint design and sizing)

- basics of technical drawing

- calculating forces in a mechanical system (equilibrium laws)

- calculating stresses (torsion and bending of beams)

Useful info

Contacts

Education manager
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Place

Toulouse

Improving autonomy and building a professional project

ECTS
4 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
39h

Presentation

Objectives

Construire une équipe projet, Approfondir ses connaissances,

Investir le métier, les domaines d'activité, les fonctions.

L'étudiant devra être capable de :

- d'analyser avec les autres un problème posé (Identifier le problème, définir les axes d'approche dans un bilan interactif : organisation, physique, technique, stratégique, motivation, confiance...

- de décider ensemble (permettre à tout le monde d'exprimer son avis, ajuster et réguler sa conduite en fonction de l'analyse collective),

- d'identifier les ressources du groupe (sens critique, repérage des points forts et faibles de chacun).

Place

Toulouse

Useful info

Improve your management abilities

ECTS
4 credits

Number of hours
45h

Presentation

Objectives

At the end of this module, the student will have understood and be able to explain :

* The basic rules of business law

* The objectives, principles and means of marketing

* The principles and procedures of financial diagnosis and/or investment.

The student will be able to apply principles and rules of management and law in simple situations. Take into account the parameters of the management (customer needs, cost effectiveness an legal compliance).

Useful info

Contacts

Education manager
LUCIE LECLERT
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Control Systems

ECTS
4 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
39,25h

Presentation

Objectives

Introduction to basic concepts of analysis and design of continuous-time feedback systems.

Introduction to SIL (Software in the loop) and HIL (Hardware in the loop).

Useful info

Contacts

Education manager
GWENDOLINE LE CORRE
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Place

Toulouse

Power systems and instrumentation

ECTS
7 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
85,5h

Presentation

Objectives

To be able to identify standard power transmission architectures. To be able to generate

or to analyse architectures of power systems

To acquire a global knowledge in the technology for power transmission (mechanical,

hydraulic, electrical and thermal). To able to characterise them with respect to

performance, advantages and drawbacks.

Acquire knowledge in measurement and computer-controlled data acquisition:

-selection and design of the components involved in an acquisition circuit

- use a graphical programming language dedicated to data acquisition (Labview).

Pre-requisites

1D multiphysics

Electro-kinetics. Algorithms and textual language programming (C, ADA)

Useful info

Place

Toulouse

Multiphysic modeling

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
72,75h

Presentation

Objectives

To design and analyse high-level models of multidomain energy-transfer

systems or mechatronic systems.

Formalisation of physics concepts from previous years as lumped-parameter

modelling (0D-1D) in electrical, magnetic, hydraulic, thermal and

mechanical systems. Lectures, tutorial, lab-work with Modelica or Amesim.

Implementation and analysis of multiphysics systems with block diagrams and

state-space simulation models. Several modelling problems using lumped

parameter systems: setting to equations in various domains, simulation using

simulink, time and frequency analysis. Lectures, tutorials, lab-with Matlab /

Simulink or Amesim.

Defining and designing models using the bond-graph formalism.

Lectures and modelling project

Pre-requisites

General physics (mechanics, electricity, fluid mechanics, thermodynamics).

Useful info

Place

Toulouse

Modelling and Optimization

ECTS
5 credits

Number of hours
60h

Presentation

Objectives

At the end of this module, the student will have understood and be able to explain :

- Various approaches to analyze and evaluate the performances of discrete event system DES

- Various types of modelling adapted to the problems considered (deterministic of stochastic models, numerical and combinatorics optimization models, models of concurrency)

-Algorithms available to solve these problems.

The student will be able to :

- Model and solve operational research problems (optimization, linear programming, graphs, stochastic process) and discrete event systems problems

- Model stochastic systems, such as a network of queues, using Markov chains. Comptute their stationary performance measures, and dimension its capacity

- Model a DES by Petri net, analyse the properties of the Petri net by various methods of analysis (exhaustive and structural).

Useful info

Contacts

Education manager
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Improve your management abilities

ECTS
4 credits

Number of hours
45h

Presentation

Objectives

At the end of this module, the student will have understood and be able to explain :

* The basic rules of business law

* The objectives, principles and means of marketing

* The principles and procedures of financial diagnosis and/or investment.

The student will be able to apply principles and rules of management and law in simple situations. Take into account the parameters of the management (customer needs, cost effectiveness and legal compliance).

Useful info

Contacts

Education manager
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Advanced heat transferts and fluid flow

Level
BAC +3

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
65h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

Viscous Fluid Flows :

Lectures and Tutorials

* Intro: viscosity, fluid particle, deformation, Eulerian and Lagrangian reference system
* Fundamental eqs : Conservation of Mass, Linear Momentum (Navier-Stokes eq) and Energy, dimensional analysis and similarity
* Internal flows: Analytical solution of the fundamental equations, friction factor, head losses, hydraulic circuits
* External flows: laminar and turbulent boundary layers, forces on immersed bodies, elementary aerodynamics.

Heat and Mass Transfer :

Lectures and tutorials

* unsteady conduction
* additional external convection (tube batteries, impacting jets, mass transfer and evaporation)
* internal flow convection.

Numerical simulation lab work: introduction to Ansys Fluent code and realization of a project related to the course.

Objectives

At the end of this course, the student should have understood and will be able to explain the basics allowing to approach a phenomenon involving real (viscous) fluids. He will be able to tackle situations involving more or less complex heat and mass transfers.

The student will also be able to conduct a numerical simulation with Ansys Fluent code.

Pre-requisites

Inviscid fluid dynamics (I3ICFT01 – Fluid Mechanics 1)

Introduction to heat transfer (I3ICFT01 – Heat Transfer 1)

Useful info

Place

Toulouse

Advanced mechanical modelling

Level
BAC +3

ECTS
7 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
99h

Presentation

Description

Mechanical systems :

The basis of behavior under preload is highlighted through the study of fatigue life of shafts, angular contact bearings, fasteners, interference shaft assemblies and mechanical springs.

Materials :

Training to the fundamental basis of plasticity, creep, corrosion and mechanical damage.

Vibrations and transient dynamics :

Vibrations with finite elements : modal superposition, FRF, damping

Transient dynamics : explicit computing, Newmark's algorithm.

Practical sessions illustrates some experimental aspects of vibration : impact hammer, shaker.

Objectives

At the end of this module, the student will have understood and be able to explain how works a pre-stressed (or preloaded) mechanical system, basis of fracture mechanics and computations of vibrations and transient dynamics.

The student will be able to identify mechanical systems that are preloaded, discuss with a specialist of fracture mechanics and carry out a simulation of vibrations and transient dynamics.

Useful info

Contacts

Education manager
ALAIN DAIDIE
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Place

Toulouse

Multidisciplinary industrial project

Level
BAC +3

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
86h

Presentation

Description

Students work in teams in order to propose their answer to an industrial project. This work induces working on eco-design, life-cycle analysis, quality, security and project management.

Organization :

Few lectures are organized. The main work is done in teams with meetings with our industrial partners on dedicated issues (quality, security...). At the end of the project the students have to promote their work to the author of the project.

Objectives

At the end of this module, the student will have understood and be able to explain the main principles and definitions of quality management, the importance of health and safety at work, how to assess and prevent risks, eco-design and life-cycle analysis.

The student will be able to develop their capabilities in mechanical design in an industrial project.

Pre-requisites

Bachelor in mechanical design

Useful info

Contacts

Education manager
MANUEL PAREDES
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Place

Toulouse

Research projects and Sports

Level
BAC +3

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
37h

Presentation

Description

The first semester if the 4th year (semester 7) deals with the bibliographical search. It is managed by the library staff.

The second semester of the 4th year (semester 8) addresses the scientific communication and is used to generation the scientific propositions. It is driven jointly by the scientific tutor and the English professors (a specific UE).

The third part is devoted to the implementation and assessment of the scientific proposals. It takes place in the first semester of the 5th year (semester 9), as another UE.

Organization:

Semester S7 : 2x1h15 lectures on bibliographical search, delivered by the library staff, plus 30 hours personal work.

Semester S8 : 55 h hour personal work for the team project, driven by the scientific tutor. Close link with English courses for written and oral communication.

Main difficulties for students:

- Manage their time to work every week on the project

- Allocate enough time for the generation of deliverables

- Process with scientific rigor, including for produced documents.

Objectives

The module aims at giving the students a first experience with research through a tutored project in teams (2 to 4 students).

At the end of the module, the student will :

- know how to conduct a bibliography search, synthesise and cite it, for a given scientific topic;

- communicate with rigor in English, orally of through written documents to highlight the research activity performed;

- perform a simple research action in a team organization to generate scientific propositions, then implement and finally assess them.

Useful info

Contacts

Education manager
JEAN-CHARLES MARE
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Place

Toulouse

Communicating with in organizations

ECTS
6 credits

Number of hours
75h

Presentation

Objectives

The classes given in French will focus on :

-How to react to society's demand for technical and scientific information

- How to foster critical thinking in order to give appropriate answers when questioned about such issues

- How to communicate effectively in the workplace

The classes given in English will focus on the specific linguistic characteristics of English used in such contexts in order for the students to understand and master therm.

The students will also be made aware of the specificity of professional communication within the English-speaking world.

Module L2

The objectives, defined in reference to ther CEFRL for the 5 language activities, depend on the language studied - Chinese, German, Spanish - and the level of the student.

They can be consulted on :

https://moodle.insa-toulouse.fr/course/view.php?id=44

In certain cases, students may be authorised to follow an English module instead of another language.

Pre-requisites

For classes in English : mastery of general English

Useful info

Contacts

Education manager
BEATRICE JALENQUES-VIGOUROUX
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Tutored projects

ECTS
4 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
60h

Presentation

Description

The work is composed of two parts :

* a bibliographical study dealing with a research theme in relationship with the project. This study is concluded by the witting of a document whose content and form have to follow the recommendations given by the tutors,
* a technical realization which is performed during a full semester.

Organisation:

4 hours of documentary research teaching then 10 hours of project management teaching, then 30h of project.

Objectives

The module is aimed at motivating students with research activities by means "tutored projects" involving groups of several students and directed by an academic or an industrial tutor. Those projects are completed by a formation to documentary research. A course of project management allows guiding the realisation part of the project.

At the end of this module, the student will have understood and be able to explain (main concepts):

* the concepts, norms and techniques related to the building of a state of the art in relationship with the subject of the project subject,
* the concepts and techniques in relationship with the management of the project involving several persons.

The student will be able to:

* elaborate a state of the art dealing with a domain in relationship with the project,
* manage a project involving several persons,
* integrate techniques of different scientific domains to reach the realization goals of the project.

Pre-requisites

Depends of the subject of the project.

Useful info

Contacts

Education manager
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Place

Toulouse

Systems Engineering processes

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
76h

Presentation

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts) :

Learn to define, gather, analyse and express the needs and expectations of

involved parties in order to design and implement a system, a product, a service.

Learn to translate the needs and expectations into technical requirements, define

and analyse technical requirements in order to design and implement a

system, a product, a service.

Useful info

Place

Toulouse

Dynamics of structures and control

ECTS
4 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
54h

Presentation

Objectives

Vibrations of mechanical systems and structures.

Controlling the articulated systems and flexible structures.

The global and local modelling of electromagnetic actuators.

Pre-requisites

Basis in electromagnetism, solid mechanics and control

Place

Toulouse

Useful info

Contacts

Education manager
SEBASTIEN SEGUY
seguy@insa-toulouse.fr

Object oriented and real time programming

ECTS
3 credits

Number of hours
55h

Presentation

Description

The module addresses the specification and design of real time systems, an introduction to main real-time operating systems services, method to program and to test a real-time application.

Objectives

This module presents real time systems, concepts, attributes, constraints, applications and teach how to program these systems using object oriented languages and using real time operating systems.

Useful info

Contacts

Education manager
PIERRE-EMMANUEL HLADIK
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Mechatronic project

ECTS
4 credits

Number of hours
60h

Presentation

Objectives

At the end of this module, the student will have understood and be able to explain :

- Power and information channels of mechatronic systems

- The place of system simulation activities in the design cycle (V design cycle) of complex systems

- The principle of data acquisition with computers.

The student will be able to :

- Establish models suitable for various engineering tasks during the design of mechatronic systems

- Implement models in a system simulation environment and perform validation and verification tasks associated to the V design cycle

- Specify and conduct model-in-the-loop and software-in-the-loop activities for a complex system

- Design the different elements of a simple data acquisition system

- Implement a graphical programming language dedicated to the acquisition (LabWIEW)

- Perform a security analysis

- Perform a lifeclycle analysis with a dedicated software

Useful info

Contacts

Education manager
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QSE and Sport

ECTS
4 credits

Number of hours
48,75h

Useful info

Contacts

Education manager
MANUEL PAREDES
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Communication with in organizations

ECTS
6 credits

In brief

Number of students: 75

Presentation

Objectives

The classes given in French will focus on :

-How to react to society's demand for technical and scientific information

- How to foster critical thinking in order to give appropriate answers when questioned about such issues

- How to communicate effectively in the workplace

The classes given in English will focus on the specific linguistic characteristics of English used in such contexts in order for the students to understand and master therm.

The students will also be made aware of the specificity of professional communication within the English-speaking world.

Module L2

The objectives, defined in reference to ther CEFRL for the 5 language activities, depend on the language studied - Chinese, German, Spanish - and the level of the student.

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In certain cases, students may be authorised to follow an English module instead of another language.

Pre-requisites

For classes in English : mastery of general English

Useful info

Contacts

Education manager

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