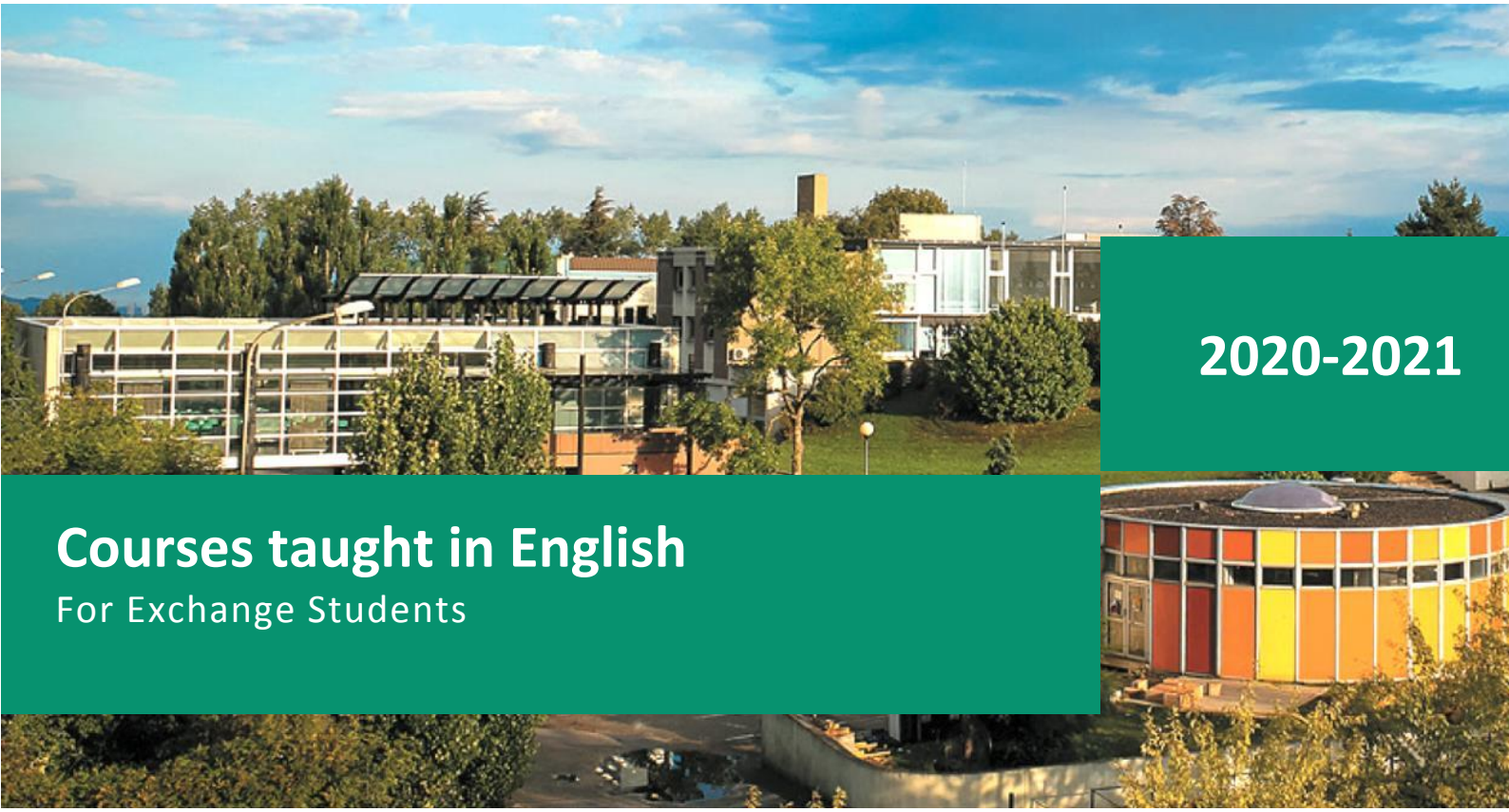
International semesters



2020-2021

Courses taught in English

For Exchange Students

UNIVERSITÉ DE LYON

ENISE
Ecole Nationale d'Ingénieurs de Saint-Etienne

Associée à
ÉCOLE CENTRALE LYON

ENISE

National Engineering School of Saint-Etienne

New international Programmes proposed for exchange students

Getting Started

The **ENISE, National Engineering School of Saint-Etienne**, trains engineers with a strong technological expertise at the service of the industry of the future within 5 years, in the fields of Mechanical Engineering, Civil Engineering and Physical Engineering. The training provides scientific, technological and humanist skills through new educational methods to bring all students to their excellence. Numerous internships in companies as well as strong links with industrial partners enable ENISE engineers to immediately be efficient in their work.

Studying on an **international semester** at the ENISE will enable you to **gain an original knowledge** developed by experts researchers working in the fields of mechanical, civil, and sensory engineering and involved in international-scale projects.

- The **Mechanical engineering** semester offers knowledge in both subtractive and additive manufacturing as well as in hybrid technologies. An innovative approach combining the versatility of the additive manufacturing with the advantages of the subtractive methods revolutionized the way of manufacturing parts and functional surfaces.
- The **Sensory engineering** semester, a field of study that overlaps both mechanical and civil engineering, presents a cutting-edge knowledge in design, manufacturing techniques, and subjective human perception on product manufactured with new configurations between visual, texture and touch features.
- The **Civil engineering** semester provides a new look at how to think out and implement modern technological solutions for constructing buildings and engineering structures in a human and environmentally friendly way.

The emphasis can be **personalized** depending on your choice of subjects and your personal goals and motivation, but all our international semesters will contribute to achieve your full potentials in studies enhancing also your employability.

General Information

■ Course structure

The Programme proposed in each department is based on a Major topic related to the **expertise fields** of ENISE.

Each Programme consists in several **mandatory core modules** that will cover 15 ECTS.

Additional modules can be **freely** selected to reach the desired number of ECTS up to 30 ECTS per semester.

100% English taught – French as Foreign language (FLE) course is also offered

1 ECTS credit is approximately equivalent to **14 hours** of courses or personal work

The following colour legend will be used to distinguish the different types of modules:

Scientific core modules

Humanities and Open Your Mind

Scientific Elective Modules

Technical/Research Project

■ Deadlines and Application

Schedule:

Fall semester from September to January.

Spring semester from February to June

Application deadlines:

May 15th for the Fall semester and academic year.

November 15th for the Spring semester.

Application procedure:

https://www.enise.fr/en/International-relations/incoming-mobility.html

■ Tuition fees

Free of charge for exchange students nominated by a partner institution

601€ for EU students coming as free movers

1885€ for each semester for Non-European students coming as free movers

"A new opportunity for international students looking for a specific technical and scientific expertise…

… in Saint-Etienne!

ECTS = European Credits Transfer System

Mechanical Engineering

Major in «Advanced Manufacturing»

Fall Semester (September to January)

	Reference	Modules	Hours	ECTS
Mandatory Core modules	I5GMPIoSNPT	Comput. Methods for Manuf. Processes	28	4
	I5GMPIoIOMA	Tool-Material Interaction	14	2
	I5GMXXoFADD	Additive Manufacturing	28	4
	I4GSGSoRSAS	Surface Engineering	28	4
	OYM	Open Your Mind *(Seminars, Guest lecturers, company visits…)*	14	1
				15

+

	Reference	Modules	Hours	ECTS
"A la Carte" up to 15 ECTS	I5SHTCx_FLE/ANGL	Modern language: French or English	30	2
	I5OPTCx_EPS/PROP	Sport or Student club	-	1
	I5SHTCoMANA	Strategic Management	18	2
	I5GMXXoTRSU	Surface Texturing	28	4
	I5SHXXoCHAI	Supply Chain	28	4
	I5GMXXoOSPR	Production system optimization	28	4
	I5GMTCoPTECI	Technical Project I	112	8
	I5GMTCoPTECII	Technical Project II	210	15

Spring Semester (February to June)

Reference	Modules	Weeks	ECTS
I5GMGMo_PFE	Laboratory Research Project	24	30
	The student works on a research based scientific problem following a project approach. The student will have to develop abilities in managing objectives, planning, decision making, working independently and with initiative, delivering and presenting results in a written and oral way.		

Contact: cedric.courbon@enise.fr

Sensory Engineering

Major in «Perception»

Fall Semester (September to January)

	Reference	Modules	Hours	ECTS
Mandatory Core modules	I4GSGSoPROD	Development in Sensory Engineering	30	4
	I4GSGSoPTAC	Tactile perceptions	14	2
	I4GSGSoPROD	Practice of Sensory Engineering	20	2
	I5GMXXoCMEC	Mechatro. & Micro controllers	14	2
	I4GSGSoMTEX+I4GSGSSHAR	Augmented Reality	28	4
	OYM	Open Your Mind *(Seminars, Guest lecturers, company visits…)*	14	1
				15

+

	Reference	Modules	Hours	ECTS
"A la Carte" up to 15 ECTS	I5SHTCx_FLE/ANGL	Modern language: French or English	30	2
	I5OPTCx_EPS/PROP	Sport or Student club	-	1
	I5SHTCoMANA	Strategic Management	18	2
	I5GMXXoTRSU	Surface Texturing	28	4
	I4GSGSoRSAS	Surface Engineering	28	4
	I5GMGSoBMAT	Bio-materials	12	2
	I5GSTCoPTECI	Technical Project I	112	8
	I5GSTCoPTECII	Technical Project II	210	15

Spring Semester (February to June)

Reference	Modules	Weeks	ECTS
I5GSGSo_PFE	Laboratory Research Project	24	30
	The student works on a research based scientific problem following a project approach. The student will have to develop abilities in managing objectives, planning, decision making, working independently and with initiative, delivering and presenting results in a written and oral way.		

Contact: clementine.didier@enise.fr

Civil Engineering

Major in «Building envelope»

Fall Semester (September to January)

	Reference	Modules	Hours	ECTS
Mandatory Core modules	I5GCXXoPARA	Seismic Engineering	28	4
	I5GCXXoCNLI	Non linear mechanics	14	2
	I5GCXXoGIND	Lean Manufacturing in Civil Engineering	14	4
	I5GCXXoBCNU	Numerical basis for Civil Engineering	18	2
	I5GCXXoMCOM	Composite materials in Civil Engineering	28	4
	OYM	Open Your Mind *(Seminars, Guest lecturers, company visits…)*	14	1
				15

+

	Reference	Modules	Hours	ECTS
"A la Carte" up to 15 ECTS	I5SHTCx_FLE/ANGL	Modern language: French or English	30	2
	I5OPTCx_EPS/PROP	Sport or Student club	-	1
	I5SHTCoMANA	Strategic Management	18	2
	I5GCBAoOTCO	Acoustics in Civil Engineering	10	2
	I5GCTCoPTECI	Technical Project I	112	8
	I5GCTCoPTECII	Technical Project II	210	15

Spring Semester (February to June)

Reference	Modules	Weeks	ECTS
I5GCGCo_PFE	Laboratory Research Project	24	30
	The student works on a research based scientific problem following a project approach. The student will have to develop abilities in managing objectives, planning, decision making, working independently and with initiative, delivering and presenting results in a written and oral way.		

Contact: hanene.souli@enise.fr

Course Syllabi

ENISE I5GMPIoSNPT

Computational methods for manufacturing processes

Lecturers: **E. Feulvarch**

Lectures: 28h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 28h | Lang. :

Objectives

The objectives of this course are to make the students aware of the multi-physical modelling of manufacturing processes. This course will thus browse:

- the modelling of heat transfer coupled with metallurgical transformations,
- the simulation of thermal stresses and distortions induced by thermo-metallurgical phenomena,
- the computational strategies for the simulation of coupled physical phenomena.

Keywords: Computational methods, heat transfer, residual stresses, metallurgical transformations, multiphysics, manufacturing processes

Programme

1. Interest of computational methods for manufacturing processes
2. Computational modelling of heat transfer (Joule effect, mechanical dissipation)
3. Computational modelling of thermo-metallurgical couplings (metallurgical kinetics, influence of the phase composition on physical properties)
4. Simulation of mechanical induced phenomena (thermal expansion, volume changes, transformation plasticity)
5. Computational strategies for the simulation of coupled physical phenomena (fusion welding, FSW, drilling, carbonitriding,…)

Learning outcomes

After attending this course, the student will:

- Be aware of the benefits and requirements of process modelling
- Be able to identify the main physical couplings that need to be taken into account for a given process and a predefined objective (thermal kinetics, residual stresses, multi-phase mechanical behavior…)
- Be able to propose an efficient computational strategy

References

"Thermo–Mechanical Industrial Processes: Modeling and Numerical Simulation" - Wiley - J.M. Bergheau

Hugo Robe, Christophe Claudin, Jean-Michel Bergheau, Eric Feulvarch (2019) R-ALE simulation of heat transfer during friction stir welding of an AA2xxx/AA7xxx joint on a large process window, International Journal of Mechanical Sciences, 155:31-40

E. Feulvarch, J.M. Bergheau, Modeling and numerical simulation of resistance spotwelding process, Encyclopedia of thermal stresses, ISBN 978-94-007-2740-3, R. Hetnarski (Ed.), Springer, 15 pages.

E. Feulvarch, V. Robin, J.M. Bergheau (2011) Thermo-metallurgical and mechanical modeling of welding - application to multipass Dissimilar metal girth welds, Science and Technology ofWelding and Joining, 16:221-231.

Assessment

1 Oral presentation in groups with self-assessment by the classmates

The topic will be related to one case study based on a research papers in the literature.

I5GMPIoIOMA

Tool-Material Interaction

Lecturers: **C. Courbon, J. Rech, F. Valiorgue**

Lectures: 14h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 14h | Lang. :

Objectives

The objectives of this course are to make the students aware of the new trends in manufacturing engineering and the future challenges. In order to be competitive in a global industrial environment, modelling the whole production chain appears as a key step. This implies that each manufacturing processes involved in this chain has to be modelled, raising strong scientific and technical questions to be answered.
This course will thus browse:

- The context in which numerical simulation can have a high added value
- The requirements to build a numerical model of a manufacturing process
- The characterisation of the main input data with a special emphasis on material removal
- How to build a numerical approach to predict the surface integrity of a machined part.

Keywords: manufacturing, cutting, numerical simulation, tribology, surface integrity

Programme

1. Introduction to the context and needs of numerical simulation
2. Experimental methods to investigate a material removal process
3. Experimental methods to determine the workmaterial constitutive model
4. Experimental methods to assess the tribological interaction between the tool and the workmaterial
5. Input data and methodology for the numerical prediction of surface integrity

Learning outcomes

After attending this course, the student will:

- Be aware of the benefits and requirements of process modelling
- Be able to select a material characterization technique depending on the target thermos-mechanical loadings applied to a given material
- Be able to select a tribological characterization technique to measure friction, heat partition and wear under severe conditions
- Be able to develop a simple numerical model to predict residual stresses

References

"Machining - Fundamental and recent advances" - Springer - J. Paulo Davim

PJ. Arrazola, T. Ozel, D. Umbrello, M. Davies, IS. Jawahir (2013) Recent Advances in Modelling of Metal Machining Processes. CIRP Annals - Manufacturing Technology 62(1):695–718.

Rech J, Arrazola PJ, Claudin C, Courbon C, Pusavec F, Kopac J (2013) Characterization of Friction and Heat Partition Coefficients at the Tool–workmaterial Interface in Cutting. CIRP Annals — Manufacturing Technology 62(1):78–82.

A. Mondelin, F. Valiorgue, J.Rech, M. Coret, E. Feulvarch (2012) Hybrid model for the prediction of residual stresses induced by 15-5PH steel turning, International Journal of Mechanical Sciences 58(1):69-85

Assessment

1 Oral presentation in groups with self-assessment by the classmates

The topic will be related to one of the key aspects from the course and based on a research paper in the literature

ENISE I5GMXXoFADD

Additive Manufacturing

Lecturers: **I. Smurov**

Lectures: 30h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 30h | Lang. :

Objectives

Additive Manufacturing is the most common name given to a host of related technologies which are used to fabricate physical objects layer-by-layer directly from Computer- Aided Design (CAD) data sources. The key to how AM works is that parts are made by adding material in layers; each layer is a thin cross-section of the part derived from the original CAD data. The objective is to explain the scientific and technological background of various AM technologies and the corresponding application fields.

Keywords: additive manufacturing, rapid prototyping, rapid tooling, rapid casting.

Programme

1. Process Categories to be discussed: Vat Photopolymerisation; Material jetting by single and multiple nozzles; Binder jetting; Material extrusion; Powder bed fusion; Sheet lamination; Direct material deposition; Hybrid AM.
2. Scaling-up and scaling-down AM processes.
3. Materials applied in AM, properties of manufactured parts.
4. Basic drives: Design complexity; Personalised products; Supply chain realignment; Parts functionality; Low volume production.
5. Market of AM, growth areas, AM equipment.
6. Integral analysis of Selective laser Melting and Laser Cladding including experimental parametric analysis, optical diagnostics and numerical simulation.
7. Cold Gas dynamic Spraying as AM process.

Learning outcomes

After attending this course, students will:

- Have basic knowledge of AM including corresponding thermo-physical phenomena, different technologies, eventual applications, materials, etc.
- Be able to select an appropriate AM technology, equipment and material to realise chosen industrial objective.

References

I. Gibson, I. D. W. Rosen, I. B. Stucker // Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2014.

G. Gladush, I. Smurov // Laser Processing of Materials: Theory, Experiment Springer, 2011.

Doubenskaia, A. Domashenkov, I. Smurov, P. Petrovskiy // Study of Selective Laser Melting of intermetallic TiAl powder using integral analysis, International Journal of Machine Tools and Manufacture, Vol. 129, 2018, pp. 1-14.

D. V. Bedenko, O.V. Kovalev, I. Smurov, A.V. Zaitsev, Numerical simulation of transport phenomena, formation the bead and thermal behavior in application to industrial DMD technology, International Journal of Heat and Mass Transfer, Vol. 95, 2016, 902-912.

Assessment

2 hours examination without any technical support:

written answers on a few questions based on lectures content. 1 oral presentation in groups from 5-6 students with self-assessment by the classmates. The topic will be related to one of the key aspects of the course and based on the research papers recently published in International journals.

I4GSGSoRSAS

Surface Engineering

Lecturers: **A. Sova**

Lectures: 16h | Tutorials: 0h | Labs: 12h | Project: 0h | Autonomy : 28h | Lang. :

Objectives

In this course the basics of surface physics and surface chemistry are discussed. In particular, the correlation between physical properties of the surface and its sensorial perception behavior is considered. The modern approaches of surface analysis and surface modifications as well as their applications are presented.
In laboratory work students perform several case studies in order to obtain practical experience of work with different type of surface characterization tools and to apply the analytical approach of surface engineer presented in theoretical part of the course.

Keywords: surface engineering, coatings, materials

Programme

1. Description of surfaces: ideal solid surface, real surface, surface stability and evolution
2. Physical, chemical and functional properties of the surface: surface morphology, hardness, wettability, emissivity, surface perception.
3. Surface friction : abrasive wear, fatigue wear, erosive wear
4. Chemical wear: corrosion, photo degradation.
5. Methods of surface analysis : morphology characterization, material structure characterization,
6. Methods of surface modification and surface treatment : texturing, chemical treatments, anodization, thin films, thick coatings, painting
7. Case studies and industrial applications
8. New trends in surface science, smart surface and smart coatings

Learning outcomes

After attending this course, the student will:

- Be able to make a correlation between required surface functional properties and its physical and chemical properties
- Have theoretical and practical knowledge of surface characterization methods
- Have theoretical and practical knowledge of surface treatment methods, their advantages and disadvantages.

References

Introduction to Surface Engineering and Functionally Engineered Materials, Peter M. Martin, WILEY

PAINT AND SURFACE COATINGS Theory and Practice, R. LAMBOURNE and T.A. STRIVENS, Woodhead Publishing Ltd

Physique et Ingénierie des Surfaces, A. Cornet et J.-P. Deville (EDP Sciences)

Assessment

Written exam with theoretical questions and case study

ENISE I5GMXXoTRSU

Surface Texturing

Lecturers: **I. Smurov, F. Salvatore, S. Valette**

Lectures: 28h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 28h | Lang. :

Objectives

This course is dealing with the design and manufacturing of functional surfaces. A first part of lectures on **Surface Texturing** is related to deposition of thick (normally in the range 100 – 300 µm) protective coatings **by Thermal Spraying Technologies (TS),** as for example, High Velocity Oxygen Fuelling, Plasma Spraying, Detonation Spraying, Cold Gas Dynamic Spraying. The objective is to explain the scientific and technological background of various TS technologies, the properties of deposited coatings and the corresponding application fields.
A second part intends to browse the multi-physics and multi-scale aspects of functional surfaces. It will present the parameters that can be used to define the mechanical, topological and chemical properties of a surface, the different evolutions, wear modes as well as several processes that can be applied to tailor it.

Keywords: protective coatings, thermal spraying, optical diagnostic, wear, extreme surface, superfinishing

Programme

1. Deposition Processes to be discussed: High Velocity Oxygen Fuelling (HVOF), Plasma Spraying (PS), Detonation Spraying (DS), Cold Gas Dynamic Spraying (CS), Wire Spraying (WS). Industrial TS equipment.
2. Materials applied in TS, properties of deposited coatings. Market of TS.
3. Nanostructured and nanocomposite coatings.
4. Analysis and optimisation of TS using optical diagnostics and numerical simulation.
5. Deposition of thin solid films by Physical and Chemical Vapour Deposition.
6. Surface and extreme surface (surface integrity and physico-chemical properties)
7. Surface topography characterisation
8. Surface modifications (wear, treatments, superfinishing processes)
9. Lubricated contacts

Learning outcomes

After attending this course, students will:

- Have basic knowledge of HVOF, TS, DS, CS, WS including corresponding thermo-physical phenomena, materials to be used, eventual applications and markets, etc.;
- Be able to select an appropriate TS technology, equipment and material to reach chosen industrial objective.
- Be able to characterise, analyse and tailor a functional surface

References

- Lech Pawlowski, The Science and Engineering of Thermal Spray Coatings, Wiley-Blackwell, 2nd Edition, 2008.
- Armelle Vardelle, Christian Moreau, Jun Akedo, et al, // The 2016 Thermal Spray Roadmap, Journal of Thermal Spray Technology, December 2016.
- A. Sova, D. Pervushin, I. Smurov. Development of multimaterial coatings by cold spray and gas detonation spraying // Surface & Coatings Technology, vol. 205, 2010, pp. 1108–1114.

Assessment

2hours written examination without any technical support + a group project

I5SHXXoCHAI

Supply chain management

Lecturers: **S Bayard**

Lectures: 22h | Tutorials: 0h | Labs: 0h | Project: 6h | Autonomy : 28h | Lang. :

Objectives

The purpose if this course is to allow students to catch up with logistics and supply chain management issues. It is meant to be an overview of the evolving context, SCM can be a competitive weapon if you know how to use it and its impact on business model is still growing.
This course will thus browse:

- Flow management
- Operations' management
- Optimization models for logistics

Keywords: flow management, logistics, production

Programme

1. Introduction to supply chain management
2. Managing the upstream and downstream supply chain : issues and tools
3. Operations management : a clue to efficiency
4. The Fresh connection : a serious game to apply learning outcomes

Learning outcomes

After attending this course, the student will:

- Be able to identify the main issues of Supply Chain management
- Be able to establish a Supply Chain diagnosis, to propose solutions and to deploy them

References

Christopher Martin, « Logistics and supply chain management »; Pearson UK; 2016

Mentzer,et al ; « Handbook of global Supply Chain Management »; Sage Publications;

Sustainable Logistics and Supply Chain Management : Principles and Practices for Sustainable Operations and Management Ed. 2
Mondon Caroline, "The missing link";

Vallin, "la logistique: le pilotage de la supply chain", 5° édition Economica, 2010

Assessment

1 report about a subject chosen by each group of students
The topic will be related to one of the key aspects from the course and will include a practical inquiry.

I5GMXXoOSPR

Production systems optimization

Lecturers: **S Bayard**

Lectures: 4h | Tutorials:24h | Labs: 0h | Project: 8h | Autonomy :28h | Lang. :

Objectives

The purpose if this course is to bring the student to use Discrete Event Simulation software to solve some operation management issues within the shop floor or within a logistics organization. Students are supposed to model the production situation and to propose different solutions they can test through the simulation.

Keywords: discrete event simulation, flow management, production planning, scheduling,

Programme

1. Introduction to Discrete event simulation and queuing theory
2. Basic models simulation with Flexsim software
3. Design and lead an experiment on Flexsim software
4. Use of the optimizer to solve problems

Learning outcomes

After attending this course, the student will be able to:

- Model a production situation on a Discrete Event simulation Software
- Use the simulation to propose alternatives solutions

References

"Discrete-Event System Simulation", Banks et Al , Pearson, 2014
" Simulation with Arena", Kelton et Al, Mac Graw Hill, 2015
“An Introduction to Stochastic Modeling”, Pinsky, Mark A.Karlin, Samuel, 2011
“Operations research methodologies”, Ravi Ravindran, 2009

Assessment

An individual report including the description and analysis of discrete event model of a given situation or a situation the student would like to explore
.

I4GSGSoPROD

Development in Sensory Engineering

Lecturers: **C. Didier**

Lectures: 0h | Tutorials: 0h | Labs: 0h | Project: 30h | Autonomy : 26h | Lang. :

Objectives

The objectives of this course are to make the students aware of the importance of the sensory perception in a new conception and development of a device. This implies notions in conception, modelling, electronics, VR, etc.

This course will thus browse:

- How to take into account, in advance, the sensory perception of a device and apply it to a conception and evaluation
- The characterisation of sensory evaluation in a context

Keywords: sensory perception, prototyping

Programme

1. Introduction to the subject
2. Creation of the specifications (sensory, mechanics, electronics, etc.)
3. Scenario determination
4. Feasibility study
5. Implementation, prototyping, sensory evaluation

Learning outcomes

After attending this course, the student will:

- Be aware of taking into account the sensory perception of a user
- Capable of sensory evaluation

References

Will depend on the topic of the project

Assessment

1 Oral poster presentation in groups with self-assessment by the classmates based

1 paper delivery on the feasibility study of the project

I4GSGSoPTAC

Tactile perceptions

Lecturers: **C. Didier**

Lectures: 14h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 14h | Lang. :

Objectives

The objective of this course is to give generalities on tactile perceptions and their characterization.
This course will thus browse:

- How people are able to feel a sensation via the skin
- The characterisation of the touch

Keywords: tactile perception, skin properties

Programme

1. How to measure a sensation
2. Physiology of touch
3. Sensory properties of touch
4. Gesture of touch
5. The hand

Learning outcomes

After attending this course, the student will:

- Be aware of how the perception of the touch is made possible
- To characterize the touch

References

I. L. CIESIELSKA-WROBEL et L. VAN LANGENHOVE, «The hand of textiles - definitions, achievements, perspectives - a review,» *Textile Research Journal,* vol. 82, pp. 1457-1468, 2012.

M. ALBANNA et J. H. HOLMES IV, Skin Tissue Engineering and Regenerative Medicine, Elsevier Science, 2016.

H. GRAY, «Anatomy of the Human Body,» Bartely.com,

K. JOHNSON, «The roles and functions of cutaneous mechanoreceptors,» *Current Opinion in Neurobiology,* vol. 11, pp. 455-461, 2001.

R. JOHANSSON et A. VALLBO, «Tactile sensibility in the human hand: relative and absolute densities of four types of mechanoreceptive units in glabrous skin,» *The Journal of Physiology,* vol. 286, pp. 283-300, 1979.

Assessment

1 oral presentation per groups, presented during a lecture, evaluated by the classmates
1 multiple choice quizz

I4GSGSoPROD

Practice of Sensory Engineering

Lecturers: **C. Didier**

Lectures: 0h | Tutorials: 0h | Labs: 20h | Project: 0h | Autonomy : 4h | Lang. :

Objectives

The objective of this course is to present some means of objectives sensory evaluation.
This course will thus browse:

- How to measure objectively the perception, depending on the context
- The characterisation of sensory evaluation in a context

Keywords: sensory perception, prototyping

Programme

1. Spatialized sound in Virtual Reality
2. Objective tactile measurements
3. Sound in manufacturing
4. Motion Capture and movement analysis
5. Light measurement

Learning outcomes

After attending this course, the student will:

- Be aware of how to measure objectively a perception

References

Will depend on the topic of the project

Assessment

1 delivery at the end of each session (5 deliveries in total)

I5GMXXoCMEC

Mechatronics and microcontrollers

Lecturers: **J-C. Dumas, I.A. Ivan**

Lectures: 12h | Tutorials: 0h | Labs: 0h | Project: 2h | Autonomy : 14h | Lang. :

Objectives

This course gradually introduces the students into the design of mechatronic systems, rather focusing on the Programming of microcontrollers for applications such as sensor data acquisition and motor control. The application target will be based on the well-known Arduino microcontroller architecture. Hands-on tutorials will allow to practically discover the Arduino Programming, from beginner to experienced, according to the students level.

Keywords: mechatronics, sensors, actuators, microcontrollers, Programming

Programme

1. Introduction to the concept of mechatronics
2. Introduction in the architecture of a mechatronic system, with emphasis on the mechanical, electro-mechanical, electronic and control sub-systems
3. Introduction in the architecture of a microcontrollers and microcontroller targets.
4. Details about the Arduino family of microcontrollers
5. A number of 15 Hand-on lab classes using an Arduino kit, from simple (lighting a LED, debouncing push buttons) to complex (reading sensors, actuating servomotors, connecting an LCD display)
6. Development of a simple project based on the parts of the KIT taught at point 5.

Learning outcomes

After attending this course, the student will:

- Be aware of the steps required in the design of a mechatronic system (mechanics, electro-technics and electronics, Programming and control)
- Be able to select the required microcontroller targets according to the application
- Be capable to identify the required input and output devices (sensors, buttons, potentiometers, LED lamps and displays, motors and servomotors)
- Be able to basically Programme an Arduino microcontroller target for a specific mechatronic application
- Be able to basically Programme an Arduino microcontroller target for a specific data acquisition and processing in a sensory engineering application

References

Musa Jouaneh, Fundamentals of Mechatronics: SI Edition, CENGAGE Learning Custom Publishing, 2012, ISBN 978111156902,

Richard Blum, Arduino Programming in 24 Hours, Sams Teach Yourself 1st Edition ISBN 978-0672337123

Assessment

1 Continuous evaluation during the hands-on classes
2 Small project (design schematic, electric connections and Programming)

I4GSGSoMTEX+I4GSGSSHAR

Augmented Reality

Lecturer: **J. Pascal, G. Debono**

Lectures: 4h | Tutorials: 0h | Labs: 0h | Project: 24h | Autonomy : 28h | Lang. :

Objectives

Augmented reality (AR) for business is no longer a futuristic concept. Many innovative projects have shown to the world that AR has a very good commercial value and future potential. Large-scale businesses are witnessing the growth of augmented reality and they have planned on developing their upcoming projects using AR.
Big brands already reap the benefits of using AR in real estate, design, gaming, education, wellness and many other industries.

Objectives of this course are to make students aware of the potential that Augmented Reality can bring in industry and get a well understanding of the stakes by giving them a better understanding of this technology.

This course will thus browse:

- A state of art about the hardware and software, actual market and future trends.
- A global understanding of how it is working and what this technology can do and bring.
- Learn to drawn up specifications and gameplay (UX), and select relevant 3D contents regarding to the system.
- Develop an AR app with Unity.

Keywords: Augmented Reality, Unity, C#, Vuforia, 3D.

Programme

1. Understanding of Augmented Reality
2. Specifications for development
3. 3D contents optimisation
4. Design an AR application

Learning outcomes

After attending this course, the student will:

- Have a better understanding of AR's stakes.
- Be able to drawn up specification regarding to AR development.
- Be aware of AR's limitations (3D contents, optimisation…)
- Be able to develop a simple and interactive 3D application in Augmented Reality

Assessment

1 Develop an AR application

2 Specifications and Gameplay of the AR experience

3 Oral presentation in groups with self-assessment by the classmates

I5GMGSoBMAT

Bio-materials

Lecturers: **C. Didier**

Lectures: 12h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 16h | Lang. :

Objectives

The objective of this course is to connect the mechanical properties of a material and the requirement of the bio-materials. The overall of the bio-mechanics for the bone and the muscle is presented to understand the biological context of bio-materials. The course will evoke :

- How people are able to feel a sensation via the skin
- The characterisation of the touch

Keywords: Bio-materials, Degradation, Bio-mechanics, Bone, Muscles

Programme

1. Properties of a materials
2. Biomaterials and degradation
3. Bones
4. Muscle

Learning outcomes

After attending this course, the student will:

- Be aware of bio-materials and integration, degradation in the body
- Be aware of bones and muscles characterization, mechanicals properties, anatomy
- Argue for or against a problematic based on scientific facts

References

XXX

Assessment

4 role games

I5GCXXoPARA

Seismic Engineering

Lecturers: **E. Perrin**

Lectures: 16h | Tutorials: 12h | Labs: 0h | Project: 0h | Autonomy : 28h | Lang. :

Objectives

The objectives of this course are to make students understand the way to verify building in seismic conditions and to understand the behaviour of building when submitted to seismic waves. All the constructions have to be calculated in order to withstand mainly gravity loads and also horizontal wind loads. Earthquake induces waves that themselves induce soil deflections and as a consequence strong inertia forces to the building. This course is focused on the way to design construction in seismic conditions and focused on the European Code for seismic design EUROCODE 8. Students would be able to determinate the value of these inertia forces and displacements according to the construction structural configuration. The construction could be building or civil construction like bridges. To access this course, students have to be aware of dynamic calculation, simple mode and also multiple mode of vibration.

Keywords: seismic, waves, dynamic calculation, Eurocode 8, ductility, inelastic behaviour

Programme

1. Construction Elastic behaviour in seismic condition– System with simple vibration motion
2. Construction Elastic behaviour in seismic condition– System with multiples vibration modes
3. Construction Inelastic behaviour in seismic condition – behaviour factor
4. Torsion and seismic design
5. Seismic design according to European seismic code Eurocode 8
6. Buildings after earthquake waves: description and analysis

Learning outcomes

After attending this course, the student will:

- Be aware of the construction behaviour in seismic condition
- Be able to analyse the effects of earthquake on buildings
- Be able to determinate a spectrum acceleration in a construction
- Be able to determinate the inertia forces induced by this acceleration
- Be able to use a professional structural analysis software for seismic design

References

« Séismes et Bâtiments – conception et normes parasismiques – C3291 », André Plumier, Techniques de l'Ingénieur, 2014

« Constructions parasismiques en acier – contexte de l'Eurocode 8 - C2559 », André Plumier, Techniques de l'ingénieur, 2015

« Eurocode 8: Seismic Design of Buildings Worked examples », Bisch and alt, JRC European Symposium, 2011, European Seismic code EN 1998-1 / EN 1998-2

National French annex for European Code: NF EN 1998-1 and NF EN 1998-2

"Génie Parasismique-Etudiants-5GC20182019" document used for the course, Eric Perrin, 2018

Assessment

2hours individual exam at the end of the course

I5GCXXoCNLI

Non-linear mechanics

Lecturers: **M.Y. Ferroukhi, A. Si Larbi**

Lectures: 14h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 14h | Lang. :

Objectives

The objectives of this course is to study the hygrothermal behaviour of the building walls by focussing on the different coupled phenomena of heat and mass transfer in porous media as well as the hygric and thermal exchanges with the external environment.
This course will thus browse:

- The interest of hygrothermal transfers in the assessment of building energy consumption
- Construction materials and porous building media
- Thermophysical and hygric characterization of building materials
- Nonlinear behaviour of coupled heat and moisture transfers in building materials
- Numerical modelling of hygrothermal transfers in building materials

Keywords: Energy consumption, hygrothermal transfer, porous building material

Programme

1. Introduction to the context
2. Porous building materials and its properties
3. Experimental characterization of hygric and thermal behaviour of building material
4. Coupled heat and mass transfer phenomena
5. Input data and methodology for the numerical modelling of hygrothermal transfer in building envelop

Learning outcomes

After attending this course, the student will:

- Be able to describe a porous medium and know its main characteristics
- To know the main experimental devices allowing the hygric and thermophysical characterization of building materials
- Be able to analyse a material and predict its hygrothermal behaviour from its thermal and hydric properties
- Understand hygrothermal transfer phenomena and be able to describe them with a numerical model

References

Balance and Transfers in Porous Media, Part One. Joseph Fourier University, Daïan, J.-F. (2013).

Assessment of the effects of temperature and moisture content on the hygrothermal transport and storage properties of porous building materials, Ferroukhi, M.Y., Belarbi, R., Limam, K., Si Larbi, A., Nouviaire, A., 2018, Heat and Mass Transfer

Hygrothermal behavior modeling of the hygroscopic envelopes of buildings: A dynamic co-simulation approach, Ferroukhi, M.Y., Djedjig, R., Limam, K., Belarbi, R., 2016, Building Simulation, 9(5), pp. 501-512.

Development of an analytical method for simultaneous heat and moisture transfer in building materials utilizing transfer function method, Qin, M., Belarbi, R., 2005, Journal of Materials in Civil Engineering, 17(5), pp. 492-497

Assessment

Project report and MCQ at the end of the course

I5GCXXoGIND

Lean Manufacturing in Civil Engineering

Lecturers: **P. Celle Dahuron**

Lectures: 10h | Tutorials: 4h | Labs: 0h | Project: 0h | Autonomy : 14h | Lang. :

Objectives

The objectives of this course are to make the students aware of the benefits of Lean in construction. It will help students to address competitiveness problems they can face in their future work field and give them keys to take part in the improvement of global performance of a construction project.
This course will thus browse:

- The context in which Lean principles are the key for improvement
- The identification of adding value/non adding value work
- The key Lean Tools
- The experience of a simulation of applying the last Planner System

Keywords: performance, adding value/non adding value, collaboration, planning, organisation, process

Programme

1. Introduction to Lean Construction
2. Adding value/non adding value (wastes) to work
3. Lean Tools: 5S Work place Organisation, Visual Management, Problem Solving, Collaborative Planning and Production Control, Value Stream Mapping, Standardised Working
4. Last planner System simulation

Learning outcomes

After attending this course, the student will:

- Be aware of the benefits of Lean on the construction industry
- Be describe the principles of Lean Construction
- Be able to identify and categorise wastes in a given situation
- Be able to describe key Lean tools and apply them in a simple context of collaborative environment
- Be able to apply the Last Planner system and compare its benefits to the traditional system

References

« LEAN CONSTRUCTION DEFINED » United States Lean Construction Institute
https://planet-lean.com/ - the Lean Global Network Journal
https://www.supplychainschool.co.uk/
« LEAN CONSTRUCTION : Optimiser coûts, qualité,sécurité et délais en mode, collaboratif »-DUNOD - Fabien Font, Hervé Gruat

Assessment

Quizz
1 Oral presentation in groups with self-assessment by the classmates
The topic will be related to one of the Lean tools from the course and based on a research paper in the literature.

I5GCXXoBCNU

Numerical basis for Civil Engineering

Lecturers: **F. Salvatore**

Lectures: 18h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 10h | Lang. :

Objectives

The objective of this course is to provide Civil Engineers a practical application of the finite element theory. It will be based on the finite element code ABAQUS and a case study will be selected by each group of students to detail the modelling process.

Keywords: Numerical modelling, finite element method, surfaces

Programme

1. Resolution of static problems
2. Modelling surfaces and interfaces
3. Modelling external loads and boundary conditions

Learning outcomes

After attending this course, the student will:

- Be aware of the principle behind the finite element theory
- Be able to run a finite element simulation
- Be able to model and simplify a complex problem to solve it
- Be aware of assumptions and limitations of the methodology

References

ABAQUS (2018) `ABAQUS Documentation', Dassault Systèmes, Providence, RI, USA.

Assessment

1 group project

I5GCXXoMCOM

Composite Material and structures

Lecturers: **E. Ferrier, A. Si Larbi**

Lectures: 14h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 14h | Lang. :

Objectives

The objectives of this course are to make the students aware of the use of FRP and cement based composite in structural engineering and the future challenges. In order to be able to understand the mechanical response of composite structures. This implies introducing experimental and modelling of composite structures.
This course will thus browse:

- The context of composite material
- The requirements to calculate a composite structure
- The better understanding of notion of concrete strengthening

Keywords: CFRP, Strengthening RC structures, Composite structures

Programme

1. Introduction to composite material, cement and polymer based
2. Mechanical Behaviour of composites structures
3. Modelling of multi-material structures
4. Case study of RC structures externally strengthened by FRP
5. Case study of RC structures externally strengthened by TRC
6. Case study of Full FRP structures

Learning outcomes

After attending this course, the student will:

- Be aware of experiments and modelling of composite structures
- Be able to calculate a linear mechanical response of composite structures
- Be able to calculate a EB strengthening material for shear and flexural upgrade
- Be able to calculate column and beam made of full FRP or TRC system

References

Hwai-Chung Wu, Christopher D Eamon Strengthening of Concrete Structures Using Fiber Reinforced Polymers (FRP): Design, Construction and Practical Applications, ISBN-13:9780081006368, Publisher:Elsevier Science Publication date: 03/18/2017 Edition description: New Edition, Pages: 340

Design Procedures for the Use of Composites in Strengthening of Reinforced Concrete Structures, State-of-the-Art Report of the RILEM Technical Committee 234-DUC, Editors: Pellegrino, Carlo, Sena-Cruz, José (Eds.)

Composites for Construction: Structural Design with FRP Materials, Lawrence C. Bank ISBN: 978-0-471-68126-7 July 2006 560 Pages

Assessment

1 written exam

The topic will be related to one of the key aspects from the course and based on exercises done during the course

I5GCBAoOTCO

Acoustics in Civil Engineering

Lecturers: **P. Celle Dahuron**

Lectures: 10h | Tutorials:0h | Labs: 0h | Project: 0h | Autonomy : 18h | Lang. :

Objectives

The objectives of this course are to make the students able to take part in building acoustics design. The building construction industry has to face the challenge of the sustainable development issues such as the improvement of people's well-being and health, the high energetic performance and the environment protection. Building acoustics is one of the key field in the design of a construction that will help to meet these goals.

This course will thus browse:

- The basic concepts of physics in acoustics
- The issues of noise control and insulation
- The tools for acoustics design and noise control by legislation

Keywords: insulation, absorption, reverberation, sound pressure level, noise spectrum

Programme

1. Basic concepts of physical acoustics
2. Room acoustics
3. Air born sound insulation
4. Impact sound insulation
5. Equipment sound insulation

Learning outcomes

After attending this course, the student will:

- Be aware of the different fields of building acoustics
- Be able to identify the main acoustics issues of a given and simple building
- Be able to select a material or a technical system depending the acoustic target
- Be able to calculate the main acoustic parameters that will meet the legislation requirement

References

Building Science: Concepts and Application. Jens Pohl. © 2011 John Wiley & Sons, Ltd. Published 2011 by John Wiley & Sons, Ltd.

Assessment

1 case study with a design calculation note

ENISE OYM

Open Your Mind

Lecturers: **Various**

Lectures: 14h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 0h | Lang. :

Objectives

This course intends to give the students an opening on different topics that can be out of their study field. Speakers from the different departments (i.e. Mechanical, Civil or Sensory Engineer departments), from industry or guest professors will be invited to present their research work, recent results, new projects and ideas or a lecture on their field of expertise.

Keywords: -

Programme

1. Lectures given by guest professor during this semester in various topics
2. Seminars given by researchers from the LTDS laboratories
3. Seminars given by invited speakers from academy or industry
4. Company visits

Learning outcomes

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References

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Assessment

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I5SHTCx_FLE/ANGL

Modern Language (French/English)

Lecturers: **Various**

Lectures: 30h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 0h | Lang. :

Objectives

This course aims at making the students able to communicate in French/English in current life, for job interviews and in professional situations (meetings and working reports). As regards to the French course, it intends to support their social, cultural and professional integration by a better knowledge of French culture.

Keywords: Language, professional skills, inter-cultural

Programme

1. French:
   Grammar, vocabulary, conjugation, culture, oral and written expression, oral and written comprehension, French for specific purposes (technical vocabulary), preparation to situations related to the curriculum (note taking, oral presentation, argumentation, CV and cover letter, recruitment interview, etc.)
2. English:
   Course about professional/technical English, knowing how to understand and how to react in a professional English-speaking setting.

Learning outcomes

Improved skills in the selected language

References

French learning methodologies available at the library
Bescherelle

TV5 Monde

Assessment

Assessment will be based on:

- Attendance to the lectures
- Oral participation
- Home assignments
- Oral presentations

I5OPTCx_EPS/PROP

Sport or Student club

Lecturers: **Various**

Lectures: 00h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 0h | Lang. :

Objectives

This course aims at developing the following through sports and personal projects: team spirit, group work, the ability to join a group and to take on responsibilities, to put together an event, organisation and work sharing.

Keywords: -

Programme The student will have to register to a sport activity or one of the student clubs

Learning outcomes -

References -

Assessment Attendance to the sport session and involvement in the student club

I5SHTCoMANA

Strategic Management

Lecturers: **P. Laurent, alii**

Lectures: 14h | Tutorials: 0h | Labs: 0h | Project: 0h | Autonomy : 14h | Lang. :

Objective

The objective of this course is to help students to understand the strategic issues of the company, the methods and tools for shaping a strategy.

Keywords: strategic thinking, human and social sciences, value chain, innovation

Programme

1. Introduction: From military strategy to firms strategy
2. Dimensions for a strategic thinking : technico-economic and socio-political dimensions
3. Industry analysis, competition analysis
4. Strategic segmentation and analysis of a company's activities

Learning outcomes

After attending this course, the student will:

- Be able to understand firm's environments different levels of analysis
- Be able to take an integrative point of view to predict competitive behaviour, to develop and sustain a competitive edge

References

For instance :

Harvard Business Review publications

Association Internationale de Management Stratégique 's publications

Assessment

Each student will have to produce, individually, a text on which he will be assessed.
The produced text will be based on two or three papers issued from peer-reviewed scientific journal, proposed by the lecturer.
The presentation of the main ideas and positions included in the proposed papers is required. Furthermore, students have to develop an argumentation including:

- a problem definition and justifications regarding the chosen problem,
- the definition and justification about the structure of an argumentation,
- the argumentation itself,
- a persuasive conclusion.

Of course, in order to do this, students can use the contents of the strategy course.

I5GCTCoPTECI

Technical Project I

Lecturers: **Various**

Lectures: 0h | Tutorials: 0h | Labs: 0h | Project: 112h | Autonomy : 0h | Lang. :

Objectives

The objective of this course is to learn in practice how to set up an experimental or theoretical methodology in order to solve an engineering problem. The project gives the students the opportunity to apply the theoretical knowledge acquired in different core modules and to develop an operational know-how. They will also learn how to present orally a scientific work.

Keywords: team work, initiation in research, experimental, numerical

Programme

Every project group (2-3 students max) will be assigned a tutor who proposes a subject and who will be in charge of supervising the whole process (approx. **1 day a week**)

Topics will be proposed by experienced teachers/researchers or by industry and may concern various topics related to the selected Department/Major such as Additive Manufacturing, Modelling of machining processes, Tribological investigations, Prediction of distortion and residual stresses in welding, Mechatronics, Bio applications, Virtual reality, Mechanical properties of composite reinforced concrete, BIM, etc…

The project will include different phases:
• short literature review on the topic
• methodology and experimental/numerical procedure
• performing tests/simulations to be carried out and data analysis

Learning outcomes

After attending this module, the student will:

- Be able to follow a project approach with managing objectives, planning, monitoring and deliverables
- Be able to analyse a given problem, constructing and applying a solving approach.
- Develop capabilities of autonomy and initiative.
- Be able to present obtained results as well as to defend choices and assumptions.

References

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Assessment

1 Oral presentation and short report on the conducted work

I5GCTCoPTECII

Technical Project II

Lecturers: **Various**

Lectures: 0h | Tutorials: 0h | Labs: 0h | Project: 210h | Autonomy : 0h | Lang. :

Objectives

The objective of this course is to learn in practice how to set up an experimental or theoretical methodology in order to solve an engineering problem. The project gives the students the opportunity to apply the theoretical knowledge acquired in different core modules and to develop an operational know-how. They will also learn how to present a scientific work both in an oral and written form. This is the **Advanced level of Technical Project I** with more time dedicated to the project.

Keywords: team work, initiation in research, experimental, numerical

Programme

Every project group (2-3 students max) will be assigned a tutor who proposes a subject and who will be in charge of supervising the whole process (approx. **2 days a week**)

Topics will be proposed by experienced teachers/researchers or by industry and may concern various topics related to the selected Department/Major such as Additive Manufacturing, Modelling of machining processes, Tribological investigations, Prediction of distortion and residual stresses in welding, Mechatronics, Bio applications, Virtual reality, Mechanical properties of composite reinforced concrete, BIM, etc…

The project will include different phases:
• short literature review on the topic
• methodology and experimental/numerical procedure
• performing tests/simulations to be carried out and data analysis

Learning outcomes

After attending this module, the student will:

- Be able to follow a project approach with managing objectives, planning, monitoring and deliverables
- Be able to analyse a given problem, constructing and applying a solving approach.
- Develop capabilities of autonomy and initiative.
- Be able to present obtained results as well as to defend choices and assumptions.

References

-

Assessment

1 Oral presentation and **a scientific report** on the conducted work

I5GCGCo_PFE

Laboratory Research Project

Lecturers: **Various**

Lectures: 0h | Tutorials: 0h | Labs: 0h | Project: 420h | Autonomy : 0h | Lang. :

Objectives

This course is defined as a full semester internship conducted in the LTDS laboratory and intends to be an initiation to scientific research. It aims to deepen knowledge and abilities in a research problem and to develop advanced experimental/computational skills leading to a more elaborated contribution.

Keywords: -

Programme

Every student will be part of a research team and work under the close supervision of an experienced researcher. He might be associated to an on-going PhD student to support his research work.

The subject may concern various expertise fields related to the selected Department/Major such as Additive Manufacturing, Modelling of machining processes, Tribological investigations, Prediction of distortion and residual stresses in welding, Mechatronics, Bio applications, Virtual reality, Mechanical properties of composite reinforced concrete, etc…

Learning outcomes

After attending this module, the student will:

- Be able to follow a project approach with managing objectives, planning, monitoring and deliverables
- Be able to analyse a given problem, constructing and applying a solving approach.
- Be able to work independently in a research team
- Be able to present obtained results as well as to defend choices and assumptions.
- Be able to formalize his results in a scientific way and write a journal paper

References

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Assessment

1 Oral presentation and **a scientific article** on the conducted work

Practical information

■ Accommodation

Furnished accommodations are guarantee and pre-booked before arrival for each student registered in these semesters

For more information, please look at the International Students Guide on our website:
https://www.enise.fr/en/International-relations/incoming-mobility.html

■ Intensive French course

Possibility to attend an intensive French course during the last week of August and first week of September.

■ Saint-Etienne in a few words and figures

- **400 000** inhabitants with suburbs
- more than **11 000** companies, 2nd national region for SMEs
- **UNESCO** City of Design since 2010
- **25 000** students, **15%** of foreign students
- **Student integration:** "Sainté Accueille Ses Étudiants" : more than **25** free events during **10 days** with more than **4000** participants

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