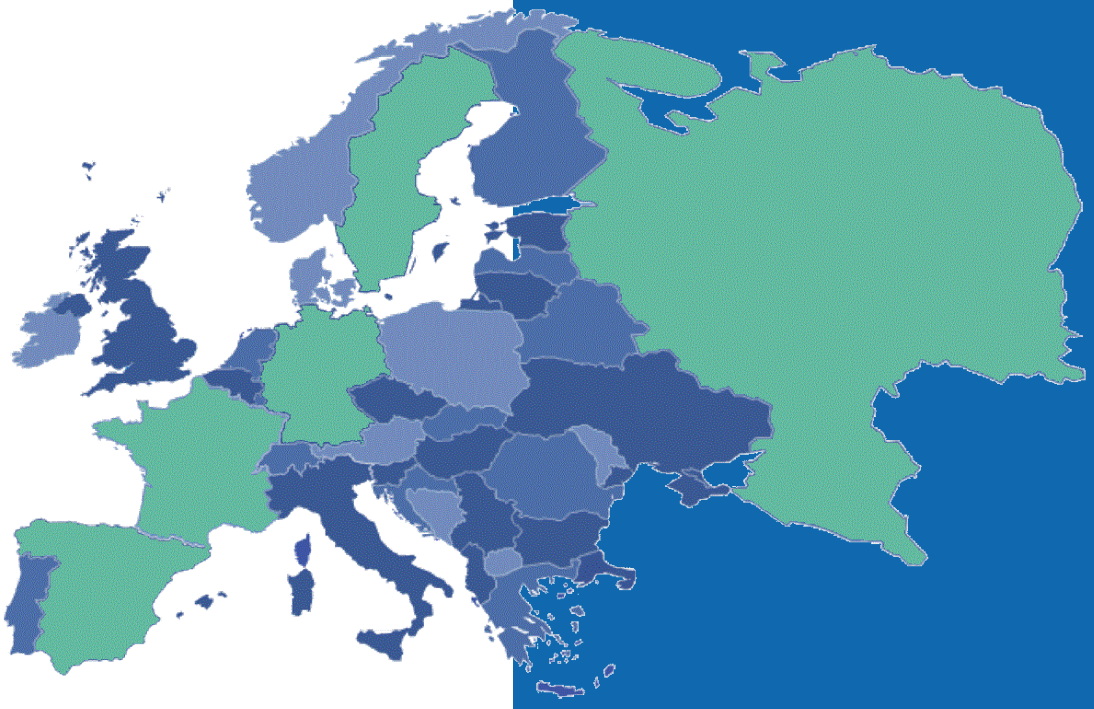
EEIGM ÉCOLE EUROPÉENNE D'INGÉNIEURS EN GÉNIE DES MATÉRIAUX

2024-2025

SYLLABUS – EEIGM



EUROPEAN SCHOOL OF MATERIALS SCIENCE AND ENGINEERING

EEIGM ÉCOLE EUROPÉENNE D'INGÉNIEURS EN GÉNIE DES MATÉRIAUX

	GENERIC SKILLS	Descriptors (examples of skills to identify)	EEIGM code
DEVELOPING KNOWLEGDE	Learning to learn	Collecting and organising knowledge	C1
		Analysing and synthesising knowledge	
		Assimilating new concepts quickly and easily	
		Reasoning and developing critical thinking	
		Developing new knowledge	
SOLVING MULTIDISCIPLINARY PROBLEMS (PROFESSIONAL SKILLS I)	Formulating and analysing complex problems	Thinking of a problem as a whole and acknowledging its multidisciplinary dimensions	C2
		Knowing how to simplify and outline a complex problem	
		Knowing how to proceed by analogy in order to identify a problem	
		Modelling appropriately a problem	
		Identifying the parameters to take into account	
	Adopting an applied scientific approach	Identifying the current state of knowledge in a given problem	C3
		Indicating possible ways of resolution	
		Establishing selection criteria from possible solutions	
		Designing and operating an experimental or simulation device and interpreting the results	
		Assessing and selecting the optimal solution in a global context	
	Innovating	Designing original solutions	C4
		Showing initiative and creativity	
		Thinking the problem beyond its limits	
		Rejecting norms and constraints when appropriate	
	Implementing solutions	Mastering and choosing the most appropriate methodology and technology	
		Mastering mathematical, technological and experimental tools	

		Acting in concrete terms in order to put theory into practice	C5
		Validating or criticising performances in relation to objectives	
MANAGING PROJECTS (PROFESSIONAL SKILLS II)	Planning and completing engineering projects	Defining and decomposing a project	C6
		Determining deadlines and deliverables	
		Evaluating the necessary and available resources	
		Identifying the different participants in a project and coordinating their action	
		Leading a project following strict specifications and constraints	
		Identifying, anticipating and managing risks and uncertainties in order to react and adapt to new situations	
MASTERING COMMUNICATION AND RELATIONSHIPS	Using scientific and technological communication appropriate to the task	Communicating in several languages	C7
		Using clear and rigorous language	
		Preparing high-quality and clear documents, and giving well-produced presentations, adapted to the target audience	
		Organising arguments in a logical and coherent manner	
	Teamwork and leadership in professional projects	Interpersonal communication skills in different contexts – different culture, hierarchy relationships, conflict situations	C8
		Chairing a meeting, leading a group	
		Identifying, assessing and optimizing co-workers' skills	
		Motivating a team	
		Behaving responsibly, being attentive to co-workers	

A competence is a **dynamic combination** of various related skills

- knowledge (declarative knowledge)
- cognitive and metacognitive skills (know-how-to-learn)
- technical and methodological skills (know-how)
- interpersonal and intellectual skills (know-how-to-be)

that enables a person to act effectively in a given professional situation (know-how-to-act)

SPECIFIC SKILLS (CTI 2016)	EEIGM Code
Designing or choosing a material according to a specification based on a systemic analysis of the life cycle and an assessment of costs.	CS1
Mastering the processes of elaboration, transformation, treatment (thermal or surface treatment) and processing of materials (metallic materials, polymers, glasses, ceramics and composites).	CS2
Mastering the techniques of chemical, physical, microstructural and mechanical characterization of materials (laboratory investigation techniques, data acquisition techniques, methods and software tools for analysis and data processing).	CS3
Understanding the chemical, physical and microstructural properties of materials at atomic, nano-, micro-, meso-, and macroscopic scales and being able to link them to their functional properties	CS4
Conducting and managing research and development work on innovative and sustainable alternative materials.	CS5
Managing investigation, product development or industrialization projects in an international context: mastering 4 European languages, teamwork in a multicultural network	CS6

1st year

[SEMESTER 1]

TEACHING UNITS	ECTS	Lectures (hours)	*Lectures (numbers)*	Tutorials (hours)	*Tutorials (numbers)*	Lab work (hours)	*Lab work (numbers)*	Tests	*Tests (numbers)*	In-Person classes	Teachers
EEIGM Department: Engineering sciences	**13,0**	**73,75**		**93,75**		**9,25**		**11,91625**		**188,66625**	
Single variable calculus *	3,5	22,5	*18*	25	*20*	0	*0*	2,5	*2*	50	E. DEGRYSE
Geometry and Vectors for Physics *	3,5	21,25	*17*	26,25	*21*	0	*0*	2,5	*2*	50	S.ANDRE
Complex numbers for Physics *	1	5	*4*	7,5	*6*	0	*0*	1,25	*1*	13,75	Y. GRANJON
Extra tutoring in mathematics *	0	0	*0*	12,5	*10*	0	*0*	0	*0*	12,5	E. DEGRYSE
Study of the physical signals *	2	6,25	5	8,75	7	5,5	2	1,66625	1,333	22,16625	J. MARTIN
Point mass mechanics *	3	16,25	*13*	12,5	*10*	0	*0*	4	*3*	32,75	J.P. TINNES
Tools and guidelines for lab work *	0	2,5	*2*	1,25	*1*	3,75	*3*	0	*0*	7,5	J. MARTIN
EEIGM Department: Structural and functional properties of materials	**4**	**16,25**		**17,5**		**5,5**		**2,91625**		**42,16625**	
Mechanical waves *	1,5	5	*4*	6,25	*5*	5,5	*2,00*	1,66625	*1,333*	18,41625	J. MARTIN
Electrostatics *	2,5	11,25	*9*	11,25	*9*	0	*0*	1,25	*1*	23,75	S. HILPERT
EEIGM Department: Elaboration and processing of materials	**6**	**37,5**		**7,5**		**0**		**3,75**		**48,75**	
Atomic theory	3	16,25	*13*	0	*0*	0	*0*	2,5	*2*	18,75	L. SPEYER
From natural resources to materials	0	6,25	*5*	0	*0*	0	*0*	0	*0*	6,25	J. ZOLLINGER
Chemical families and reactions	3	15	*12*	7,5	*6*	0	*0*	1,25	*1*	23,75	D. RENAUX
EEIGM Department: European languages and cultures, SEHS	**7**	**5**		**83,5**		**24**		**6,8325**		**119,3325**	
English I	2	0	*0*	24,5	*14*	0	*0*	3,5	*2*	28	N. BRIE
Spanish I	1,5	0	*0*	21,25	*17*	0	*0*	1,66625	*1,333*	22,91625	C.SAVARD-CHAMBARD
German I	1,5	0	*0*	21,25	*17*	0	*0*	1,66625	*1,333*	22,91625	P. BEYER
Writing workshops	1	0	*0*	16,5	*6*	0	*0*	0	*0*	16,5	S.ANDRE
Orthodidacte Project QUITUS	0,5	0	*0*	0	*0*	1,25	*1*	0	*0*	1,25	D. RENAUX
Physical activities and sport I *	0,5	0	*0*	0	*0*	22,75	*13*	0	*0*	22,75	A. VAN DRIESSCHE
Industrial conferences and tours	0	5	*4*	0	*0*	0	*0*	0	*0*	5	Z. AYADI
TOTAL semester I	**30,0**	**132,5**		**202,25**		**38,75**		**25,415**		**398,915**	

<table>
<tr><td colspan="2">Teaching Unit:
SINGLE VARIABLE CALCULUS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: E. DEGRYSE</td></tr>
<tr><td colspan="2">EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 50</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>22.5</td><td>25</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 45</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
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Educational objectives of the course:

At the end of the course, the student should be able to use fundamental techniques in single variable calculus (differentiation, integration, limits) in other mathematics courses as well as in other domains (physics, thermodynamics, mechanics...)

Syllabus:

Topics covered in this course are : real-valued functions (continuity, limits), differentiation and integration, transcendental functions (exponentials, logarithms, trigonometric, hyperbolic functions and their inverse)

Pedagogical procedures (organization, assessment, pedagogical resources):

Two mid-terms (I1 and I2) and a final exam (F). The final grade is (5*F+4*I2+3*I1)/12

Student's expected work in autonomy:

Weekly study of the lecture notes and exercises

Bibliographic references:

B. Aebischer, Introduction à l'analyse, Vuibert
J. Stewart, Analyse : concepts et contextes, De Boeck
P. Crocy, E. De Brauwère, Mathématiques PCSI-PTSI, Tech&Doc Lavoisier

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: Introduction to differential equations, Multivariate calculus and vector fields, Study of the physical signals, Mechanic waves, Electromagnetism and optics, Deformable solid mechanics

Teaching Unit: GEOMETRY AND VECTORS FOR PHYSICS	Year/Semester of EEIGM studies: 1A - 1st semester				
	Course manager: **S. ANDRE**				
EEIGM Department: Engineering sciences	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 50				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	21.25	26.25			2.5
	Autonomous work: 28				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☒ **C2** ☐ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to solve a problem of geometric nature both in the plane or in the space using vectorial tools, apply the tools of geometric and complex calculus in the next physics and mathematics courses.

Syllabus:

The program of the cours is divided into 5 themes:
A] Vectors as a pure geometrical object (affine geometry, barycenters) followed by
B] algebric vectors (Indépendancy conditions, concept of a vector basis, of orthonormal basis, of vector components, of polar coordinates and the change of coordinates framework using the matrix object);
C] vector algebra (dot and cross products, scalar triple product and determinants) applied to the calculus of lengths, angles, areas, volumes…)
D] Vectors and their relationship with the description and handling of objects from the plane or the space (lines, circles, planes, spheres);
E] Geometry in the complex plane: similarity transformations as a didactical tool to introduce to the existence of imaginary and complex numbers, and more generally geometric transformations in space (isometry)

Pedagogical procedures (organization, assessment, pedagogical resources):

Courses (Definitions, interesting demonstrations, historical backgrounds)
Exercices in small groups or tutorials (Problem solving by the students under teacher supervision)
Pedagogical ressources on Arche platform with useful links
Workbook incuding a lexicon, a recall of basic results of euclidean geometry (pre-requisites), a list of the subject of exercices for tutorials, individual tutoring and independent work (with partial answers).

Student's expected work in autonomy:

- Reshaping of its own courses notes
- Preparing exercises suggested for independent work
- Starting again the solution of exercises suggested for tutorial with alternative solving strategies
- temporary work : lecture and analysis of solved problems in the suggested mathematical textbooks

Bibliographic references:

Calcul vectoriel, Cours et exercices corrigés, Claire David, Dunod, 2012 (SCD-Cote:515.6 DAV C)
Autoformation aux bases des mathématiques (Bases en Géométrie), C.Rouxel, Ellipses, 2009, (SCD-Cote 516 ROU)
Géométrie, Cours et exercices, Warusfe, Attali, Collet, Gautier Nicols, Vuibert, 2002 (SCD-Cote 516 WAR)

Other EEIGM courses directly linked to this course:

Upstream: Single variable calculus

Downstream: Physics I (Electrostatics, waves), Point mass mechanics, Matrix algebra, Multivariate calculus and vector fields

<table>
<tr><td colspan="2">Teaching Unit:
COMPLEX NUMBERS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: Y. GRANJON</td></tr>
<tr><td colspan="2">EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 15</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>5</td><td>7.5</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 8</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
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Educational objectives of the course:

A the end of the course, the student should be able to master all the tools likely to be applied in sinusoidal and harmonic phenomena studied subsequently in physical sciences in general and in particular in the fields of electricity, mechanical or electromagnetic waves, and mechanics

Syllabus:

Reminder on sets of numbers
Construction of the set of complex numbers
Algebraic form, complex number conjugate
Graphical representation, polar form
Euler formulas
Moivre's formula
Geometric properties
Solving simple equations
Complex roots of the quadratic trinomial
Square roots of a complex number
Nth roots of 1
Applications

Pedagogical procedures (organization, assessment, pedagogical resources):

Four lecture sessions, 6 tutorials and 2 knowledge tests

Student's expected work in autonomy:

Study of the corrected exercises and examples provided in the handout accompanying the course

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: Study of physical signals
Mechanical waves
Electromagnetic waves
Mechanics of the material point

<table>
<tr><td colspan="2">Teaching Unit:
EXTRA TUTORING IN MATHEMATICS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: E. DEGRYSE</td></tr>
<tr><td colspan="2">EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 12.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>12.5</td><td></td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
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Educational objectives of the course:

At the end of the course, the student should be able to overcome some issues in mathematics as well as evaluate the amount of personal homework required to pass mathematics exams.

Syllabus:

Topics covered in this course are first year courses in mathematics

Pedagogical procedures (organization, assessment, pedagogical resources):

The student receives from the lecturer a review of his homework either consisting in personal tutoring on additional exercises or formative assessments (online quizzes & tests). Methological advices are given and the use of mathematical softwares (MATLAB) is promoted.

Student's expected work in autonomy:

Weekly study of the lecture notes and exercices.

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Single variable calculus, Geometry and vectors for physics

Downstream:

Teaching Unit: **STUDY OF THE PHYSICAL SIGNALS**	**Year/Semester of EEIGM studies:** 1A - 1st semester
	Course manager: J. MARTIN
EEIGM Department: Engineering sciences	**Hours/student:**
Teaching method: Academic	**In-person classes:** 22.17

Lecture	Tutorial	Lab work	Project	Test
6.25	8.75	5.5		1.67

Assessment: Classic	**Autonomous work:** 22.33

Generic EEIGM competencies	**Specific EEIGM competencies**
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☒ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**

Educational objectives of the course:

At the end of the course, the student should be able to solve with appropriate mathematical habits the differential equations (1er order) and display graphically their solutions in order to explain the time response of various physical systems taking into account both the initial conditions and the influence of various physical parameters.

Syllabus:

General aspects on electrical circuits - Permanent regime - Sinusoidal regime - Transient regime - Basic concepts of electrical power - Basic concepts of resonance - Modelling of physical systems with time using RLC electrical circuits

Pedagogical procedures (organization, assessment, pedagogical resources):

5 sessions of lecture, 6 sessions of tutorial and 4 sessions of lab work, 1 session of test (in the course of november)
1 manuscript combining the manuscripts of lectures, tutorials and lab works (uploaded on the Arche pedagogical platform)
1 manuscript of the slides displayed during lectures (uploaded on the Arche pedagogical platform)
Test will include 1/3 on the theoretical basic concepts presented during lectures, 1/3 on the application exercises solved during tutorials and 1/3 on the experimental concepts applied during the lab works.

Student's expected work in autonomy:

Read carefully the manuscript before each session of lecture and each session of tutorial.
Prepared carefully the application exercises for the next session of tutorial
Training (individually or in group) to the resolution of exercises on the basis of the proposed exercises through the manuscript and the proposed bibliography.

Bibliographic references:

Y. Granjon, Exercices sur les circuits électriques, Ed. Masson, Collection Enseignement de la Physique, 1997
H. Benson, Physique 3. Ondes Optiques et Physique Moderne, Ed. De Boeck, 2009

Other EEIGM courses directly linked to this course:

Upstream: Tools and guidelines for lab works, Single variable calculus

Downstream: Introduction to differential equations, Point mass mechanics, Electrostatics, Electromagnetism and optics, heat transfers, Physics and mechanics lab works, Atomic diffusion, Intoduction to materials physics, Applications of the physics of materials, Data processing lab works, Flows and transfers, Mechanical behaviour of materials : viscoelasticity, Physical properties of materials, Systems and signals modeling

<table>
<tr><td rowspan="2">Teaching Unit:
POINT MASS MECHANICS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: J.-P. TINNES</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 32.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>16.25</td><td>12.5</td><td></td><td></td><td>4</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
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</table>

Educational objectives of the course:

At the end of the course, the student should be able to:

- Understand and manipulate the basics of the point mass mechanics.
- Understand and manipulate the basics of the rigid body mechanics, by using the rotation of a rigid body around an axis as an example.
- Work with some of the fundamental mathematical tools used in classical mechanics and basic physics (differential equations, cylindrical coordinates, spherical coordinates, multiple integrals…).

Syllabus:

- Introduction to the kinematics of a particle.
- Study of the dynamics of a particle: Newton's laws, motion of a charged particle subjected to an electric field.
- Energetics of a particle: kinetic energy theorem, conservation of mechanical energy
- Introduction to rigid body mechanics: moments of inertia, rotation around an axis

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization:
Lecture: 13 * 1h15 courses. Tutorial classes: 10 * 1h15 sessions.

Pedagogical resources:
Copies of the lectures notes and tutorial class exercises' subjects will be available
The corrected versions of the tutorial class exercises will be available online after the classes.

Assessment:
One mid-term test (duration: 1h20) and one final test (duration: 2h00) at the end of the semester
The unit final grade is calculated by averaging the two evaluations scores, weighted by the tests durations.

Student's expected work in autonomy:

Reading and working on the lectures notes and the exercises completed during the tutorial classes. Redoing these exercises with the help of the corrected versions if needed.

Bibliographic references:

- BOUDET R. et CHAUVIN A., Mécanique, Hermes
- CHEZE C. et LANGE H., Mécanique générale, Ellipses
- PEREZ JP, Mécanique des structures, points matériels, solides, fluides, MASSON

Other EEIGM courses directly linked to this course:

Upstream: Mathematics

Downstream: Strength of Materials

<table>
<tr><td rowspan="2">Teaching Unit:
TOOLS AND GUIDELINES FOR LAB WORKS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: J. MARTIN</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td></td><td colspan="5"></td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 7.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>2.5</td><td>1.25</td><td>3.75</td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work: 8</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to respect the guidelines required during session of lab works such as the respect of security guidelines (chemical, electrical…), the respect of the integrity of the scientific equipments and also the respect of the expected work in each serie of lab work (reports, oral presentation ….). The student must also be able to critizise its experimental results on the basis of the uncertainty claculation methods.

Syllabus:

Presentation of the security guidelines - Presentation of the scientific equipments - Presentation of the expected work in each serie of lab work - Methods for uncertainty calculation (B-type uncertainty)

Pedagogical procedures (organization, assessment, pedagogical resources):

1 session of lecture on the security guidelines, the use of the scientific equipments and the expected work in each serie of lab work (chemistry and physic)
1 session of lecture on the uncertainty calculation methods (B-type uncertainty)
1 session of tutorial on the uncertainty calculation methods (B-type uncertainty) from concrete examples
1 manuscript combining the manuscripts of lectures and tutorials on the uncertainty calculation (uploaded on the Arche pedagogical platform)
1 manuscript of the slides displayed during lectures (uploaded on the Arche pedagogical platform)
No test

Student's expected work in autonomy:

Read carefully the manuscript on the uncertainty calculation before each session of lecture and each session of tutorial.
Prepared carefully the application exercises for the only one session of tutorial dedicated to the uncertainty calculation.
Training (individually or in group) to the resolution of exercices on the basis of the proposed exercises through the manuscript and the proposed bibliography.

Bibliographic references:

A. Charki, D. Louvel, E. Renaot, A. Michel, T. Tiplica, Incertitudes de mesures : Applications concrètes pour les étalonnages, Ed. EDP Science, 2012

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: Single variable calculus, Study of the physical signals, Thermodynamics, Mechanical waves, Introduction to differential equations, Physical chemistry practicals, Caracterization techniques, Electrostatics, Electromagnetism and optics, Physics lab work, Inorganic chemistry practicals, Statistics, Organic chemistry practicals, Data processing lab works, Process Engineering lab works, Elaboration and processing lab works, …

<table>
<tr><td rowspan="2">Teaching Unit:
MECHANICAL WAVES</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: J. MARTIN</td></tr>
<tr><td rowspan="2">EEIGM Department:
Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 18.42</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>5</td><td>6.25</td><td>5.5</td><td></td><td>1.66</td></tr>
<tr><td colspan="5">Autonomous work: 17,33</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to (i) use mathematical models to describe the propagation of a wave in a dense, isotropic and homogeneous medium, (ii) identify the influence of the physical properties of the medium on the wave propagation and (iii) explain the phenomena of reflection and transmission at the boundary of two media.

Syllabus:

Introduction to mechanical waves (examples and definitions) - Mathematical formulation of mechanical waves - Travelling-wave - The principle of superposition and the stationary mechanical waves - Power of mechanical waves - Basic concepts of impedance - Reflexion and transmission - Particular case of the sound waves

Pedagogical procedures (organization, assessment, pedagogical resources):

4 sessions of lecture, 5 sessions of tutorial and 2 sessions of lab work, 1 session of test (in the course of January)
1 manuscript combining the manuscripts of lectures, tutorials and lab works (uploaded on the Arche pedagogical platform)
1 manuscript of the slides displayed during lectures (uploaded on the Arche pedagogical platform)
Test will include 1/3 on the theoretical basic concepts presented during lectures, 1/3 on the application exercises solved during tutorials and 1/3 on the experimental concepts applied during the lab works

Student's expected work in autonomy:

Read carefully the manuscript before each session of lecture and each session of tutorial.
Prepared carefully the application exercises for the next session of tutorial
Training (individually or in group) to the resolution of exercises on the basis of the proposed exercises through the manuscript and the proposed bibliography.

Bibliographic references:

H. Benson, Physique 3. Ondes Optiques et Physique Moderne, Ed. De Boeck, 2009
T. Brunhes, A. Ramspacher, Ondes mécaniques et sonores, Collection Puissance Prépas, Ed. Bréal, 1999

Other EEIGM courses directly linked to this course:

Upstream: Tools and guidelines for lab works, Single variable calculus

Downstream: Introduction to differential equations, Point mass mechanics, Ectromagnetism and optics, Materials resistance, Physics and mechanics lab works, Introduction to materials physics, Applications of the physics of materials, Data processing lab works, Mechanic behaviour of materials : viscoelasticity, Physical properties of materials, Signals and systems modeling

<table>
<tr><td colspan="2">Teaching Unit:
ELECTROSTATICS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: S. HILPERT</td></tr>
<tr><td colspan="2">EEIGM Department:
Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 13.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>11.25</td><td>11.25</td><td></td><td></td><td>1.25</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to compute the electric field created by point or distributed loads (linear, surface or volume distributions) using direct calculation, electric potential or the Gauss theorem and the symmetry properties.

Syllabus:

Coulomb's law, electric field, electric potential, cartesian, cylindrical and spherical coordinate systems, symmetry properties of the electric fiel depending on the symmetry of distributed loads, Gauss theorem

Pedagogical procedures (organization, assessment, pedagogical resources):

9 one hour and fifteen minutes lecture sessions
9 one hour and fifteen minutes tutorial sessions
Assessment :
- one 1h15 test during the exam week in January
- quick test of 15 or 30 minutes
Pedagogical ressources:
- 1 photocopied handout containing lessons and exercises
- the expected learnings are available on the pedagogical platform Arche for all chapters

Student's expected work in autonomy:

Students have to learn the lessons before the tutorial session. They must do the exercices that are requested.

Bibliographic references:

Bertin, Faroux, Renault, Electromagnétisme 1 : Electrostatique des milieux conducteurs,
Pierre Grécias, Jean-Pierre Migeon, Physique Sup MPSI PCSI,
Feynman, Leignton, Sands, Le cours de physique de Feynman Electromagnétisme 1

Other EEIGM courses directly linked to this course:

Upstream: Mechanics : point mass, geometry and vectors for physics

Downstream: Electromagnetism and optics, Application of the physics of materials, physical properties of materials

<table>
<tr><td rowspan="2">Teaching Unit:
ATOMIC THEORY</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: L. SPEYER</td></tr>
<tr><td rowspan="2">EEIGM Department:
Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 18.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>16.25</td><td></td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="5">Autonomous work: 20</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☐ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to:
- Understand the quantum model for atoms
- Understand the periodic table of chemical elements
- Know the main families of chemical elements and their properties
- Know how atoms form bonds and molecules
- Understand the quantum description of simple molecules
- Predict a molecular geometry

Syllabus:

Part A: Structure of atoms. Introduction: notions of atom, element and molecule history, first atomic models. Quantification of the atom energy: quantum numbers, electron configuration. Periodic table of chemical elements. Quantum model of the atom.
Part B: Chemical bonds and structure of molecules. Lewis model of chemical bond. Quantum model of chemical bond for diatomic and polyatomic molecules. Orbital hybridisation. VSEPR model for molecular geometry.

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: lectures
Pedagogical resources: lecture handout available on ARCHE portal
Assessment: Mid- and final test (1h15 each) and one or several short tests during lectures (if progression allows). The final grade is the average of the different assessments, weighted by their duration.

Student's expected work in autonomy:

The lecture has to be regularly reviewed.

Bibliographic references:

Housecroft et Sharp, Chimie inorganique, de Boeck.

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: Reactions and chemical families, Chemistry in solutions, Organic chemistry, Crystalline structures.

<table>
<tr><td colspan="2">Teaching Unit:
FROM NATURAL RESOURCES TO MATERIALS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: J. ZOLLINGER</td></tr>
<tr><td colspan="2">EEIGM Department:
Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 6.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>6.25</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment :</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☒ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to make the link between natural resources and the different classes of materials, passing through the different processing routes. This short module introduces materials science to the students and show them the link between the applications and the scientific courses they will follow during their studies at EEIGM.

Syllabus:

The module consists of a series of lectures. A first lecture makes the general introduction to the place of materials in our society, and presents the different classes of materials. The following courses introduce metallic, ceramic and polymer materials by presenting the various areas ranging from resources to products.

Pedagogical procedures (organization, assessment, pedagogical resources):

5 lectures.

Student's expected work in autonomy:

None.

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: None.

Downstream: All the courses.

Teaching Unit: CHEMICAL FAMILIES AND REACTIONS	Year/Semester of EEIGM studies: 1A - 1st semester				
	Course manager: **D. RENAUX**				
EEIGM Department: **Elaboration and processing of materials**	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 23.75				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	15	7.5			1.25
	Autonomous work: 17				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☐ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to determine the main chemical properties of compounds involved in elaboration and transformation of materials and to calculate the material balances involved in elaboration and transformation processes as well as in analytical characterization methods.

Syllabus:

Chemical families:
Halogen, sulphur, nitrogen based compounds
Common acids
Oxides / Hydroxides
Transition metals

Chemical reactions:
Acido-basicity / redox reactions
Stoichiometry and material balance
Volumetric and spectroscopic titration methods

Pedagogical procedures (organization, assessment, pedagogical resources):

Students make use of a document draft for the course and a document draft specific for exercises.
Short controls (15-20 min) are regularly organised in order to check the aquired knowledge (Quizzbox or on paper) .

Student's expected work in autonomy:

Fundamental knowledge must be learned between two consecutive lectures.
Practical exercises are to prepare before tutorial classes.

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Atomic theory

Downstream: Chemistry in solutions - Kinetics - Chemical thermodynamics - Elaboration of inorganic materials - Experimental works in physical chemistry - Experimental works in inorganic materials- Chemical engineering - Industrial safety - Selection of materials

<table>
<tr><td rowspan="2">Teaching Unit:
ENGLISH 1</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: N. BRIE</td></tr>
<tr><td>EEIGM Department:
European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 28</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>24.5</td><td></td><td></td><td>3,5</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 5</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should have more knowledge concerning the mandatory external Cambridge examinations FCE, CAE or CPE. They should also be able to express themselves in a more appropriate manner and use a good level of language.

Syllabus:

Enrichment of the students' cultural knowledge and linguistic abilities in the four skills: oral and written comprehension, oral and written expression

Pedagogical procedures (organization, assessment, pedagogical resources):

Course book: "Speak Out" (upper-intermediate or advanced)
Exploitation of various resources from Anglo-Saxon media and on-line resources (e.g BBC website)
Continuous assessment (oral and written tests) + a common test for all groups
The students are streamed into groups adapted to their level

Student's expected work in autonomy:

Preparation to oral presentations on Anglo-Saxon culture
Use of resources in the Foreign Language Learning Center

Bibliographic references:

"Speak Out" upper-intermediate or advanced, Pearson
Oxford English grammar course, intermediate or upper-intermediate
Collins Cobuild Dictionary

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: English 2

Teaching Unit: **SPANISH 1 (LV2)**	**Year/Semester of EEIGM studies:** 1A - 1st semester				
	Course manager: **C. SAVARD-CHAMBARD**				
EEIGM Department: **European languages and cultures, SEHS**	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 23				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic		21,25			1,67
	Autonomous work: 2,5 per week				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☒ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to express oneself on social and everyday life topics. Levels to achieve A2 to B2 (self-assessment grid European Framework).

Syllabus:

At the beginning of the course, a level test is organized to create groups of appropriate levels, depending on the knowledge of the students
Training in listening, writing, reading and speaking

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students)
Continuous assessment: evaluation of the 5 language skills
Review of daily and general press and use of texts and audio recordings available on the Cervantes Institute website

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Prepare oral presentations on social and cultural issues
Use of the resources of the library and language lab

Bibliographic references:

Class workbooks: 1/ "Hablando se aprende a hablar", Les Editions de l'Ecole Polytechnique, Paris, 2009; 2/ "Aula Internacional 3: curso de español Nivel B1", Difusión, Madrid, 2013; 3/ and 4/ "Prisma, Nivel Intermedio (B1 + B2), Libro del alumno y Libro de ejercicios", Edinumen, Madrid, 2014
Grammar book: "Universo gramatical para estudiantes franceses", Edinumen, Madrid, 2013
Dictionaries: 1/ Le vocabulaire de l'espagnol, Hachette, Paris, 2010; 2/ "Diccionario de la lengua española", Real Academia Española, Madrid, 2017
Vocabulary book: Maribel Molio, 60 fiches de vocabulaire espagnol, Studyrama, Paris, 2012
Conjugation book: Bescherelle, "El arte de conjugar en español"

Other EEIGM courses directly linked to this course:

Upstream**:**

Downstream**:** Spanish 2, 3 and 4 (LV2)

<table>
<tr><td rowspan="2">Teaching Unit:
SPANISH 1 (BEGINNERS)</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: C. SAVARD-CHAMBARD</td></tr>
<tr><td rowspan="2">EEIGM Department:
European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 23</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td></td><td>21,25</td><td></td><td></td><td>1,67</td></tr>
<tr><td colspan="5">Autonomous work: 2 per week</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should have acquired basic knowledge to understand and be understood in situations of everyday life. Level to achieve A2 (self-assessment grid European Framework)

Syllabus:

Acquisition of basic knowledge and skills necessary to understand and express oneself both orally and writing

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students)
Continuous assessment: evaluation of the 5 language skills
Studies of Spanish press articles and use of textual resources and audio documents available on the Cervantes Institute website

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Prepare oral presentations on everyday life topics
Use of the resources of the library and language lab

Bibliographic references:

Class workbooks: 1/ and 2/ "Prisma, Nivel Inicial (A1 + A2), Libro del alumno y Libro de ejercicios", Edinumen, Madrid, 2014
Grammar book: "Competencia gramatical en uso", Nivel A2, Edelsa, Madrid, 2014
Bilingual dictionary Larousse
Vocabulary book: Maribel Molio, 60 fiches de vocabulaire espagnol, Studyrama, Paris, 2012
Conjugation book: Bescherelle, "El arte de conjugar en español"

Other EEIGM courses directly linked to this course:

Upstream**:**

Downstream**:** Spanish 2, 3 and 4 (LV3)

Teaching Unit: GERMAN 1	Year/Semester of EEIGM studies: 1A - 1st semester
	Course manager: **P. BEYER**
EEIGM Department: European languages and cultures, SEHS	Hours/student:
Teaching method: Academic	In-person classes: 22.9
Assessment: Classic	Lecture: — / Tutorial: 21.25 / Lab work: — / Project: — / Test: 1.67
	Autonomous work: 4

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

At the end of the course, the student should be able to practice German with the objective of reaching the level either A1 (Beginner) or B1 (Intermediate), B2 (Upper Intermediate) or C1 (Advanced) of the Common European Framework of Reference for Languages CEFR.

Syllabus:

Introduction to German or consolidation and enrichment of the language. Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").

Pedagogical procedures (organization, assessment, pedagogical resources):

Working in groups according to the level. Continuous assessment.
Resources are course books (see Bibliographic references), articles and videos from digital and analogic media.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

Level A1: "Menschen", Hueber; "Studio A1", Cornelsen.
Levels B1/B2: "Studio B1", Cornelsen; "Begegnungen B1+" and/or "Erkundungen B2", Schubert; "Ziel B2", Hueber.

Other EEIGM courses directly linked to this course:

Upstream: Downstream: German 2

<table>
<tr><td rowspan="2">Teaching Unit:
WRITING WORKSHOPS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: S. ANDRE</td></tr>
<tr><td>EEIGM Department:
European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Competencies approach</td><td colspan="5">Autonomous work: 6</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☐ C3 ☒ C4 ☐ C5 ☐ C6 ☒ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should adopt a reflexive attitude in front of a cultural object which poses an issue, structure its thought and ideas, identify the structure of a reasoning, all that in order to produce a critical analysis of an artistic work. The student will also be able to transpose a fiction literary or philosophical material in order to comprehend and think the real with a different look.

Syllabus:

- Analytical reading of literary texts or film or dramatic work, production of argument writings, summaries or with an objective of reappropriation,
- oral presentations aiming at preserving a formal structure within improvisation (example of critical roundtables),
- Construction and use of tools to analyse and observe artistic works… (Artworks, Mind map)
- One activity will be based on a cultural outing (Live shows, Cinema, Artistic show, Museum exhibition, literature circle meeting… In 2018, theater show (monolog) "Le père" from J.Gosselin, adapted from novel "L'Homme incertain" S.Chailloux

Pedagogical procedures (organization, assessment, pedagogical resources):

2hours 45 mns of sequences of pedagogigal activities in small groups (<20 students) tutored by a teacher

- Group working occasionnaly (debate sessions)
- Documentary ressources provided by the teacher.
- Two written and two oral productions per student (will be assessed). Oral participation of students is a necessary condition to assessment.

Student's expected work in autonomy:

- Readings
- Written productions and training in oral presentations

Bibliographic references:

Documents provided by the teacher (as an example:)

- Extraits de "Entretien entre d'Alembert et Diderot", Incipit, Denis Diderot, 1769.
- Le défi de la molécule, in Lilith, Primo Lévi, 1968.
- 'Primo Lévi' et les métiers de science, Carte blanche à P.G. de Gennes, Article extrait du web magazine "futura techno", 2002.
- Nostalgie de la lumière, film de Patricio Guzmán, documentaire 2010 (Festival de Cannes, 2010).
- Les sorciers, in Lilith, Primo Lévi, 1968.

Other EEIGM courses directly linked to this course:

Upstream: Groundless

Downstream: Philosophy, Writing of reports or essays

Teaching Unit: **PHYSICAL ACTIVITIES AND SPORTS 1**	**Year/Semester of EEIGM studies:** 1A - 1st semester				
	Course manager: A. VAN DRIESSCHE				
EEIGM Department: **European languages and cultures, SEHS**	**Hours/student:**				
Teaching method: Active Learning	**In-person classes:** 22.75				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Competencies approach			22.75		
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☒ **C1** ☐**C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐**C7** ☒ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**

Educational objectives of the course:

At the end of the course, the student should be able to identify the principles that govern communication and collaboration with others, understand the mechanisms of group dynamics. It is expected that the student could have developed relational and behavioral skills, be aware of issues related to the role of sport in health and well-being for professional development, could have developed individual coping skills and responsibility

Syllabus:

Three cycles of activities composed of 9 or 10 sessions throughout the whole year. The student can choose among different types of activities.

Pedagogical procedures (organization, assessment, pedagogical resources):

1h45 activity sessions in a small group (<20 students) supervised by an APS teacher - Assessment by skills grid.

Student's expected work in autonomy:

Bibliographic references:

TOCQUER Monique. La place des activités physiques et sportives dans la formation des élèves des Grandes Ecoles. Conférence des Grandes Ecoles. Work group A.P.S.1994

Other EEIGM courses directly linked to this course:

Upstream**:**

Downstream**:** Physical and sports activities 2

Teaching Unit: **INDUSTRIAL CONFERENCES AND TOURS**	**Year/Semester of EEIGM studies:** 1A - 1st semester				
	Course manager: Z. AYADI and J. ZOLLINGER				
EEIGM Department: **European languages and cultures, SEHS**	**Hours/student:**				
Teaching method: Active Learning	**In-person classes:** 5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment:	5				
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☒ **C4** ☒ **C5** ☐ **C6** ☐**C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Completing the training and bringing a different lignt by professionals. Narrow contact between students and profesionnals. Participation of the companies and the socio-economic environment in the training.

They also constitute an important opportunity to take advantage of internship or job offers and make the link between the courses at EEIGM and the industrial needs in materials engineering.

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

The conferences are usually scheduled on Wednesdays from 11h15 to 12h30. It is mandatory for the students to attend the conferences by which they are concerned. The tours are scheduled on Thursdays afternoon.

Student's expected work in autonomy:

Bibliographic references:

Arche: Direction of partnerships

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

1st year

[SEMESTER 2]

TEACHING UNITS	ECTS	Lectures (hours)	*Lectures (numbers)*	Tutorials (hours)	*Tutorials (numbers)*	Lab work (hours)	*Lab work (numbers)*	*Tests (numbers)*	*Contrôles (séances)*	In-Person classes	Teachers
EEIGM Department: Engineering sciences	**6**	**42,5**		**42,50**		**0**		**5**		**90**	
Introduction to differential equations *	3	21,25	*17*	21,25	*17*	0	*0*	2,5	*2*	45	H. LACRESSE
Matrix algebra*	3	21,25	*17*	21,25	*17*	0	*0*	2,5	*2*	45	E. DEGRYSE
Extra tutoring in mathematics *	0	0	*0*	10,00	*8*	0	*0*	0	*0*	10	E. DEGRYSE
EEIGM Department: Structural and functional properties of materials	**5**	**31,25**		**31,25**		**8,25**		**5,83325**		**76,58325**	
Strength of Materials *	2,5	15	*12*	13,75	*11*	1,375	*0,5*	2,916625	*2,3333*	33,041625	Z.AYADI
Electromagnetism et Optics *	2,5	16,25	*13*	17,50	*14*	6,875	*2,5*	2,916625	*2,3333*	43,541625	E. ADOUL
EEIGM Department: Elaboration and processing of materials	**12**	**62,5**		**57,5**		**15,555556**		**7,5**		**143,05556**	
Thermodynamics **	3,5	20	*16*	22,5	*18*	0	*0*	2,5	*2*	45	S. HILPERT
Organic chemistry I	3	16,25	*13*	12,50	*10*	0	*0*	2,5	*2*	31,25	J. BODIGUEL
Chemical kinetics	1,5	7,5	*6*	8,75	*7*	0	*0*	1,25	*1*	17,5	V. VITZTHUM
Chemistry in solutions	3	18,75	*15*	13,75	*11*	0	*0*	1,25	*1*	33,75	D. RENAUX
Physical chemistry practicals	1	0	*0*	0	*0*	15,56	*5*	0	*0*	15,555556	C. CARPIER
EEIGM Department: Development and Research	**1**	**5**		**1,25**		**0**		**0**		**6,25**	
Materials project QUITUS	1	5	*4*	1,25	*1*	0	*0*	0	*0*	6,25	S. BRUYERE
EEIGM Department: European languages and cultures, SEHS	**6**	**5**		**68,75**		**22,75**		**1,75**		**98,25**	
English II	2,5	0	*0*	26,25	*15*	0	*0*	1,75	*1*	28	N. BRIE
Spanish II	1,5	0	*0*	21,25	*17*	0	*0*	0	*0*	21,25	C.SAVARD-CHAMBARD
German II	1,5	0	*0*	21,25	*17*	0	*0*	0	*0*	21,25	P. BEYER
Physical activities and sport II *	0,5	0	*0*	0	*0*	22,75	*13*	0	*0*	22,75	A. VAN DRIESSCHE
Industrial conferences and tours	0	5	*4*	0	*0*	0	*0*	0	*0*	5	J. ZOLLINGER
TOTAL semester II	**30,0**	**146,3**		**201,3**		**46,6**		**20,1**		**414,1**	

Teaching Unit: INTRODUCTION TO DIFFERENTIAL EQUATIONS	Year/Semester of EEIGM studies: 1A - 2nd semester				
	Course manager: **H. LACRESSE**				
EEIGM Department: Engineering sciences	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 45				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	21.25	21.25	0	0	2.5
	Autonomous work: 16				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to solve a physical problem modeled by a differential equation and to graphically represent the solution

Syllabus:

Taylor series
Parametric equation
Solving of first- and second-order ordinary differential equation
Introduction to Laplace transform

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: 17 lectures and 17 tutorials
Assessment: 2 tests and several short assessments during the tutorials

Student's expected work in autonomy:

Read the course book before each lecture
Prepare the exercises before each tutorial

Bibliographic references:

Azoulay E., Avignant J., Mathématiques (Tomes 1, 2, 3 et 4), McGraw-Hill Bayen, Analyse Prépa MPSI, Vuibert Supérieur
Cottet-Emard F., De Boeck, Analyse, cours et exercices corrigés Merlin, Methodix algèbre, Ellipses
Monier J.M., Cours de Mathématiques Maths sup - Analyse 1 - Analyse 2, "j'intègre", Dunod
Oudot, Delye, Chevalier, Analyse, H-Prépas, Hachette

Other EEIGM courses directly linked to this course:

Upstream: Single variable calculus, Geometry and Vectors for Physics

Downstream: Point mass mechanics, Physics Practicals

<table>
<tr><td colspan="2">Teaching Unit:
MATRIX ALGEBRA</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: E. DEGRYSE</td></tr>
<tr><td colspan="2">EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 45</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>21.25</td><td>21.25</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 45</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student could be able to solve linear systems, use matrix algebra for problem solving (linear algebra, dynamical systems) as well as in multivariate statistics and scientific computing.

Syllabus:

Topics covered in this course are linear systems and matrix algebra, determinants, vector spaces, linear mappings and Diagonalization.

Pedagogical procedures (organization, assessment, pedagogical resources):

A mid-term (I) and a final exam (F). The final grade is (5*F+4*I)/9

Student's expected work in autonomy:

Weekly study of the lecture notes and exercises

Bibliographic references:

P. Crocy, E. De Brauwère, Mathématiques 1ére année PCSI-PTSI, Tech&Doc Lavoisier
G. Strang, Linear algebra and its applications, Thomson Brooks/Cole
D. Lay, Linear algebra and its applications, Addison-Wesley
H. Anton, C. Rorres, Elementary linear algebra, Wiley

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: Computational mathematics in engineering and science

<table>
<tr><td colspan="2">Teaching Unit:
EXTRA TUTORING IN MATHEMATICS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: E. DEGRYSE</td></tr>
<tr><td colspan="2">EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 10</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>10</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should overcome some issues in mathematics as well as evaluate the amount of personal homework required to pass mathematics exams.

Syllabus:

Topics covered in this course are first year courses in mathematics

Pedagogical procedures (organization, assessment, pedagogical resources):

The student receives from the lecturer a review of his homework either consisting in personal tutoring on additional exercises or formative assessments (online quizzes & tests). Methological advices are given and the use of mathematical softwares (MATLAB) is promoted.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Introduction to Differential Equations, Matrix Algebra

Downstream:

Teaching Unit: STRENGTH OF MATERIALS	Year/Semester of EEIGM studies: 1A - 2nd semester
	Course manager: **Z. AYADI**
EEIGM Department: Structural and functional properties of materials	**Hours/student:**
Teaching method: Academic	**In-person classes:** 33,125
Assessment: Classic	Lecture: 15 / Tutorial: 13.75 / Lab work: 1.375 / Project: / Test: 3
	Autonomous work:
Generic EEIGM competencies	**Specific EEIGM competencies**
☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☒ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able
to design a simple structure in strength of materials. Indeed, he should be capable of defining the loading applied to a structure, of determining the internal forces which result from it, to calculate the geometrical characteristics of beams, to determine the deformation shape, the strain and the stress by taking into account the properties of the material

Syllabus:

Introduction, Notions on torsors, Geometry of beams, Statics of beams (external forces, internal forces, Fundamental Experiments: tensiles tests (elastic behavior of a homogeneous and isotropic material,Young Modulus, Coulomb Modulus, Poisson ratio, Elasticity limit or yield stress),
Summary and hypotheses, Applications in the simple requests:
Tensile-compression, normal effort, normal stress, normal strain, graphic method of Crémona,
bending
Structural design
The module is supported by an industrial conference.

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

The students will be informed of the organization, the running and the evaluation rules in the first lecture.
1 mid-term exam and 1 final exam
During exams, documents, programmable calculators and cell phones are forbidden. The non-compliance of these instructions will be considered as a fraud.
The teachers occurring in TD will rotate in the different groups of exercises as far as their availability allow them.

Educational web-portal ARCHE
The handouts of lessons (with holes) are available on arche in PDF file
The exercises is available (in arche) one week before the session and the solution is available after the exercises session

Bibliographic references:

A list of books available in libraries is offered during the first class. Usefull links on the ARCHE web-portal: RDM forms, others exercises, other lessons, ...

Other EEIGM courses directly linked to this course:

Upstream: MPM

Downstream: DSM, MM1, MM2, MM3

Teaching Unit: ELECTROMAGNETISM AND OPTICS: EO	Year/Semester of EEIGM studies: 1A - 2nd semester				
	Course manager: **E. ADOUL**				
EEIGM Department: Engineering sciences	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 43.625				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	16.25	17.5	6.875		3
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to unify electrostatics and magnetostatics in the theory of electromagnetism (electromagnetic field and interaction with charged particles) and use the applications of the theory (induction, geometrical optic, diffraction) with the mathematic tools at his disposition (vector operator, differential …)

Syllabus:

EO : electromagnetism and optics

*Magnetostatics: (Biot Et Savard, Ampère theorem)
*EO : electrostatics and magnetostatics : local laws.
vector operator (grad, div, rot), theorem of Stokes, Green,notion of flow)
Electromagnetic waves, propagation equation, plan waves.
geometrical optics
Interference. Diffraction.

Pedagogical procedures (organization, assessment, pedagogical resources):

3 sessions of lecture (magnetostatics)
3 sessions of tutorial (magnétostatics)
10 sessions of lecture EO
10 sessions of tutorial EO
1 handout document dedicated to lectures with training exercices (uploaded to the web-based learning platform Arche)
1 handout document dedicated to tutorials (uploaded to the web-based learning platform Arche)
Use of the blackboard for demonstrations and detailed explainations during each lecture and tutorial sessions

Student's expected work in autonomy:

Read the lectures handout document before coming in lectures and tutorials sessions
Prepare tutorials exercices fir the next tutorial session
Try to solve (in group or individually) training exercices based on training exercices of the lecture handout and bibliographic references

Bibliographic references:

Alonso &Finn, physique générale 2, Gié électromagnétisme II, Hecht optique

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: Differential calculations - Mechanics of the material point- Hands-on sessions of physics - Physics of electromagnetic phenomena- Introduction to physics of materials- Electronics and crystallographics properties of materials- Physical properties of materials

<table>
<tr><td colspan="2">Teaching Unit:
THERMODYNAMICS</td><td colspan="5">Year/Semester of EEIGM studies: 1A – 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: S. HILPERT</td></tr>
<tr><td colspan="2">EEIGM Department:
Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 45</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>20</td><td>22.5</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 15</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to define basic knowledge and demonstrate main relationships of thermodynamics, solve problems and analyze phase transformations

Syllabus:

Systems definition. Exchanges of energy: heat and work. 1st principle and internal energy.
2nd principle and entropy. Gibbs energy. Phase transitions and phase diagrams.

Pedagogical procedures (organization, assessment, pedagogical resources):

Lecture notes and taking notes during the course
One mid-term test and a final exam

Student's expected work in autonomy:

Understand lectures and prepare tutorials

Bibliographic references:

Cengel, Boles, Lacroix, Thermodynamique, 2008, De Boeck.
Foussard JN., Julien E., Thermodynamique, 2005, Dunod.
Fer F., Thermodynamique macroscopique, 1970, Gordon & Breach
Lumbroso H., Thermodynamique, 1984, McGraw-Hill
Papon P., Leblond J., Thermodynamique des Etats de la Matière, 1990, Hermann

Other EEIGM courses directly linked to this course:

Upstream: Single variable calculus

Downstream: Chemical thermodynamics, Phase transformations, Polymer physics , Glasses and glass ceramics, Ceramics : elaboration and forming, properties and applications

<table>
<tr><td colspan="2">Teaching Unit:
ORGANIC CHEMISTRY I</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: J. BODIGUEL</td></tr>
<tr><td colspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 31,25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>16,25</td><td>12.5</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 13</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to

1) draw, name and determine the geometry and the electronic structure of organic molecules.
2) use curly arrows to show the movement of electron pairs or single electrons in reaction mechanisms.
2) understand the fundamental reaction mechanisms relevant to organic chemistry, beginning with alkenes
3) predict the result of a reaction applied to any simple term of these series
4) build a simple synthetic pathway allowing the transformation of any function to another one.

Syllabus:

General organic chemistry: Structure & Bonding, The Shape of Molecules, Analysis of Molecular Formulas
Nomenclature: Alkanes, Cycloalkanes, Alkenes & Alkynes, Other Functional Groups
Conformational isomers: Ethane, Butane, Substituted Cyclohexanes
Configurational isomers: Alkene (Z and E) Enantiomery and diastereoisomery, chirality, assymetric carbon,
Electronic effects: inductive effects and resonance
Introduction to the reactivity of functions: Nucleophile and electrophile
Reactivity of main organic functions: Part I: Alkene

Pedagogical procedures (organization, assessment, pedagogical resources):

mid-term exam : 1h15
Final exam : 1h15
The marks can be modulated according to the participation of the students in lecture.

Student's expected work in autonomy:

It is asked the student to attend the course by having seen beforehand the already treated part. The exercises are distributed before the tutorial sessions and must be prepared in advance. During the tutorial sessions, students should be able to solve the exercises and / or explain the difficulties encountered when solving them.

Bibliographic references:

Les cours de Paul Arnaud : Chimie organique. Edition Dunod, 19e edition
de B. Jamart, N. Brosse, J. Bodiguel

Other EEIGM courses directly linked to this course:

Upstream: Atomic theory
Chemical kinetics

Downstream: Organic chemistry II and III, Macromolecular chemistry

<table>
<tr><td colspan="2">Teaching Unit:
CHEMICAL KINETICS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 2nd semester
Course manager: V. VITZTHUM</td></tr>
<tr><td colspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 17,5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>7,5</td><td>8.75</td><td></td><td></td><td>1.25</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 7</td></tr>
<tr><td colspan="3">Generic EEIGM competencies

☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">Specific EEIGM competencies

☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to define the reaction rate, determine the evolution of the concentrations when a rate law with orders can model the reaction rate, verify that the proposed rate law can explain the experimental results, deduce the rate law from the proposed mechanism, define and describe the action of a catalyst.

Syllabus:

The course is divided in four parts: 1) Definitions (kinetics, homogeneous/heterogeneous, different types of reactors, definitions of the rate, experimental measurement of the rate); 2) Rate laws (initial and current, partial and global orders, half-life, Arrhénius' law); 3) Reaction mechanism (elementary process, reaction intermediary, transition state, QSSA, KDS, reactions by steps or in chains); 4) Catalysis (Introduction to homogeneous and heterogeneous catalysis).

Pedagogical procedures (organization, assessment, pedagogical resources):

The lectures are given with slides which are available for students. The slides have to be completed by notes and course demonstrations. The assessment is performed by short tests (MCQ by Quizzbox) and the final test,

Student's expected work in autonomy:

Prepare the exercises before the tutorials and draw the curves of the tutorial for next week.

Bibliographical references:

Cinétique Chimique par Scacchi et al.

Other EEIGM courses directly linked to this course:

Upstream: Chemical Families and Reactions, Introduction to Differential Eqtions

Downstream : Organic Chemistry, Chemical Reaction Engineering, Polymer Chemistry

Teaching Unit: CHEMISTRY IN SOLUTIONS	Year/Semester of EEIGM studies: 1A - 2nd semester				
	Course manager: **D. RENAUX**				
EEIGM Department: Elaboration and processing of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 33.75				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	18.75	13.75			1.25
	Autonomous work: 30				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☐ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to draw the pH-potential diagramm of an element and therfore identify the different chemical forms of this element in solution relative to the chemical conditions. He should also master the working of batteries.

Syllabus:

General points about reactions in aqueous media
Acid-base reactions/pH calculations
Complexation reactions
Precipitation reactions/solubility
Redox reaction
Working of batteries
pH-potential diagramms

Pedagogical procedures (organization, assessment, pedagogical resources):

Students make use of a document draft for the course and a document draft specific for exercices.
Short controls (15-20 min) are regularly organised in order to check the aquired knowledge.

Student's expected work in autonomy:

Practical exercices are to prepare before tutorial classes.

Bibliographic references:

P. Arnaud, Chimie Physique: cours et exercices corrigés, Edition Dunod, Paris (2002).
Pierre Grécias, Chimie 1ère année PCSI, Collection Références Prépas, Edition Tec et Doc, Paris (2009).
Daniel Balou, Eric Fabritius, André Gilles, Toute la Chimie, Edition Ellipses, Paris (2004).

Other EEIGM courses directly linked to this course:

Upstream: Chemical reaction : basics - Normal / transition elements

Downstream: Degradation and protection of metallic materials - Chemical Engineering - Surface treatment - Experimental works in physical chemistry - Experimental works in inorganic chemistry - Waste treatment

<table>
<tr><td colspan="2">Teaching Unit:
PHYSICAL CHEMISTRY PRACTICALS</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: C. CARPIER</td></tr>
<tr><td colspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 15.56</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td>15.56</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: equivalent</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to

- Master the use of laboratory equipment and instruments
- Master and apply security standards
- Use the main physical chemistry techniques of analysis
- Conduct an experimental study of the thermodynamics and kinetics of chemical reactions

Syllabus:

- Calorimetry
- Conductimetry
- Quantitative Analysis
- Kinetics study
- Spectrophotometry
- Potentiometry, Coulometry

Pedagogical procedures (organization, assessment, pedagogical resources):

- Practicals last 3 x 3.5 hours + 2 x 2.5 hours
- Continuous assessment + written reports
- Documentary resources provided by the teaching team and expanded by students' personal research

Student's expected work in autonomy:

- Students usually work in groups of three
- Personal research work is required before and after the practical lesson
- Interactive teaching and technical supervision requires full interactivity
- Results, analysis & conclusions are written up in a report

Bibliographic references:

- Student handout: Travaux Pratiques de Chimie Physique
- Physical Chemistry, Atkins 5th edition Oxford University Press

Other EEIGM courses directly linked to this course:

Upstream:

- Thermodynamics
- Kinetics
- Physics

Downstream:

- Measurement and data interpretation
- Corrosion
- Characterisation

<table>
<tr><td rowspan="2">Teaching Unit:
MATERIALS PROJECT WORK</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 1st and 2nd semesters</td></tr>
<tr><td colspan="5">Course manager: S. BRUYERE</td></tr>
<tr><td>EEIGM Department: Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 6.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>5</td><td></td><td>1.25</td><td></td><td></td></tr>
<tr><td>Assessment: Competencies approach</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☒ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to

- Make a bibliographical research work, •Plan a reflection and organize the information,
- Draft a scientific report respecting the right written scientific expression, • Present orally a synthesis of the bibliographic research

Syllabus:

Presentation of the course and pedagogical objectives (1h): general objectives, calendar deadlines, proposed subjects, the evaluations in competencies approach, the associated formations and the CES Edupack software.
Associated formations: Initiation to the bibliographic research work and plagiarism (1.25h lecture and 1.25h lab work), Introduction to the scientific report writing (1.25h) Introduction to the rules of the scientific oral presentation (1h +1h)

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: • Groups of 2 students (3 maximum) and an EEIGM teacher • The teacher guides the students in the driving of the project. He estimates the work (project and report monitoring) and formulates the requirements of improvement. He gives advices for the preparation of the oral presentation. • Meetings between students and teacher: progress of the project, exchanges of ideas, decision-making • Associated formations synchronized with the calendar deadlines

Assessment by competencies approach: • Three "competencies" assessments formulated from precise criteria, concerning the management of the project, the written report and the oral presentation. Distinction between students from a same team for the management of the project and the oral presentation. • A report written on word processor (maximum 30 pages). • An oral presentation in front of a jury (20 + 10 min. of questions): imperative change of speaker, without any handwritten notes, two stylistic devices (equation, chemical reaction, technical diagram,…) •

Pedagogical ressources: Files on Arche, SCD, CES Edupack software, Nancy-Clic, Web of Science

Student's expected work in autonomy:

Management of time, respect for the calendar deadlines, the definition of tasks and organization of the priorities, the strategy of research and classification of the information, the animation of the group, the diversification of the information supports.

Bibliographic references:

M.M. Such, D. Perol, Initiation à la bibliographie scientifique, Edition PROMODIS, 1987, ISBN 2-903181-59-4
D. Lindsay, P. Poindron, Guide de la rédaction scientifique, Edition QUAE, 2011, ISBN 978-2-7592-1022-0
J-L. Lebrun, Guide pratique de la rédaction scientifique, Edition EDP Sciences, 2007, ISBN-10: 2868839045

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
ENGLISH 2</td><td colspan="5">Year/Semester of EEIGM studies: 1A – 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: N. BRIE</td></tr>
<tr><td colspan="2">EEIGM Department:
European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 28</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>26.25</td><td></td><td></td><td>1.75</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should have more knowledge concerning the mandatory external Cambridge examinations FCE, CAE or CPE. They should also be able to express themselves in a more appropriate manner and use a good level of language.

Syllabus:

Enrichment of the students' cultural knowledge and linguistic abilities in the four skills: oral and written comprehension, oral and written expression

Pedagogical procedures (organization, assessment, pedagogical resources):

Course book: "Speak Out" (upper-intermediate or advanced)
Exploitation of various resources from Anglo-Saxon media and on-line resources (e.g BBC website)
Continuous assessment (oral and written tests) + a common test for all groups
The students are streamed into groups adapted to their level

Student's expected work in autonomy:

Preparation to oral presentations on Anglo-Saxon culture
Use of resources in the Foreign Language Learning Center

Bibliographic references:

"Speak Out" upper-intermediate or advanced, Pearson
Oxford English grammar course, intermediate or upper-intermediate
Collins Cobuild Dictionary

Other EEIGM courses directly linked to this course:

Upstream: English 1 Downstream: English 3

<table>
<tr><td rowspan="2">Teaching Unit:
SPANISH 1 (LV2)</td><td colspan="5">Year/Semester of EEIGM studies: 1A – 2nd semester</td></tr>
<tr><td colspan="5">Course manager: C. SAVARD-CHAMBARD</td></tr>
<tr><td rowspan="3">EEIGM Department:
European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="2">Teaching method: Academic</td><td colspan="5">In-person classes: 21.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>Assessment: Classic</td><td></td><td>21.25</td><td></td><td></td><td></td><td>Autonomous work: 2h30 per week</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to express oneself on social and everyday life topics. Levels to achieve A2 to B2 (self-assessment grid European Framework).

Syllabus:

At the beginning of the course, a level test is organized to create groups of appropriate levels, depending on the knowledge of the students
Training in listening, writing, reading and speaking

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students)
Continuous assessment: evaluation of the 5 language skills
Review of daily and general press and use of texts and audio recordings available on the Cervantes Institute website

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Prepare oral presentations on social and cultural issues
Use of the resources of the library and language lab

Bibliographic references:

Class workbooks: 1/ "Hablando se aprende a hablar", Les Editions de l'Ecole Polytechnique, Paris, 2009; 2/ "Aula Internacional 3: curso de español Nivel B1", Difusión, Madrid, 2013; 3/ and 4/ "Prisma, Nivel Intermedio (B1 + B2), Libro del alumno y Libro de ejercicios", Edinumen, Madrid, 2014
Grammar book: "Universo gramatical para estudiantes franceses", Edinumen, Madrid, 2013
Dictionaries: 1/ Le vocabulaire de l'espagnol, Hachette, Paris, 2010; 2/ "Diccionario de la lengua española", Real Academia Española, Madrid, 2017
Vocabulary book: Maribel Molio, 60 fiches de vocabulaire espagnol, Studyrama, Paris, 2012
Conjugation book: Bescherelle, "El arte de conjugar en español"

Other EEIGM courses directly linked to this course:

Upstream: Spanish 1

Downstream: Spanish 3 and 4 (LV2)

<table>
<tr><td colspan="2">Teaching Unit:
SPANISH 2 (BEGINNERS)</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: C. SAVARD-CHAMBARD</td></tr>
<tr><td colspan="2">EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 21,25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>21,25</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 2h per week</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should have acquired basic knowledge to understand and be understood in situations of everyday life. Level to achieve A2 (self-assessment grid European Framework)

Syllabus:

Acquisition of basic knowledge and skills necesary to understand and express oneself both orally and writing

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students)
Continuous assessment: evaluation of the 5 language skills
Studies of Spanish press articles and use of textual resources and audio documents available on the Cervantes Institute website

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Prepare oral presentations on everyday life topics
Use of the resources of the library and language lab

Bibliographic references:

Class workbooks: 1/ and 2/ "Prisma, Nivel Inicial (A1 + A2), Libro del alumno y Libro de ejercicios", Edinumen, Madrid, 2014
Grammar book: "Competencia gramatical en uso", Nivel A2, Edelsa, Madrid, 2014
Bilingual dictionary Larousse
Vocabulary book: Maribel Molio, 60 fiches de vocabulaire espagnol, Studyrama, Paris, 2012
Conjugation book: Bescherelle, "El arte de conjugar en español"

Other EEIGM courses directly linked to this course:

Upstream: Spanish 1

Downstream: Spanish 3 and 4 (LV3)

<table>
<tr><td rowspan="2">Teaching Unit:
GERMAN II</td><td colspan="5">Year/Semester of EEIGM studies: 1A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: P. BEYER</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 21,25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>21,25</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 4</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to practice German with the objective of reaching the level either A1 (Beginner) or B1 (Intermediate), B2 (Upper Intermediate) or C1 (Advanced) of the Common European Framework of Reference for Languages CEFR.

Syllabus:

Consolidation and enrichment of the language. Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").

Pedagogical procedures (organization, assessment, pedagogical resources):

Working in groups according to the level. Continuous assessment.
Resources are course books (see Bibliographic references), articles and videos from digital and analogic media.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

Level A1: "Menschen", Hueber; "Studio A1", Cornelsen.
Levels B1/B2: "Studio B1", Cornelsen; "Begegnungen B1+" and/or "Erkundungen B2", Schubert; "Ziel B2", Hueber.

Other EEIGM courses directly linked to this course:

Upstream: German I

Downstream: German III

<table>
<tr><td rowspan="2">Teaching Unit:
PHYSICAL ACTIVITIES AND SPORTS 2</td><td colspan="5">Year/Semester of EEIGM studies: 1A – 2nd semester</td></tr>
<tr><td colspan="5">Course manager: A. VAN DRIESSCHE</td></tr>
<tr><td>EEIGM Department:
European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 22.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>22.75</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Competencies approach</td><td colspan="5">Autonomous work:</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☐C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐C7 ☒ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to identify the principles that govern communication and collaboration with others, understand the mechanisms of group dynamics. It is expected that the student could have developed relational and behavioral skills, be aware of issues related to the role of sport in health and well-being for professional development, could have developed individual coping skills and responsibility

Syllabus:

Three cycles of activities composed of 9 or 10 sessions throughout the whole year. The student can choose among different types of activities.

Pedagogical procedures (organization, assessment, pedagogical resources):

1h45 activity sessions in a small group (<20 students) supervised by an APS teacher - Assessment by skills grid.

Student's expected work in autonomy:

Bibliographic references:

TOCQUER Monique. La place des activités physiques et sportives dans la formation des élèves des Grandes Ecoles. Conférence des Grandes Ecoles. Work group A.P.S.1994

Other EEIGM courses directly linked to this course:

Upstream: Physical and sports activities 1

Downstream: Physical and sports activities 3

Teaching Unit: **INDUSTRIAL CONFERENCES AND TOURS**	**Year/Semester of EEIGM studies:** 1A – 2nd semester
	Course manager: Z. AYADI and J. ZOLLINGER
EEIGM Department: **European languages and cultures, SEHS**	**Hours/student:**
Teaching method: Active Learning	**In-person classes:** 5

Lecture	Tutorial	Lab work	Project	Test
5				

Assessment:	**Autonomous work:**

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐C7 ☐ C8	☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Completing the training and bringing a different lignt by professionals. Narrow contact between students and profesionnals. Participation of the companies and the socio-economic environment in the training.
They also constitute an important opportunity to take advantage of internship or job offers and make the link between the courses at EEIGM and the industrial needs in materials engineering.

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

The conferences are usually scheduled on Wednesdays from 11h15 to 12h30. It is mandatory for the students to attend the conferences by which they are concerned. The tours are scheduled on Thursdays afternoon:

– 20 to 30 seats / tour
– Registration on Arche

Before the tour:

• Preparation of tour (informations about the company)
• Setting up thematic groups

After the tour :

• Report

Student's expected work in autonomy:

• Parts of the report
– presentation of the company: products, strategy, technology, etc.
– Work done by the engineers in this company ?
– Health and safety
– Input of EEIGM skills

Bibliographic references:

Arche: Direction of partnerships

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

2ème année

[SEMESTER 3]

TEACHING UNITS	ECTS	Lectures (hours)	*Lectures (numbers)*	Tutorials (hours)	*Tutorials (numbers)*	Lab work (hours)	*Lab work (numbers)*	*Tests (numbers)*	*Contrôles (séances)*	In-Person classes	Teachers
EEIGM Department: Engineering sciences	**10**	**53,75**		**65,42**		**0,00**		**8,75**		**127,92**	
Multivariate calculus and vector fields*	3,5	20,00	*16*	20,00	*16*	0,00	*0*	1,25	*1*	41,25	Y. CHENY
Descriptive and inferential statistics	3,5	20,00	*16*	21,25	*17*	0,00	*0*	2,50	*2*	43,75	S. FERRIGNO
Oral tests in mathematics III *	0	0,00	*0*	0,42	*0,333*	0,00	*0*	0,00	*0*	0,42	Y. CHENY
Computer science I *	3	13,75	*11*	23,75	*19*	0,00	*0*	5,00	*4*	42,50	C. DAUL
EEIGM Department: Structural and functional properties of materials	**7,00**	**46,25**		**46,25**		**7,50**		**6,25**		**106,25**	
Deformable Solid Mechanics*	3	16,25	*13*	15,00	*12*	7,50	*6*	2,50	*2*	41,25	L. TERREI
Crystalline Structures	1,5	10,00	*8*	10,00	*8*	0,00	*0*	1,25	*1*	21,25	L. SPEYER
Introduction to materials physics	2,5	20,00	*16*	21,25	*17*	0,00	*0*	2,50	*2*	43,75	T.CZERWIEC
EEIGM Department: Elaboration and processing of materials	**6,00**	**37,50**		**28,75**		**15,56**		**5,00**		**86,81**	
Thermochemistry	2,5	18,75	*15*	17,50	*14*	0	*0*	1,25	*1*	37,50	R. SOLIMANDO
Organic chemistry II	2	11,25	*9*	11,25	*9*	0,00	*0*	2,50	*2*	25,00	J. BODIGUEL
Characterization techniques	0,5	7,50	*6*	0,00	*0*	0,00	*0*	1,25	*1*	8,75	C. CARPIER
Inorganic chemistry practicals	1	0,00	*0*	0,00	*0*	15,56	*5*	0,00	*0*	15,56	C. CARPIER
EEIGM Department: European languages and cultures, SEHS	**7**	**4,17**		**73,28**		**19,25**		**1,75**		**98,44**	
English III	2,5	0,00	*0*	24,50	*14*	0,00	*0*	1,75	*1*	26,25	N. BRIE
FCE/CAE/CPE: Mock exam	0	0,00	*0*	3,78	*2,833*	0,00	*0*	0,00	*0*	3,78	N. BRIE
Spanish III	2	0,00	*0*	22,50	*18*	0,00	*0*	0,00	*0*	22,50	C.SAVARD-CHAMBARD
German III	2	0,00	*0*	22,50	*18*	0,00	*0*	0,00	*0*	22,50	P. BEYER
Physical activities and sport III *	0,5	0,00	*0*	0,00	*0*	19,25	*11*	0,00	*0*	19,25	A. VAN DRIESSCHE
Industrial conferences and tours	0	4,17	*3,333*	0,00	*0*	0,00	*0*	0,00	*0*	4,17	J. ZOLLINGER

Teaching Unit: MULTIVARIATE CALCULUS AND VECTORS FIELDS	Year/Semester of EEIGM studies: 2A - 1st semester
	Course manager: **Y. CHENY**
EEIGM Department: Engineering sciences	**Hours/student:**
Teaching method: Academic	**In-person classes:** 41.25
Assessment: Classic	Lecture: 20 / Tutorial: 20 / Lab work: / Project: / Test: 1.25
	Autonomous work: 20

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to apply differential/integral operators to scalar/vector fields involved in PDE for engineering.

Syllabus:

Differential calculus of multivariable functions (continuity, partial derivatives, optimization), Multiple Integrals (iterated integrals, change of variables), Vector Fields (fundamental theorem for line integrals, Green's theorem, Stokes' theorem, and the divergence theorem).

Pedagogical procedures (organization, assessment, pedagogical resources):

1 test and 1 oral examination.

Student's expected work in autonomy:

Regular reading of lectures notes.

Bibliographic references:

Maths en Pratique à l'usage des étudiants, François Liret, édition Dunod, 1996 (chapitres 12 et 13).
Analyse. Fonctions de plusieurs variables et géométrie analytique : Cours et exercices corrigés. Licence 2 Mathématiques Bruno Aebischer, Vuibert, 2011.
Analyse concepts et contextes : Volume 2, Fonctions de plusieurs variables, James Stewart, éditions De Boeck, 2011

Other EEIGM courses directly linked to this course:

Upstream: Analysis : Functions of a Single Variable, Differential Calculus.

Downstream: Flows and Transfers, Partial Differential Equations, Heat Transfer.

<table>
<tr><td colspan="2">Teaching Unit:
DESCRIPTIVE AND INFERENTIAL STATISTICS</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: S. FERRIGNO</td></tr>
<tr><td colspan="2">EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 43.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>20</td><td>21.25</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 40</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to analyze data from various sources (which can be related to the course of EEIGM Physics / Signal and TP Physics / Mechanics) and extract the maximum information . It will also have acquired the basics of using the R software in statistics, useful for analyzing this kind of data.

Syllabus:

Vocabulary Introduction to statistics: statistics, statistical characterization of a population, different types of sampling. Descriptive statistics univariate definition of different types of random variables (discrete quantitative, continuous quantitative, qualitative), graphs (bar charts, histograms, pie charts), characterization of laws reference (uniform, exponential, normal, bernoulli, binomial), normal distribution studied in connection with the random walk-diffusive processes in materials science. Examples of practical illustrations of normal distributions (noise "white" a = sensor outputs of a random phenomenon) and Poisson (radiation from a radioactive source for testing materials). Characterization of the indices of central tendency (mean ....) and dispersion (variance ...). Estimation and confidence intervals: mean estimator and the variance of a population, a proportion, unbiased estimate of minimum variance, confidence intervals of the parameters of a normal distribution. This section requires the introduction of new statistical laws such as the Student, the chi2 and Fisher-Snedecor. Theory tests: Application to the analysis of images (grayscale) or treatment of a signal from a sensor. Principle of statistical tests. Risk of first and second species, introduction of pvaleur. Comparison test medium, or proportion of variance. Introduction to bivariate statistics: contingency tables, Chi2 test of independence.

Pedagogical procedures (organization, assessment, pedagogical resources):

An intermediate inspection (1h15) and a final exam (1h15)
Evaluation of TD throughout the semester
Handout courses and TD material (transparent course , statements of TD , data sets) to Arche
R statistical software.

Student's expected work in autonomy:

Weekly tutorials with the software R

Bibliographic references:

Mathématiques pour les sciences de l'ingénieur, Frédéric Bertrand, Myriam Maumy-Bertrand, Sandie Ferrigno et autres, Dunod
Initiation à la Statistique avec R, Frédéric Bertrand, Myriam Maumy-Bertrand, Dunod
Probabilités, analyse des données et statistique, Gilbert Saporta, Technip

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: Statistical modeling, Laboratory work : measurement and data interpretation, Divided Solids

<table>
<tr><td rowspan="2">Teaching Unit:
COMPUTER SCIENCE I</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: C. DAUL</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 42.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>13.75</td><td>23.75</td><td></td><td></td><td>5</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 25</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☐ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to write and implement algorithms using a sequential and objetc based language widespread in industry for solving simple numerical problems in various fields, like mathematics, physics, mechanics, etc.

Syllabus:

The teaching unit consists mainly of three part.

1) An introductive part: general computer architecture, programing languages of different levels, program editing/ compiling/interpreting, data coding, number size and precision.
2) Basics in algorithmics : simple sequential pseudo-codes, conditional structures, loops, all type of simple numerical calculus, (vectorial calculus, numerical integrals, basics in statistics, ect).
3) Programming in JAVA: primitive data types, arrays, sequential language, object oriented language.

Pedagogical procedures (organization, assessment, pedagogical resources):

This teaching corresponds to a classical combination of lectures and tutorials on personnal computers. The concepts presented in lectures are translated into algorithms and implemented in JAVA. Knowledge and know-how acquisition: 1) Constantly revise the lectures 2) Personal work on algorithmics, 3) algorithm correction during practical work sessions and 4) Translation of the algorithms in JAVA language.
Knowledge evaluation: two intermediate examinations (each with a weight of one) and a final examination (with weight 2) dealing mainly on algorithmics and on basics of JAVA programming.
Teaching aid: duplicated lecture note, programming in the Netbeans development environment

Student's expected work in autonomy:

Personnal preparation of algorithms before each practical work session.

Bibliographic references:

The numerous algorithmic and JAVA lectures notes on internet

Other EEIGM courses directly linked to this course:

Upstream**:**

Downstream**:** Computer science II, Computational Mathematics in Engineering & Science

Teaching Unit: DEFORMABLE SOLID MECHANICS	Year/Semester of EEIGM studies: 2A - 1st semester				
	Course manager: **L. TERREI**				
EEIGM Department: Structural and functional properties of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 41.25				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	16.25	15	7.5		2.5
	Autonomous work: 30				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☒ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☒ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to determine analytically and numerically (FlexPDE®) the mechanical state (displacements field, strain and stress) of a solid with a simple geometry (parallelepiped rectangle, cylinder of circular section, sphere) submitted to combined constraints of not uniform triaxiale traction / compression, in pure cutting, in twisting, in uniform temperature with consideration of volume strengths and whose material will be supposed isotropic homogeneous with a linear elastic behavior. The student will also be made aware of experimental techniques allowing the implementation of the previously mentioned stresses as well as existing tools to measure the deformation of a solid such as strain gauges or the contact extensometer.

Syllabus:

Mechanical tests, Displacement, Deformations, Equations of compatibility, Stress, Boundary Conditions, Hooke's Law, Balance equation, St Venant's principle, Curie's principle, Solution kinematically and statically eligible, Regular problem, Mohr's circle, Thermo-elasticity, Hypothesis of planes stresses and strain, Capacities of deformations.

Pedagogical procedures (organization, assessment, pedagogical resources):

The student has a duplicated lecture note said " hole " (documents who resumes all the slides of the lecture but in an incomplete way so that the student remains active by filling and by annotating the latter), of a collection of exercises of TD.
The student is evaluated in a continuous way by 1 or 2 tests from 10 till 90 minutes and by a final control of 2.5 hours. The final mark of the module corresponds to the average balanced (by their duration) by all the tests.

Student's expected work in autonomy:

Every week, the student will have to work again the points of the course which were not assimilated in session, to make the exercises proposed in the end of the previous TD and to prepare the questions of the next TD indicated by the teacher.

Bibliographic references:

Fourar, Chère, Mécanique des Milieux Déformables, Ellipses
Lemaitre, Chaboche, Mechanics of Solids Materials, Cambridge
Grédiac, Hild, Mesures de champs et identification en mécanique des solides, Hermès

Other EEIGM courses directly linked to this course:

Upstream: Strength of Materials, Single variable calculus, Multivariate Calculus and Vectors Fields, Physics Lab work I

Downstream: Physics and mechanics Lab work, Mechanics of Materials I, Structures and defects structures, Flows and Transfer, Mechanics of Materials II, Composite materials : mechanical behavior

Teaching Unit: CRYSTALLINE STRUCTURES	Year/Semester of EEIGM studies: 2A - 1st semester				
	Course manager: **L. SPEYER**				
EEIGM Department: Structural and functional properties of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 21.25				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	10	10			1.25
	Autonomous work: 20				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☐ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to:
- Know the definition of a crystal and the main notions of crystallographic geometry associated with crystal structures
- Know the main crystal types (metallic, ionic, covalent, molecular) and the description of their crystal cell
- Know other materials of interest: carbon materials, silicate materials
- Understand the relationships between the structure of a crystalline material and some of its properties

Syllabus:

Introduction: definition of a crystal, notions of crystallographic geometry (crystal cell, crystal lattice, centering types), notions of real crystal and perfect crystal
Metallic crystals: metallic bond, notions of close-packing, close-packed and pseudo-close-packed metallic structures, substitutional and interstitial alloys, intermetallic compounds
Ionic crystals: ionic bond, main ionic structures
Covalent crystals: examples of graphite and diamond
Molecular crystals: examples of ice and carbon dioxide
Other materials: carbon and silicate materials
Structure/properties relationships: temperatures of phase transitions, mechanical properties, conduction properties

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: lectures + tutorials
Pedagogical resources: lecture and tutorial handouts available on ARCHE portal
Assessment: Final test (1h15) and one or several short tests during lectures (if progression allows). The final grade is the average of the different assessments, weighted by their duration.

Student's expected work in autonomy:

The lecture has to be regularly reviewed. One or several exercises have to be prepared before tutorials.

Bibliographic references:

Housecroft et Sharp, Chimie inorganique, de Boeck.
Durupthy, Chimie 2ème année PC-PC*, Hachette supérieur.

Other EEIGM courses directly linked to this course:

Upstream: Atomic theory, Reactions and chemical families

Downstream: Crystallography, Application of the physical properties of materials, Structures and structure defects

<table>
<tr><td colspan="2">Teaching Unit:
INTRODUCTION TO MATERIALS PHYSICS (IMP)</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: T. CZERWIEC</td></tr>
<tr><td colspan="2">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 43.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>20</td><td>21.25</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 40</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to provide the basic concepts of quantum mechanics, relativity and physical statistics necessary to study the physico-chemical properties of materials

Syllabus:

Introduction to quantum mechanics: physical reminders of particles and waves and introduction to kinetic moments: electrical and magnetic. Elements of relativity. Duality wave-particle-complementarity. Schrödinger equation and stationary solutions: atomic energy levels and energy levels. Origin and production of X-rays
Introduction to Statistical Physics: number of complexion, Boltzmann formula and Maxwell-Boltzmann distribution. Equipartition of energy, specific heats of solids. Notion of phonon distributions, Bose-Einstein and Fermi-Dirac distributions.

Pedagogical procedures (organization, assessment, pedagogical resources):

* Prepared handout transcribing the course in detail, available on ARCHE
* Forward tutorials
* Project in group over the year: LEDs: lighting applications, Metal-oxides field effect transistor: applications in integrated circuits, laser diodes: applications in information technologies, photovoltaic cells: applications in energy, flexible electronics, CCD : Charged-coupled devices applications in digital imaging

Student's expected work in autonomy:

Given the decay of physics education in secondary school, the concepts covered by this module are difficult to assimilate for second year students. The cooperative work in TD must make it possible to reinforce the notions presented in lectures. The project, which takes shape in the second semester, is intended to make students aware of the importance of mastering the difficult concepts to be addressed in this module.

Bibliographic references:

See the many references in the course material

Other EEIGM courses directly linked to this course:

Upstream: Electrostatic, EO, Thermodynamic

Downstream: APM, PPM

<table>
<tr><td colspan="2">Teaching Unit:
ORGANIC CHEMISTRY II</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: J. BODIGUEL</td></tr>
<tr><td colspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>11.25</td><td>11.25</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to describe the main reactions that can occur from alkyl halides, alcohols, amines to link to their structure and to predict the outcome when the application of these reactions to any single term of these series; to explain the particularities of certain functions by connecting them to their mechanism; to design a simple synthesis scheme, from the above functions, to prepare other compounds.

Syllabus:

Reactivity of the main functions in Organic Chemistry : Part II
- Alkyl halides, solvents concepts
- Alcohols
- Amines

Pedagogical procedures (organization, assessment, pedagogical resources):

Students will be evaluated during an intermediate assessment (1:15) and a final check (1:15)
Each of these two notes will be adjusted according to the non-student participation in courses and tutorials.

Student's expected work in autonomy:

It is asked the student to attend the course by having seen beforehand the already treated part. The exercises are distributed before the tutorial sessions and must be prepared in advance. During the tutorial sessions, students should be able to solve the exercises and / or explain the difficulties encountered when solving them.

Bibliographic references:

Les cours de Paul Arnaud : Chimie organique. Edition Dunod, 19e edition
de B. Jamart, N. Brosse, J. Bodiguel

Other EEIGM courses directly linked to this course:

Upstream: Organic chemistry I
Chemical kinetics

Downstream: Organic chemistry III, Macromolecular chemistry

Teaching Unit: CHEMICAL THERMODYNAMICS	Year/Semester of EEIGM studies: 2A – 1st semester				
	Course manager: **R. SOLIMANDO**				
EEIGM Department: Elaboration and processing of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 37.5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	18.75	17.5			1.25
	Autonomous work: 30				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to
- define chemical equilibrium conditions and phase-equilibrium conditions
- calculate standard properties of reaction by using thermochemical tables
- calculate heat quantities involved in reacting systems
- determine a priori whether a reaction occurs at given conditions
- determine the final equilibrium state of a close reacting system
- describe vapour-liquid, liquid-liquid and liquid-solid phase-equilibrium diagrams in binary systems
- calculate vapour-liquid and liquid-solid phase-equilibrium diagrams when the liquid phase is ideal, the vapour phase is a perfect gas and the solid phase is either ideal or is unstable and give birth to two immiscible pure solid phases

Syllabus:

- Chemical potential
- Chemical reaction:
  - definition of the extent of reaction
  - Application of the 1st law of thermodynamics to close reacting systems
  - Application of the 2nd law of thermodynamics to close reacting systems
  - Prediction of equilibrium shifts
- Phase equilibria in binary systems
  - vapour-liquid
  - liquid-liquid
  - solid-liquid

Pedagogical procedures (organization, assessment, pedagogical resources):

Lectures and tutorials
Intermediate tests (<30 min) + a final exam

Student's expected work in autonomy:

Preparation of lectures and tutorials

Bibliographic references:

Lecture notes

Other EEIGM courses directly linked to this course:

Upstream: Physical thermodynamics

Downstream: Solution chemistry, introduction to Materials science and engineering, chemical engineering …

<table>
<tr><td rowspan="2">Teaching Unit:
CHARACTERIZATION TECHNIQUES</td><td colspan="5">Year/Semester of EEIGM studies: 2A – 1st semester</td></tr>
<tr><td colspan="5">Course manager: C. CARPIER</td></tr>
<tr><td rowspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 8.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>7.5</td><td></td><td></td><td></td><td>1.25</td></tr>
<tr><td colspan="5">Autonomous work: 8</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should 1) know the basics of vibrational spectroscopy, i.e. IR and Raman spectroscopy which are two complementary structural characterization techniques of materials
2) characterize an organic molecule of known molecular formula by analyzing its Raman, IR, proton NMR and / or UV spectra.

Syllabus:

A) Principle of RAMAN and Infrared spectroscopy:
I-Introduction to the principles of IR and Raman vibrational spectroscopy
II-Comparison of the Operating Principles of IR and Raman Spectroscopies
III-Example: Interpretation of an IR or Raman spectrum of a polymer
IV-Comparison of IR and Raman spectroscopy techniques
V-Conclusion on vibrational spectroscopy
B) Identification of organic molecules by analyzing spectra
I) Application of infrared for the identification of organic molecules
II) Principle of proton NMR and analysis of spectra
III) Identification of molecules by combined analysis of IR and 1 H NMR spectra
IV) Principle of UV spectroscopy and application to the analysis of organic molecules

Pedagogical procedures (organization, assessment, pedagogical resources):

Final exam

Student's expected work in autonomy:

Read the lecture again, understand it, know how to apply it
Practice analyzing NMR, IR, RAMAN and UV spectra

Bibliographic references:

References given during the lecture and
Organic chemistry: Les Cours de chimie organique de Paul Arnaud by J. Bodiguel, N. Brosse, B. Jamart 18th edition Edition Dunod.

Other EEIGM courses directly linked to this course:

Upstream: Polymer Chemistry, Polymer Physics Downstream: Organic chemistry

Teaching Unit: **INORGANIC CHEMISTRY PRACTICALS**	**Year/Semester of EEIGM studies:** 2A - 1st semester
	Course manager: **C. CARPIER**
EEIGM Department: Elaboration and processing of materials	**Hours/student:**
Teaching method: Active Learning	**In-person classes:** 15.5

Lecture	Tutorial	Lab work	Project	Test
		15.5		

Assessment: Classic	**Autonomous work:** 15.5
Generic EEIGM competencies	**Specific EEIGM competencies**
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☒ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**

Educational objectives of the course:

At the end of the course, the student should be able to

Use the technical skills and security standards required within the laboratory
Analyse and assemble chemical equipment used in the synthesis of mineral products
Synthesise inorganic materials and study their properties
Be aware of problems relating to the toughness of inorganic materials
Relate some notions to industrial chemistry

Syllabus:

Aluminium Anodisation
Corrosion of metals
Inorganic synthesis: FeCl3
Industrial Chemistry: The Solvay Process
Inorganic materials: cristal-type glass, graphite exfoliation, metallurgy of chromium

Pedagogical procedures (organization, assessment, pedagogical resources):

Practical lessons last 2.5 or 3.5 hours
Continuous assessment + written reports + lab papers + poster
Documentary resources provided by the teaching team and expanded by students' personal research

Student's expected work in autonomy:

Students usually work in pairs
Personal research work is required before and after the practicals
Interactive teaching and technical supervision

Bibliographic references:

Student handout
Physical Chemistry, Atkins 5th edition Oxford University Press

Other EEIGM courses directly linked to this course:

Upstream: Atomic theory, Thermodynamics, Chemical kinetics, Solution Chemistry, Mineral Chemistry, Physical chemistry praticals

Downstream: Organic chemistry praticals, Metallurgy, Corrosion, Cristallography, Ceramics

<table>
<tr><td rowspan="2">Teaching Unit:
ENGLISH III</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: N.BRIE</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 30,50</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>24,50</td><td></td><td></td><td>6</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should have more knowledge concerning the mandatory external Cambridge examinations FCE, CAE or CPE. They should also be able to express themselves in a more appropriate manner and use a good level of language. Third step towards these objectives.

Syllabus:

Enrichment of the students' cultural knowledge and linguistic abilities in the four skills: oral and written comprehension, oral and written expression

Pedagogical procedures (organization, assessment, pedagogical resources):

Course book: "Speak Out" (upper-intermediate or advanced)
Exploitation of various resources from Anglo-Saxon media and on-line resources (e.g BBC website)
Continuous assessment (oral and written tests) + a mock FCE, CAE or CPE test
The students are streamed into groups adapted to their level

Student's expected work in autonomy:

Preparation to oral presentations on Anglo-Saxon culture
Use of resources in the Foreign Language Learning Center
FCE, CAE or CPE exercises

Bibliographic references:

FCE, CAE, CPE Practice tests
Grammar for FCE or CAE
Vocabulary for FCE or CAE

Other EEIGM courses directly linked to this course:

Upstream**:**
English II

Downstream**:** English IV

<table>
<tr><td rowspan="2">Teaching Unit:
SPANISH III</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: C. SAVARD-CHAMBARD</td></tr>
<tr><td rowspan="2">EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 22.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td></td><td>22.5</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work: 40</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student (LV2) should be able to reason by oneself and develop critical thinking on familiar or current topics, per-sonal or professional interest. Levels to achieve B1 to C1 (self-assessment grid European Framework).
At the end of the course, the student (beginner in first year) should be able to consolidate and enrich his knowledge in the 5 language skills. Levels to achieve A2 to B1 (self-assessment grid European Framework).

Syllabus:

Training in listening, writing, reading and speaking.
(LV2) Writing CV and cover letters - Use of past DELE examinations - Class workbooks: 1/ "Expertos: curso avanzado de español orientado al mundo del trabajo", Difusión, Madrid, 2010; 2/ "Preparación al Diploma de Espa-ñol Nivel Intermedio B2", Edelsa Editorial, Madrid, 2014.
(Beginner in 1st year) Dialogues on everyday life topics. Studies of Spanish press articles and use of texts and audio recordings available on the Cervantes Institute website.

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students).
Continuous assessment: evaluation of the 5 language skills.
Review of daily and general press and use of texts and audio recordings available on the Cervantes Institute website.

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Prepare oral presentations on social and cultural issues
Prepare lectures on scientific subjects
Use of the resources of the library and language lab

Bibliographic references:

(LV2) Grammar book: "Competencia gramatical en uso, Nivel B2", Edelsa, Madrid, 2011. Dictionary: "Diccionario de la lengua española", Real Academia Española, Madrid, 2018. Vocabulary book: "Ejercicios de Léxico, Nivel Avanzado", Anaya, Madrid, 2008. Conjugation book: Bescherelle, "El arte de conjugar en español"
(Beginner in 1st year) Class workbooks: 1/ "Aula Internacional 3: Curso de español Nivel B1", Difusión, Madrid 2008; 2/ and 3/ "Al dí@: curso intermedio de español para los negocios, Libro del alumno y Cuaderno de ejercicios", SGEL, Madrid, 2010. Grammar books: 1/ "Competencia gramatical en uso", Nivel A2, Edelsa, Madrid, 2008; 2/ "Universo gramatical para estudiantes franceses", Edinumen, Madrid, 2013. Conjugation book: Bescherelle, "El arte de conjugar en español"

Other EEIGM courses directly linked to this course:

Upstream: Spanish II

Downstream: Spanish IV

<table>
<tr><td rowspan="2">Teaching Unit:
GERMAN III</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: P. BEYER</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 22.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td></td><td>22.5</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work: 4</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to practice German eather with the level A1 (Beginner) or the objective of reaching the level B1 (Intermediate), B2 (Upper Intermediate) or C1 (Advanced) of the CEFR.

Syllabus:

Consolidation and enrichment of the language. Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").

Pedagogical procedures (organization, assessment, pedagogical resources):

Working in groups according to the level. Continuous assessment.
Resources are course books (see Bibliographic references), articles and videos from digital and analogic media.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

Level A1: "Studio 21 A1", Cornelsen; "Menschen A1", Hueber.
Level B1: "Studio 21 B1", Cornelsen; "Menschen B1" and/or "Sicher B1+", Hueber; "Begegnungen B1+", Schubert.
Level B2: "Sicher B2", Hueber; "Erkundungen B2", Schubert.

Other EEIGM courses directly linked to this course:

Upstream: German II

Downstream: German IV

<table>
<tr><td colspan="2">Teaching Unit:
PHYSICAL ACTIVITIES AND SPORTS 3</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: A. VAN DRIESSCHE</td></tr>
<tr><td colspan="2">EEIGM Department:
European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 19.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td>19.25</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Competencies approach</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐C7 ☒ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to identify the principles that govern communication and collaboration with others, understand the mechanisms of group dynamics. It is expected that the student could have developed relational and behavioral skills, be aware of issues related to the role of sport in health and well-being for professional development, could have developed individual coping skills and responsibility

Syllabus:

Three cycles of activities composed of 9 or 10 sessions throughout the whole year. The student can choose among different types of activities.

Pedagogical procedures (organization, assessment, pedagogical resources):

1h45 activity sessions in a small group (<20 students) supervised by an APS teacher - Assessment by skills grid.

Student's expected work in autonomy:

Bibliographic references:

TOCQUER Monique. La place des activités physiques et sportives dans la formation des élèves des Grandes Ecoles. Conférence des Grandes Ecoles. Work group A.P.S.1994

Other EEIGM courses directly linked to this course:

Upstream: Physical and sports activities 2

Downstream: Physical and sports activities 4

Teaching Unit: INDUSTRIAL CONFERENCES AND TOURS	Year/Semester of EEIGM studies: 2A – 1st semester				
	Course manager: **Z. AYADI and J. ZOLLINGER**				
EEIGM Department: European languages and cultures, SEHS	**Hours/student:**				
Teaching method: Active Learning	**In-person classes:** 5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment:	5				
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☒ **C4** ☒ **C5** ☐ **C6** ☐**C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Completing the training and bringing a different lignt by professionals. Narrow contact between students and profesionnals. Participation of the companies and the socio-economic environment in the training.
They also constitute an important opportunity to take advantage of internship or job offers and make the link between the courses at EEIGM and the industrial needs in materials engineering.

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

The conferences are usually scheduled on Wednesdays from 11h15 to 12h30. It is mandatory for the students to attend the conferences by which they are concerned. The tours are scheduled on Thursdays afternoon:

– 20 to 30 seats / tour
– Registration on Arche

Before the tour:

• Preparation of tour (informations about the company)
• Setting up thematic groups

After the tour :

• Report

Student's expected work in autonomy:

• Parts of the report
– presentation of the company: products, strategy, technology, etc.
– Work done by the engineers in this company ?
– Health and safety
– Input of EEIGM skills

Bibliographic references:

Arche: Direction of partnerships

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

2ème année

[SEMESTER 4]

TEACHING UNITS	ECTS	Lectures (hours)	*Lectures (numbers)*	Tutorials (hours)	*Tutorials (numbers)*	Lab work (hours)	*Lab work (numbers)*	*Tests (numbers)*	*Contrôles (séances)*	In-Person classes	Teachers
EEIGM Department: Engineering sciences	**7**	**38,667**		**42,667**				**6,5**		**87,75**	
Partial differential equations*	3,5	20	*16*	20	*16*	0	*0*	4	*3*	44	S. RICHARD
Statistical modeling	3,5	20	*16*	21,25	*17*	0	*0*	2,5	*2*	43,75	S. FERRIGNO
Extra tutoring in mathematics *	0	0	*0*	6,25	*5*	0	*0*	0	*0*	6,25	S. RICHARD
EEIGM Department: Structural and functional properties of materials	**10**	**51,25**		**52,5**		**13,75**		**7,9444**		**125,44**	
Atomic diffusion	2,5	13,75	*11*	15	*12*	0	*0*	2,5	*2*	31,25	A. REDJAÏMIA
Heat transfer *	2,5	15	*12*	13,75	*11*	0	*0*	2,5	*2*	31,25	V.VITZTHUM
Physics and mechanics Lab works *	1	0	*0*	0	*0*	13,75	*5*	0,4444	*0,333*	14,194	S, BRUYERE
Cristallography	2	12,5	*10*	12,5	*10*	0	*0*	1,25	*1*	26,25	A. REDJAÏMIA
Applications of the physics of materials	2	10	*8*	11,25	*9*	0	*0*	1,25	*1*	22,5	T. CZERWIEC
EEIGM Department: Development and Research	**2**	**1,25**		**1,25**		**41,25**		**0,00**		**43,75**	
Computer science II *	2	1,25	*1*	1,25	*1*	41,25	*15*	0,00	*0*	43,75	C. DAUL
EEIGM Department: Elaboration and processing of materials	**4**	**18,75**		**15,00**		**21,778**		**3,75**		**59,28**	
Organic chemistry practicals	2	0	*0*	0	*0*	21,778	*7*	0	*0*	21,778	C. CARPIER
Elaboration of inorganic materials	1,5	8,75	*7*	5,00	*4*	0,00	*0*	1,25	*1*	15,00	D.RENAUX
Organic Chemistry III	2	10	*8*	10	*8*	0	*0*	2,5	*2*	22,5	J. BODIGUEL
EEIGM Department: European languages and cultures, SEHS	**7**	**4,1663**		**93,028**		**17,5**		**0**		**114,69**	
Philosophy: ethics, science et society QUITUS	1,5	0	*0*	18	*9 séances de 2h*	0	*0*	0	*0*	18	B. GUILLEMIN/S. NEVEU
Worker internship	0	0	*0*	0	*0*	0	*0*	0	*0*	0	Z. AYADI
English IV	2	0	*0*	26,25	*15*	0	*0*	0	*0*	26,25	N. BRIE
FCE/CAE/CPE: Mock exam	0	0	*0*	3,7778	*2,833*	0	*0*	0	*0*	3,7778	N. BRIE
Spanish IV	1,5	0	*0*	22,5	*18*	0	*0*	0	*0*	22,5	C.SAVARD-CHAMBARD
German IV	1,5	0	*0*	22,5	*18*	0	*0*	0	*0*	22,5	P. BEYER
Physical activities and sport IV *	0,5	0	*0*	0	*0*	17,5	*10*	0	*0*	17,5	A. VAN DRIESSCHE
Industrial conferences and tours	0	4,1663	*3,333*	0	*0*	0	*0*	0	*0*	4,1663	J. ZOLLINGER
TOTAL Semester IV	**30**	**114,08**		**204,44**		**94,28**		**18,194**		**430,92**	

<table>
<tr><td colspan="2">Teaching Unit:
PARTIAL DIFFERENTIAL EQUATIONS</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: S. RICHARD</td></tr>
<tr><td colspan="2">EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 44</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>20</td><td>20</td><td></td><td></td><td>4</td></tr>
<tr><td colspan="5">Autonomous work: from 30 to 40</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

A the end of the course, the student should be able to solve analytically some Partial Differential Equations (PDEs) with boundary conditions, by using Laplace transforms, Fourier transforms and separation of variables, in a few simple cases, with well-posed problems and where convergence of solutions is assumed. The one-dimensional space diffusion equation is the central example.

Syllabus:

- general concepts about PDEs, concept of operator, linearity and superposition principle;
- reducing PDE to EDO, change of variables ;
- Laplace transform (time), Dirac delta function, convolution operation, impulse response ;
- separation of variables (Fourier method), Pre-Hilbert space, Sturm-Liouville system, eigenfunctions expansions ;
- general concepts of numerical series and function series (convergences), Fourier series ;
- Fourier transform (space) ;

Pedagogical procedures (organization, assessment, pedagogical resources):

Lecture sessions (definitions, interesting demonstrations, historical backgrounds,examples, quizz)
Exercises sessions (2 practicals with MATLAB)
2 or 3 tests
Pedagogical ressources on the "Arche" platform with useful links, lecture documents to complete, exercise sheets for tutorials and autonomous work (with partial or complete answers)

Student's expected work in autonomy:

study of the lecture and exercises ; regular preparation of tutorials ; autonomous exercises

Bibliographic references:

Nakhlé H. Asmar, Partial Differential Equations with Fourier Series and Boundary Value Problems, Dover, third edition, 2016.
Alexander Komech, Andrew Komech, Principles of Partial Differential Equations, Springer, 2009.
Riley, Hobson, Essential mathematical methods for the physical sciences, Cambridge University Press, 2011.

Other EEIGM courses directly linked to this course:

Upstream: Multivariate Calculus and Vectors Fields, Introduction to Differential Equations, Atomic Diffusion

Downstream: Computational Mathematics in Engineering and Science (CMES), Flow and Transfer, Laboratory work : measurement and data interpretation, Signal processing I

Teaching Unit: STATISTICAL MODELING	Year/Semester of EEIGM studies: 2A - 2nd semester				
	Course manager: **S. FERRIGNO**				
EEIGM Department: Engineering sciences	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 43.75				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	20	21.25			2.5
	Autonomous work: 40				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to model data from various sources (which can be related to the course of EEIGM Physics / Signal and TP Physics / Mechanics). It will also have acquired many tools of using the R software in statistics, useful for analyzing this kind of data.

Syllabus:

Bivariate descriptive statistics: contingency table, chi2 test of independence, correlations, scatterplots.
Simple linear regression: graphical representation, parameter estimation, testing the joint significance of the model, test the significance of each parameter, quality of the regression, residual analysis.
Multiple linear regression: graphical representations, parameter estimation, testing the joint significance of the model, test the significance of each parameter, quality of the regression, finding "best" models, model selection up, down, not not, residue analysis.
Transformation of variables in linear regression.
Analysis of variance with a factor
Analysis of variance with two or more factors
Multivariate analysis (ACP and AFC).

Pedagogical procedures (organization, assessment, pedagogical resources):

An intermediate inspection (1h15) and a final exam (1h15)
Evaluation of TD throughout the semester
Handout courses and TD material (transparent course, statements of TD, data sets) to Arche
R statistical software.

Student's expected work in autonomy:

Weekly tutorials with the software R

Bibliographic references:

Mathématiques pour les sciences de l'ingénieur, Frédéric Bertrand, Myriam Maumy-Bertrand, Sandie Ferrigno et autres, Dunod
Initiation à la Statistique avec R, Frédéric Bertrand, Myriam Maumy-Bertrand, Dunod
Probabilités, analyse des données et statistique, Gilbert Saporta, Technip

Other EEIGM courses directly linked to this course:

Upstream: Descriptive and inferential statistic

Downstream: Laboratory work : measurement and data interpretation, Divided Solids

<table>
<tr><td rowspan="2">Teaching Unit:
EXTRA TUTORING IN MATHEMATICS IV</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: S. RICHARD</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>6,25</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to overcome some difficulties in mathematics related to the PDE (Partial differential equations) course.

Syllabus:

PDE course syllabus and other related math courses.

Pedagogical procedures (organization, assessment, pedagogical resources):

optional sessions : the students direct their work on their own and submit their own questions ;
course materials : reminders and exercises on ordinary differential equations, reminders and exercises on Laplace transform, autonomous exercises for each chapter of the PDE course.

Student's expected work in autonomy:

study of the PDE lecture notes and exercises

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Partial Differential Equations

Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
ATOMIC DIFFUSION</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: A. REDJAIMIA</td></tr>
<tr><td>EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 31.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>12.5</td><td>15</td><td></td><td></td><td>3.75</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 12.5</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to

Master the Basics of Solid State Diffusion
Solve Fick's equations
Handle the notions of chemical potential
Treat industrial problems: surface treatment: (carburizing, nitriding, etc.)

Syllabus:

Presentation of the teaching unit and teaching objectives
Matter Transfer: Concepts and elementary mechanisms of diffusion (without chemical effect). The phenomenological laws of diffusion (Fick's equations). Microscopic mechanisms. Examples of solutions of Fick's equations. Chemical Diffusion (Kirkendall effect). Other aspects of the diffusion phenomenon. Applications of diffusion in the profession of "Engineers": Surface treatments (cementation, nitriding, ...)

Pedagogical procedures (organization, assessment, pedagogical resources):

Three (3) tests (In English and / or French) with scores of (20 + 30 + 50) / 5 = X / 20.
Continuous evaluation: The test programs are cumulative: each test addresses the program carried out from the start of the module until the date before the test.

Student's expected work in autonomy:

More or less complex notions of diffusion, made very accessible by academic and industrial applications during Tutorials (TDs).

Bibliographic references:

A. Course and tutorial handouts (in English to familiarize with the technical vocabulary of the Diffusion)
B. Works available at the library (SCD) - University of Lorraine:
Techniques de l'Ingénieur,
Adda, Philibert : La diffusion dans les solides,
Bernard J. et al., : Métallurgie Générale,
Philibert J. : Diffusion et transport de matière dans les solides,
Porter D.A., Easterling K.E., Phase transformation in metals and alloys.
C. Websites on the field

Other EEIGM courses directly linked to this course:

Upstream: Heat transfer, Partial Differential Equations Downstream: Heat transfer, Phase transformations, SDS

Teaching Unit: HEAT TRANSFERS	Year/Semester of EEIGM studies: 2A - 2nd semester
	Course manager: **V. VITZTHUM**
EEIGM Department: Structural and functional properties of materials	**Hours/student:**
Teaching method: Academic	**In-person classes:** 31.25
Assessment: Classic	Lecture: 15 / Tutorial: 13.75 / Lab work: / Project: / Test: 2.5
	Autonomous work: 15

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to identify the situations where a heat transfer occurs, to distinguish the main mechanisms and to know the associated laws, to model the situation of transfer, to put into equation and to calculate the evolution of the temperatures in the considered system and / or calculate the heat powers exchanged.

Syllabus:

Course of radiation: laws of emission for a black body (Wien, Planck, Stefan-Boltzmann), fraction of radiation between 2 wavelengths (abacus) - case of gray and non-gray bodies, application to the effect of greenhouse - radiative exchanges in a cavity with black or gray surfaces: definition and calculation of view factors, Cavity Radiative Equilibrium - application to the calculation of heat losses in a furnace

Conduction course: presentation of Fourier's law for conduction and Newton's law for convection - steady state applications in the absence of source and sink: resolution for simple geometries by analogy with the Ohm's law in electricity - applications to the calculation of heat losses in the case of a house or a furnace, in the case of a fin and to the sizing of heat exchangers (DTLM method) - notions of non-steady state: heat equation

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: 6 lectures relating to radiation and 6 to conduction; 6 tutorials of radiation and 5 tutorials of conduction
Assessment: 1 written radiation examination; 1 written conduction exam with the same coefficient
Resources: 2 handouts corresponding to the slides projected in class, available on Arche (NB: these handouts do not correspond to the entire course; it is essential to complete them with notes taken during the lectures, the slides only make sense. with these notes) - 2 handouts of tutorials

Student's expected work in autonomy:

The lessons are to be reread before the next session and the exercises are to be prepared.

Bibliographic references:

Initiation aux transferts thermiques par J.F. Sacadura, Ed. Tec&Doc
Fundamentals of Heat and Mass Transfer par Incropera, DeWitt, Bergman and Lavine, Ed. Wiley

Other EEIGM courses directly linked to this course:

Upstream: Introduction to differential equations, Multivariate calculus and vector fields, Partial Differential Equations

Downstream: Atomic diffusion, Reaction Chemical Engineering, Flows and Transfers, Process Engineering lab works

<table>
<tr><td colspan="3">Teaching Unit:
PHYSICS AND MECHANICS LAB WORKS</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="3"></td><td colspan="5">Course manager: S. BRUYERE</td></tr>
<tr><td colspan="3">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="3" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 14.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td>13.75</td><td></td><td>0.5</td></tr>
<tr><td colspan="3">Assessment: Classic</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☒ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to

- Conduct and analyse traction tests
- Understand heat transfer mechanisms
- Use strain gauge
- Understand diffraction phenomenun at different scales (micrometer and angström)
- Understand absorption phenomenun
- Understand semi-conductors features

Syllabus:

3 topics in mechanics: traction tests, study of heat transfer mechanisms, study of strain gauge
3 topics in physics: diffraction by a periodic structure, X-rays absorption by a solid, study of semi-conductor

Pedagogical procedures (organization, assessment, pedagogical resources):

Every student is going to realize 5 practical classes among 6 (in a group of 2 or 3 students). Each lab work lasts 2,45h hours
Assessment :
assesment of theoretical questions at the beginning of session as well as of the work realized in session.
A final assessment which is an individual experimental test drawn the day of the test
Pedagogical resources: Handout

Student's expected work in autonomy:

Before each laboratory work session, working groups solve all theoretical questions.
During the sessions, the students have to take notes on protocols, results and their analysis and interpretation to have written trace in order to revise for the experimental final test.

Bibliographic references:

See the many references in each coupled course

Other EEIGM courses directly linked to this course:

Upstream: Physics of steady state, wave-like and transient regimes, Electromagnetism and Optics, Materials electronic properties and ratio crystallography (part 1), Heat Transfer, Deformable solid mechanics,

Downstream: Materials electronic properties and ratio crystallography (part 2)

<table>
<tr><td rowspan="2">Teaching Unit:
CRYSTALLOGRAPHY</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: A. REDJAÏMIA</td></tr>
<tr><td rowspan="3">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 26.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>12.5</td><td>12.5</td><td></td><td></td><td>1.25</td></tr>
<tr><td colspan="5">Autonomous work: 12,5</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☒ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, based on X-ray diffraction diagrams, the students should be able to identify the crystal structure of mono or polycrystal and determine, among others, the grain size of the polycrystal.

Syllabus:

Basics of crystal lattices, symmetry and periodicity - Crystal systems and Bravais lattice (Direct and inverse rotation axes, translation mirrors, helicoidal axes) - Stereographic projection - Geneis of Point and Space groups of symmetry (Direct and rceprocal spaces) - International Tables of Crystallography - X-ray (and electron) diffraction by crystal structures - Atomic Diffusion and Structure Factors - Bragg's law. Application: Based on experimental diffrcation diagrams, identification of crystal structure - Basic elements of transmission electron diffraction.

Pedagogical procedures (organization, assessment, pedagogical resources):

"Step by step" lecture on computer support (.ppt) illustrating the concepts developed and discussed in this basic course for crystalline materials. Book of "step by step" worked exercises.

Student's expected work in autonomy:

Working in groups : Diffractograms (XRD) of real structures are made available to the students, organised in groups, for analysis allowing acces to the crystallographic structure (Crystal system, Bravais lattice and lattice parameters)

Bibliographic references:

Power point of "step by step" lectures of crystallography - Worked exercices Book - Listing of crystallography books available at the library of the Université de Lorraine (eeigm)

Other EEIGM courses directly linked to this course:

Upstream**:**

Downstream**:** Defect Structure (SDS) - Phase transformation - Physical Properties of Materials (PPM) - Material Characterisation of materials (Practical work)

<table>
<tr><td colspan="2">Teaching Unit:
APPLICATIONS OF THE PHYSICS OF MATERIALS</td><td colspan="5">Year/Semester of EEIGM studies: 2A – 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: T. CZERWIEC</td></tr>
<tr><td colspan="2">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 23.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>10</td><td>11.25</td><td></td><td>1.25</td><td>1.25</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 20</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to understand the applications of materials physics in the fields of lasers, electrical conductivity of metals and semiconductors

Syllabus:

Introduction to the physics of lasers, applications of lasers. Electronic properties of conductive and semiconductor materials: electrical conductivity of nonalloyed metals (Drude-Sommerfeld model), Hall effect. Electrical conductivity of semiconductors (model of energy bands). Examples of semiconductor devices: p-n junction, unipolar and bipolar transistors. Introduction to microelectronics technologies.

Pedagogical procedures (organization, assessment, pedagogical resources):

* Prepared handout transcribing the course in detail, available on ARCHE
* Forward tutorials
* Project in group over the year: LEDs: lighting applications, Metal-oxides field effect transistor: applications in integrated circuits, laser diodes: applications in information technologies, photovoltaic cells: applications in energy, flexible electronics, CCD : Charged-coupled devices applications in digital imaging

Student's expected work in autonomy:

The concepts discussed in this module are difficult to assimilate for second year students. The work in TD, which is more cooperative, reinforces the notions presented in lectures. The project, which materializes during this semester, is intended to make students aware of the importance of mastering the concepts of physics.

Bibliographic references:

See the many references in the course material

Other EEIGM courses directly linked to this course:

Upstream: Electrostatic, EO, Thermodynamic, IPM Downstream: PPM

<table>
<tr><td rowspan="2">Teaching Unit:
COMPUTER SCIENCE II (PROJECT)</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: C. DAUL</td></tr>
<tr><td>EEIGM Department: Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 43.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>1.25</td><td>1.25</td><td></td><td>41.25</td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☐ C3 ☐ C4 ☒ C5 ☒ C6 ☐ C7 ☒ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to carry out an individual ans personnal work while contributing to a group project which aims at solving a multidisciplanary problem using informatics

Syllabus:

Project done in group, classically in trinomial.

- It aims at writing a software solving a multidisciplinary problem combining knowledge in informatics (algorithmics, numerical calculus, and JAVA langage), specific scientific knowledge (e.g. in physics, mecanics, chemistery, etc.) and a know-how in terms of work in group.
- Work in group/project management: group analysis/formalisation of a problem, task listing, allocating of roles and responsibilities, data and information flow defining, gathering of different software part.
- Concerning the individual work (non redondant inside a groupe) informatic knowledge has to be used for solving numerical problems and/or to contribute to a specific software part while observing both the specifications and the deadlines decided by the group.

Pedagogical procedures (organization, assessment, pedagogical resources):

Project organization

- A scientific tutor has a twofold role: one the hand he plays the rule of a customer giving the specifications of a software which aims at solving a particular problem, and, on the other hand, he provides the students with the required scientific knowledge for solving the problem.
- A informatic tutor advises the group for common work (task listing, work programme …) and assists students for their individual work (technical aid, algorithmics …).
- Evaluation: grades are given based on a demonstration and a presentation: 1) The demonstration of the software is carried out by the group for the client (scientific tutor). This demonstration leads to a group score given for a collective work (results achieved, ergonomics and software defense). 2) The individual work is noted through a presentation to the computer tutors of the algorithmic and software solutions developed.. The final grade is the average of the identically weighted group and individual scores.
- Pedagogic resources: group work sheet documenting the group's work, individual work sheet for personal work follow-up, a set of document on the Arche-platform (program examples, lecture notes …)

Student's expected work in autonomy:

The largest part of the hours spent to the project are achieved in autonomy and during the schedulded informatic sessions.

Bibliographic references:

Documents on the Arche plateform

Other EEIGM courses directly linked to this course:

Upstream: Computer science I

Downstream: Computational Mathematics in Engineering & Science

<table>
<tr><td colspan="2">Teaching Unit:
ORGANIC CHEMISTRY PRACTICALS</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: C. CARPIER</td></tr>
<tr><td colspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 21.8</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td>21.8</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 21.8</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☐ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to

- Master the use of laboratory equipment and instruments
- Master and apply security standards
- Use the main physical chemistry techniques of separation, purification and analysis
- Synthesise organic compounds, know their physical and chemical properties and characterise them

Syllabus:

Synthesis of an azo-based dye
Friedel-Crafts reaction
Jones oxidation synthesis
Synthesis of an ion-exchanging resin
Grignard synthesis
An introduction to Macromolecular Chemistry

Pedagogical procedures (organization, assessment, pedagogical resources):

Practical lessons last 2.5 or 3.5 hours
Continuous assessment + written reports + lab papers + poster + oral presentation
Documentary resources provided by the teaching team and expanded by students' personal research

Student's expected work in autonomy:

Students usually work in pairs
Personal research work is required before and after the practicals
Interactive teaching and technical supervision

Bibliographic references:

Student handout
Physical Chemistry, Atkins 5th edition Oxford University Press

Other EEIGM courses directly linked to this course:

Upstream: Atomic theory, Thermodynamics, Chemical kinetics, Solution Chemistry, Mineral Chemistry, Physical Chemistry practicals, Inorganic Chemistry practicals

Downstream: Macromolecular chemistry, Composite materials, Process engineeringac

<table>
<tr><td colspan="2">Teaching Unit:
ELABORATION OF INORGANIC MATERIALS</td><td colspan="5">Year/Semester of EEIGM studies: 2A – 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: D. RENAUX</td></tr>
<tr><td colspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 15</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>8.75</td><td>5</td><td></td><td></td><td>1.25</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 15</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to describe the basic chemical operations of extractive metallurgy, involved in both elaboration and recycling processes of metallic materials.

Syllabus:

Thermodynamics of pyrometallurgical transformations:
Ellingham diagramms
Oxides reduction and chloruration

Thermodynamics of hydrometallurgical transformations:
Lixiviation
Precipitation / cementation

Thermodynamics and kinetics of electrometallurgical operations:
Faraday law
Electrolysis

Some industrial processes

Pedagogical procedures (organization, assessment, pedagogical resources):

Students make use of a document draft for the course and a document draft specific for exercices.
Short controls (15-20 min) are regularly organised in order to check the aquired knowledge (Quizzbox or on paper).

Student's expected work in autonomy:

Fundamental knowledge must be learned between two consecutive lectures.
Practical exercices are to prepare before tutorial classes.

Bibliographic references:

Métallurgie : du minerai au matériau, Jean Philibert, Alain Vignes, Yves Bréchet, Pierre Combrade, Edts MASSON (Paris 1997)

Other EEIGM courses directly linked to this course:

Upstream: Atomistic - Chemical families and reactions - Chemical thermodynamics - Kinetics - Chemistry in solutions

Downstream: Experimental works in inorganic materials- Chemical engineering - Corrosion - Ceramics - Glasses and glass ceramics - Waste treatment

<table>
<tr><td rowspan="2">Teaching Unit:
ORGANIC CHEMISTRY III</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: J. BODIGUEL</td></tr>
<tr><td>EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 22.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>10</td><td>10</td><td></td><td></td><td>2.5</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to describe the main reactions that can occur from carbonyls, carboxylic acids and derivatives and predict the outcome when the application of these reactions to any single term of these series; to explain the particularities of certain functions by connecting them to their mechanism; to design a simple synthesis scheme, from the above functions, to prepare other compounds.

Syllabus:

Reactivity of the main functions in Organic Chemistry : Part III
- Carbonyl compounds
- Carboxylic acids and derivatives
- Benzene

Pedagogical procedures (organization, assessment, pedagogical resources):

Students will be evaluated during an intermediate assessment (1:15) and a final check (1:15)
Each of these two notes will be adjusted according to the non-student participation in courses and tutorials.

Student's expected work in autonomy:

It is asked the student to attend the course by having seen beforehand the already treated part. The exercises are distributed before the tutorial sessions and must be prepared in advance. During the tutorial sessions, students should be able to solve the exercises and / or explain the difficulties encountered when solving them.

Bibliographic references:

Les cours de Paul Arnaud : Chimie organique. Edition Dunod, 19e Edition B. Jamart, N. Brosse, J. Bodiguel

Other EEIGM courses directly linked to this course:

Upstream: Organic chemistry I and II
Chemical kinetics

Downstream: Macromolecular chemistry

Teaching Unit: PHILOSOPHY: ETHICS, SCIENCES, SOCIETIES	Year/Semester of EEIGM studies: 2A - 2nd semester
	Course manager: **B. GUILLEMIN/S. NEVEU**
EEIGM Department: European languages and cultures, SEHS	Hours/student:
Teaching method: Active Learning	In-person classes: 18
Assessment: Competencies approach	Autonomous work: 5

Lecture	Tutorial	Lab work	Project	Test
	18			

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☒ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to adopt a reflexive posture in front of a philosophical writing, to locate the articulations of a reasoning, to structure his thought in order to formulate oneself an argumentation on the topic of this writing. Students are expected to increase their potential for expression, both written and oral.

Syllabus:

Analytical reading of philosophical texts, texts from the written press or official documents (legislative documents for example), Production of argued essays-type writings, Training in the debate of ideas (analysis of video or audio documents presenting debates around controversial issues: GMOs , Nuclear disaster…), Construction and use of analysis tools…
Work possibly based on a cultural outing (Live Show, Cinema, Conference ...)
Main themes: Ethics and Responsibility, Science and society reports, democratic control of technology, etc.

Pedagogical procedures (organization, assessment, pedagogical resources):

2-hour activity sessions in small groups (<20 students) supervised by a teacher
Occasionally, work in groups
Documentary resources: provided by the teacher.
Two written productions and two oral productions per student which will be evaluated. The oral participation of the students is an essential condition of the evaluation.

Student's expected work in autonomy:

Readings
Writing work (productions to be handed in) and preparation of oral presentations

Bibliographic references:

Charte éthique de l'ingénieur, document du CNISF.
J.-P. Dupuy, Pour un catastrophisme éclairé : quand l'impossible est certain, coll. Points sciences, Seuil, Paris, 2002
E. Klein, La Science nous menace-t-elle ?, coll. Les Petites Pommes du savoir, Le Pommier, Paris, 2003.
La Fable des Abeilles, Mandeville, 1714
"Why I Am Leaving Goldman Sachs", by GREG SMITH, New-York Times, March 14, 2012
Charte Ethique du groupe GDF Suez
Spectacle "faRbEn" de Mathieu Bertholet (Actes Sud-Papiers 2007), Mise en scène V. Bellegarde, CDN Théâtre de la Manufacture, Nancy, Avril 2012

Other EEIGM courses directly linked to this course:

Upstream: Writing workshops

Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
WORKER INTERNSHIP</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: Z. AYADI</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 1,25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Competencies approach</td><td colspan="5">Autonomous work:</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the internship, the student should be able to understand the place occupied by the engineer in a company in terms of relationships, to integrate into a structure and to work in a group with colleagues in a professional context, to analyze the function and the functioning of the service in which he is placed and replace it in the overall context of the company.

Syllabus:

Organization: information meetings then follow-up by the Partnerships Department
The choice of the host company is subject to validation by the Partnerships Department.
Duration: 4 weeks during the summer period at the end of the 2nd year; location: in the world; agreement: compulsory before the start of the internship
Location: in a company linked to EEIGM training, in France or abroad, in positions such as technicians, assistant engineers or material handlers.

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: information meeting followed by the Industrial Relations Department
Assessment: assessment sheet to be completed by the tutor in the company and oral defense of 15 min divided into 10 min of presentation and 5 min of questions
Educational resources: set of administrative documents presenting the terms and conditions available on the Arche platform.

Student's expected work in autonomy:

Upstream, drafting of the CV and cover letter, and active search for the internship.
During the internship: work defined by the tutor in the company.
Downstream: preparation for the defense.

Bibliographic references:

Arche platform: Partnerships Department section

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: ENGLISH IV	Year/Semester of EEIGM studies: 2A - 2nd semester
	Course manager: **N.BRIE**
EEIGM Department: European languages and cultures, SEHS	Hours/student:
Teaching method: Academic	In-person classes: 30.25
Assessment: Classic	Lecture: — / Tutorial: 26.25 / Lab work: — / Project: — / Test: 4
	Autonomous work:

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should obtain his/her mandatory external Cambridge examination: FCE, CAE or CPE.

Syllabus:

Preparation to the four papers of the FCE, CAE, CPE Cambridge examinations: "Reading," "Writing," "Listening," and "Speaking."

Pedagogical procedures (organization, assessment, pedagogical resources):

Past and Practice FCE, CAE, CPE tests

Student's expected work in autonomy:

Use of the resources of the Foreign Language Learning Center
FCE, CAE, CPE exercises

Bibliographic references:

FCE, CAE, CPE Practice tests
Grammar for FCE or CAE
Vocabulary for FCE or CAE

Other EEIGM courses directly linked to this course:

Upstream: English III

Downstream: English V 15, 41; English V 25

<table>
<tr><td rowspan="2">Teaching Unit:
SPANISH IV</td><td colspan="5">Year/Semester of EEIGM studies: 2A – 2nd semester</td></tr>
<tr><td colspan="5">Course manager: C. SAVARD-CHAMBARD</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 22.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>22.5</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 4</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student (LV2) should be able to reason by oneself and develop critical thinking on familiar or current topics, per-sonal or professional interest. Levels to achieve B1 to C1 (self-assessment grid European Framework).
At the end of the course, the student (beginner in first year) should be able to consolidate and enrich his knowledge in the 5 language skills. Levels to achieve A2 to B1 (self-assessment grid European Framework).

Syllabus:

Training in listening, writing, reading and speaking.
(LV2) Writing CV and cover letters - Use of past DELE examinations - Class workbooks: 1/ "Expertos: curso avanzado de español orientado al mundo del trabajo", Difusión, Madrid, 2010; 2/ "Preparación al Diploma de Espa-ñol Nivel Intermedio B2", Edelsa Editorial, Madrid, 2014.
(Beginner in 1st year) Dialogues on everyday life topics. Studies of Spanish press articles and use of texts and audio recordings available on the Cervantes Institute website.

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students).
Continuous assessment: evaluation of the 5 language skills.
Review of daily and general press and use of texts and audio recordings available on the Cervantes Institute website.

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Prepare oral presentations on social and cultural issues
Prepare lectures on scientific subjects
Use of the resources of the library and language lab

Bibliographic references:

(LV2) Grammar book: "Competencia gramatical en uso, Nivel B2", Edelsa, Madrid, 2011. Dictionary: "Diccionario de la lengua española", Real Academia Española, Madrid, 2018. Vocabulary book: "Ejercicios de Léxico, Nivel Avanzado", Anaya, Madrid, 2008. Conjugation book: Bescherelle, "El arte de conjugar en español"
(Beginner in 1st year) Class workbooks: 1/ "Aula Internacional 3: Curso de español Nivel B1", Difusión, Madrid 2008; 2/ and 3/ "Al dí@: curso intermedio de español para los negocios, Libro del alumno y Cuaderno de ejercicios", SGEL, Madrid, 2010. Grammar books: 1/ "Competencia gramatical en uso", Nivel A2, Edelsa, Madrid, 2008; 2/ "Universo gramatical para estudiantes franceses", Edinumen, Madrid, 2013. Conjugation book: Bescherelle, "El arte de conjugar en español"

Other EEIGM courses directly linked to this course:

Upstream: Spanish III

Downstream: Spanish V 21 and 30

<table>
<tr><td rowspan="2">Teaching Unit:
GERMAN IV</td><td colspan="5">Year/Semester of EEIGM studies: 2A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: P. BEYER</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 22.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>22.5</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 4</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to practice German eather with the objective of reaching the level A2 (Elementary) or of reaching the level B1 (Intermediate), B2 (Upper Intermediate) or C1 (Advanced) of the CEFR.

Syllabus:

Consolidation and enrichment of the language. Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").

Pedagogical procedures (organization, assessment, pedagogical resources):

Working in groups according to the level. Continuous assessment.
Resources are course books (see Bibliographic references), articles and videos from digital and analogic media.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

Level A2: "Studio 21 A2", Cornelsen; "Menschen A2", Hueber.
Level B1: "Studio 21 B1", Cornelsen; "Menschen B1" and/or "Sicher B1+", Hueber; "Begegnungen B1+", Schubert.
Level B2: "Sicher B2", Hueber; "Erkundungen B2", Schubert.

Other EEIGM courses directly linked to this course:

Upstream: German III

Downstream: German V 21, German V 30

<table>
<tr><td colspan="2">Teaching Unit:
PHYSICAL ACTIVITIES AND SPORTS 4</td><td colspan="5">Year/Semester of EEIGM studies: 2A – 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: A. VAN DRIESSCHE</td></tr>
<tr><td colspan="2">EEIGM Department:
European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 17.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td>17.5</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Competencies approach</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to identify the principles that govern communication and collaboration with others, understand the mechanisms of group dynamics. It is expected that the student could have developed relational and behavioral skills, be aware of issues related to the role of sport in health and well-being for professional development, could have developed individual coping skills and responsibility

Syllabus:

Three cycles of activities composed of 9 or 10 sessions throughout the whole year. The student can choose among different types of activities.

Pedagogical procedures (organization, assessment, pedagogical resources):

1h45 activity sessions in a small group (<20 students) supervised by an APS teacher - Assessment by skills grid.

Student's expected work in autonomy:

Bibliographic references:

TOCQUER Monique. La place des activités physiques et sportives dans la formation des élèves des Grandes Ecoles. Conférence des Grandes Ecoles. Work group A.P.S.1994

Other EEIGM courses directly linked to this course:

Upstream: Physical and sports activities 3 Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
INDUSTRIAL CONFERENCES AND TOURS</td><td colspan="5">Year/Semester of EEIGM studies: 2A – 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: Z. AYADI and J. ZOLLINGER</td></tr>
<tr><td colspan="2">EEIGM Department:
European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 4,17</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>4,17</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment:</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Completing the training and bringing a different lignt by professionals. Narrow contact between students and profesionnals. Participation of the companies and the socio-economic environment in the training.
They also constitute an important opportunity to take advantage of internship or job offers and make the link between the courses at EEIGM and the industrial needs in materials engineering.

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

The conferences are usually scheduled on Wednesdays from 11h15 to 12h30. It is mandatory for the students to attend the conferences by which they are concerned. The tours are scheduled on Thursdays afternoon:

– 20 to 30 seats / tour
– Registration on Arche

Before the tour:

• Preparation of tour (informations about the company)
• Setting up thematic groups

After the tour :

• Report

Student's expected work in autonomy:

• Parts of the report
– presentation of the company: products, strategy, technology, etc.
– Work done by the engineers in this company ?
– Health and safety
– Input of EEIGM skills

Bibliographic references:

Arche: Direction of partnerships

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

3rd year

[SEMESTER 5]

TEACHING UNITS	ECTS	Lectures (hours)	*Lectures (numbers)*	Tutorials (hours)	*Tutorials (numbers)*	*Lab work (hours)*	*Lab work (numbers)*	Tests	*Tests (numbers)*	In-Person classes	Teachers
Remediation courses (optional)	**0**	**0,00**	**0,00**	**72,50**	**58,00**	**0,00**	**0,00**	**0,00**	**0,00**	**72,50**	
Organic chemistry	0,0	0,00	*0,00*	12,50	*10,00*	0,00	*0,00*	0,00	*0,00*	12,50	J. BODIGUEL
Mechanics	0,0	0,00	*0,00*	5,00	*4,00*	0,00	*0,00*	0,00	*0,00*	5,00	Z. AYADI
Cristallography	0,0	0,00	*0,00*	5,00	*4,00*	0,00	*0,00*	0,00	*0,00*	5,00	A. REDJAÏMIA
French as a Foreign Language	0,0	0,00	*0,00*	50,00	*40,00*	0,00	*0,00*	0,00	*0,00*	50,00	K. HENRY
EEIGM Department: Engineering sciences	**3,0**	**14,25**	**11,40**	**13,00**	**10,40**	**7,00**	**2,00**	**3,75**	**3,00**	**38,00**	
Flow and Transfers	2;5	14,25	*11,40*	13,00	*10,40*	0,00	*0,00*	3,75	*3,00*	31,00	Z. ACEM
Lab work: signal processing - image processing	0,5	0,00	*0,00*	0,00	*0,00*	7,00	*2,00*	0,00	*0,00*	7,00	S. RICHARD
EEIGM Department: Structural and functional properties of materials	**11**	**63,75**	**51,00**	**61,25**	**50,00**	**14,00**	**4,00**	**11,25**	**8,00**	**150,25**	
Structures and structural defects	2,5	16,25	*13,00*	16,25	*14,00*	0,00	*0,00*	3,75	*2,00*	36,25	A. REDJAIMIA
Physical properties of Materials	2,5	*15,00*	*12,00*	15,00	*12,00*	0,00	*0,00*	2,50	*2,00*	32,50	T. CZERWIEC
Structure / Property Relationships of Polymers	2,5	18,75	*15,00*	16,25	*13,00*	0,00	*0,00*	2,50	*2,00*	37,50	I. ROYAUD
Mechanics of Materials I	2,5	13,75	*11,00*	13,75	*11,00*	0,00	*0,00*	2,50	*2,00*	30,00	Z. AYADI
Lab work: Materials Characterization 1	1,0	0,00	*0,00*	0,00	*0,00*	14,00	*4,00*	0,00	*0,00*	14,00	J. ZOLLINGER
EEIGM Department: Elaboration and processing of materials	**7,0**	**22,50**	**18,00**	**23,75**	**19,00**	**24,50**	**7,00**	**5,00**	**4,00**	**75,75**	
Chemical Reaction Engineering	2,5	15,00	*12,00*	16,25	*13,00*	0,00	*0,00*	3,75	*3,00*	35,00	M.O. SIMONNOT
Phase diagrams	2,5	7,50	*6,00*	7,50	*6,00*	0,00	*0,00*	1,25	*1,00*	16,25	D. HORWAT
Lab work: Elaboration and Processing of Materials 1	1,0	0,00	*0,00*	0,00	*0,00*	10,50	*3,00*	0,00	*0,00*	10,50	JL SIX
Lab work: Process Engineering I	1,0	0,00	*0,00*	0,00	*0,00*	14,00	*4,00*	0,00	*0,00*	14,00	B. LAUBIE
EEIGM Department: Development and Research	**4,0**	**20,41**	**16,33**	**7,09**	**5,67**	**37,50**	**30,00**	**1,25**	**1,00**	**66,25**	
Professional project (ATI, GAIA, PDE)	1,5	0,00	*0,00*	0,00	*0,00*	37,50	*30,00*	0,00	*0,00*	37,50	V.VITZTHUM
Project management	1	2,50	*2,00*	0,84	*0,67*	0,00	*0,00*	0,00	*0,00*	3,34	R. ALTMEYER
Financial management	1	7,50	*6,00*	5,00	*4,00*	0,00	*0,00*	1,25	*1,00*	13,75	S. FALL
Materials Selection in Mechanical Design	0,5	6,25	*5,00*	1,25	*1,00*	0,00	*0,00*	0,00	*0,00*	7,50	S. BRUYERE
Industrial conferences and tours	0	4,16	*3,33*	0,00	*0,00*	0,00	*0,00*	0,00	*0,00*	4,16	J. ZOLLINGER
EEIGM Department: European languages and cultures, SEHS	**5**	**0,00**	**0,00**	**51,25**	**41,00**	**0,00**	**0,00**	**1,66**	**1,33**	**52,91**	
French as a Foreign Language (FFL)	1,67	0,00	*0,00*	37,50	*30,00*	0,00	*0,00*	0,00	*0,00*	37,50	K. HENRY
English V 15	1,67	0,00	*0,00*	13,75	*11,00*	0,00	*0,00*	1,66	*1,33*	15,41	N. BRIE
English V 25		0,00	*0,00*	25,00	*14,29*	0,00	*0,00*	0,00	*0,00*	25,00	N. BRIE
Spanish V 19	1,67	0,00	*0,00*	18,75	*15,00*	0,00	*0,00*	0,00	*0,00*	18,75	C.SAVARD-CHAMBARD
Spanish V 26		0,00	*0,00*	26,25	*15,00*	0,00	*0,00*	0,00	*0,00*	26,25	C.SAVARD-CHAMBARD
Spanish V 38		0,00	*0,00*	37,50	*30,00*	0,00	*0,00*	0,00	*0,00*	37,50	C.SAVARD-CHAMBARD
German V 19	1,67	0,00	*0,00*	18,75	*15,00*	0,00	*0,00*	0,00	*0,00*	18,75	P. BEYER
German V 26		0,00	*0,00*	26,25	*15,00*	0,00	*0,00*	0,00	*0,00*	26,25	P. BEYER
German V 38		0,00	*0,00*	37,50	*30,00*	0,00	*0,00*	0,00	*0,00*	37,50	P. BEYER
ZD: Mock exam (optional)	0	0,00	*0,00*	0,00	*0,00*	3,50	*2,80*	0,00	*0,00*	3,50	P. BEYER
DELE: Mock exam (optional)	0	0,00	*0,00*	0,00	*0,00*	4,00	*3,20*	0,00	*0,00*	4,00	C.SAVARD-CHAMBARD
TOTAL Semester V	**30,0**	**120,91**		**156,34**		**83,00**		**22,91**		**383,16**	

Teaching Unit: **FUNDAMENTALS OF ORGANIC CHEMISTRY**	**Year/Semester of EEIGM studies:** 3A - 1st semester				
	Course manager: **J. BODIGUEL**				
EEIGM Department: Elaboration and processing of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 12.5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment:		12.5			
	Autonomous work: 12.5				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☐ **C2** ☒ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to:
- Understand the molecular structure and stereochemistry of organic molecules
- Identify major chemical functions
- Understand the reactivity of organic molecules, analyze operatory conditions, characterize the reaction product(s)

Syllabus:

- Structure and bonding
- Isomerism
- Stereochemistry
- Alkenes, Electrophilic and Free-radical Additions reactions
- Halogenoalkanes : Nucleophilic Substitution and Elimination reactions
- Alcohols
- Aldehydes and ketones
- Carboxylic acids and derivatives

Pedagogical procedures (organization, assessment, pedagogical resources):

Lecture + exercises
Documentation: provided textbooks supplemented by personal work

Student's expected work in autonomy:

Search for complementary documentation
Personal work before and after lectures and tutorial
a

Bibliographic references:

Provided textbooks
Organic Chemistry, Vollhardt and Shaw 2nd edition, WH Freeman and Company 1994
Cours de Paul Arnaud, Chimie organique, Dunod

Other EEIGM courses directly linked to this course:

Upstream: Quantum Chemistry - General Chemistry - Chemical kinetics

Downstream: Polymer chemistry

<table>
<tr><td rowspan="2">Teaching Unit:
MECHANICAL REMEDIATION COURSE</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: Z. AYADI</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>5</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☒ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to analytically determine the mechanical state (field of displacements, strains and stresses) of a deformable solid subjected to mechanical stresses for a homogeneous and isotropic material and whose behavior is considered elastic linear.

Syllabus:

Characteristic test: tensile test
Elasticity
Linearity and non-linearity of behavior
Structure, Material
Strain
Displacement
Stress
Method of solving of an elastic problem

Pedagogical procedures (organization, assessment, pedagogical resources):

no evaluation planned

Student's expected work in autonomy:

Review what has been seen in class and consult the documents of lecture and exercises of MSD in 2A EEIGM

Bibliographic references:

Documents of lecture and exercises of MSD in 2A EEIGM

Other EEIGM courses directly linked to this course:

Upstream**:** RDM

Downstream**:** MM1, MM2, CM-MC

<table>
<tr><td rowspan="2">Teaching Unit:
CRYSTALLOGRAPHY</td><td colspan="5">Year/Semester of EEIGM studies: 3A – 1st semester</td></tr>
<tr><td colspan="5">Course manager: A. REDJAÏMIA</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>5</td><td></td><td></td><td></td></tr>
<tr><td>Assessment:</td><td colspan="5">Autonomous work:</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☒ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Based on X-ray diffraction diagrams, students are asked to identify the crystal structure of mono or polycrystal and determine, among others, the grain size of the polycrystal.

Syllabus:

Basics of crystal lattices, symmetry and periodicity - Crystal systems and Bravais lattice (Direct and inverse rotation axes, translation mirrors, helicoidal axes) - Stereographic projection - Geneis of Point and Space groups of symmetry (Direct and reciprocal spaces) - International Tables of Crystallography - X-ray (and electron) diffraction by crystal structures - Atomic Diffusion and Structure Factors - Bragg's law. Application: Based on experimental diffraction diagrams, identification of crystal structure - Basic elements of transmission electron diffraction.

Pedagogical procedures (organization, assessment, pedagogical resources):

"Step by step" lecture on computer support (.ppt) illustrating the concepts developed and discussed in this basic course for crystalline materials. Book of "step by step" worked exercises.

Student's expected work in autonomy:

Working in groups : Diffractograms (XRD) of real structures are made available to the students, organised in groups, for analysis allowing acces to the crystallographic structure (Crystal system, Bravais lattice and lattice parameters)

Bibliographic references:

Power point of "step by step" lectures of crystallography - Worked exercises Book - Listing of crystallography books available at the library of the Université de Lorraine (eeigm)

Other EEIGM courses directly linked to this course:

Upstream**:**

Downstream**:** Structures and Defect Structure (SDS) - Phase transformation - Physical Properties of Materials (PPM) - Material Characterization of materials (Practical work)

<table>
<tr><td rowspan="2">Teaching Unit:
SUPPORT COURSES IN FRENCH AS A FOREIGN LANGUAGE</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: K. HENRY</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 50</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>50</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 5</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to adapt to his new environment: he will have become familiar with French way of life, in the city of Nancy and its region, will have discovered some cultural and civilization points and will know the French university system. The student will have revised and deepened his knowledge, determined according to his initial level, in grammar, vocabulary and will be able to interact in the main communication situations that a student meets in France.

Syllabus:

Activities in the 4 skills (oral comprehension, written comprehension, oral expression and written expression) adapted to the group level, according to the objectives set by the CEFR. Priority is given to the oral. Grammar and lexical strengthening activities. Activities of discovery / strengthening of knowledge of French civilization and culture. Phonetics activities.

Pedagogical procedures (organization, assessment, pedagogical resources):

Positioning test allowing the students to be divided into level groups.
Assessment based on attendance, class participation, personal work provided, progression and a final test (at the end of the first semester).
The materials used in class are authentic documents as well as extracts from the Internet or methods.

Student's expected work in autonomy:

Complementary exercises on handouts or on the internet; written production exercises; preparation of presentations.

Bibliographic references:

French websites for information or learning French; Collections of books to study French as a foreign language from the publishing houses "Clé international", "Didier", Hachette, Presses universitaires de Grenoble (PUG)

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:** FFL V

<table>
<tr><td rowspan="2">Teaching Unit:
FLOWS AND TRANSFERS</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: Z. ACEM</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 31</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>14.25</td><td>13</td><td></td><td></td><td>3,75</td></tr>
<tr><td colspan="5">Autonomous work: 24</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to

- Have an expert knowledge of transfer mechanisms (convection/diffusion);
- Implementing a Dimensional Analysis (DA);
- Knowing how to get some adimensional numbers expression
- Performing a balance (mass, energy, momentum)
- Understanding a conservation equation

Syllabus:

Convection and diffusion phenomena
- Dimensional analysis and empirical correlations
- Balance equation
- Mass, momentum and energies balance

Pedagogical procedures (organization, assessment, pedagogical resources):

One knowledge test (10 minuts, coeff 1), one DA exam (1 h 30, coeff 1.5) and one final exam (2h30, coeff 2).
Lecture notes, tutorial and preparation available on ARCHE (http://arche.univ-lorraine.fr/course/view.php?id=3629).

Student's expected work in autonomy:

Homework preparation for Tutorial (correction provided).

Bibliographic references:

Coirier J., Mécanique des milieux continus - Concepts de base, 2° cycle, Dunod

- Guyon E., Hulin J.P., Petit L., Hydrodynamique Physique, Savoirs Actuels, InterEditions/Editions du CNRS
- Padet J., Fluides en écoulement : Méthodes et Modèles, 1990, Masson

Other EEIGM courses directly linked to this course:

Upstream: Heat transfer; Mechanics

Downstream: CMES, GRC

<table>
<tr><td colspan="2">Teaching Unit:
STRUCTURES AND STRUCTURAL DEFECTS (SDS)</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: A. REDJAÏMIA</td></tr>
<tr><td colspan="2">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 37.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>16.25</td><td>17.5</td><td></td><td></td><td>3,75</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☒ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to convey some of the essential concepts in materials science and engineering. These concepts rely the mechanical properties (strength, ductility, toughness, etc.) to the microstructures (phases, crystallography) and their crystal defects: vacancies (0D), dislocations (1D), interfaces, surfaces, grain boundaries, twins (2D), and grains, precipitates, etc. (3D).
The student will be expected to be able to explain how the microstructures are controlled, in order to optimize the physical and mechanical properties. He will learn how to use basic concepts of strengthening mechanisms (solid solution, precipitation, grain size reduction and work hardening, etc.) in understanding the performance of engineering materials and relating it to the microstructure of materials

Syllabus:

Presentation of the teaching unit and educational objectives (goals)
Control the structures, their defects and their activities at the meso-micro-nano scopic level (recovery and recrystallization, etc.). Optimize the defects organization for reinforcing the metallic materials.
Explain the mechanisms involved to ensure high levels of functional properties (mechanical strength, corrosion resistance, electrical and thermal conductivity, etc.).

Pedagogical procedures (organization, assessment, pedagogical resources):

Two or Three tests (In English and/or in French) are scheduled with the following levels (20 + 30 + 50)/5=X/20.
Continuous Assessment: Exams programs are cumulative: each exam addresses the program implemented since the beginning of the teaching unit until the day before the test.

Student's expected work in autonomy:

This teaching unit, reliying on complex concepts of Crystal Structure and Defects, is made affordable by concrete applications, often constructed in industrial practice (domain) during the tutorials, in small groups (TDs).

Bibliographic references:

A. Handouts of courses and tutorials are made available to students.
B. Books available at the library (SCD) of University of Lorraine:
Kelly and G.W. Groves, Crystallography and Crystal Defects, 1970, Longman, London,
D. Hull and D.J. Bacon, Introduction to Dislocations, Third Ed., Vol. 37, 1984, Pergamon Press,
J. and Julia Weertman, Elementary Dislocation Theory, 1966, Oxford University Press,
R.W.K. Honeycombe, The plastic Deformation of Metals, Second Ed., 1984, Edward Arnold, London,
W.T. Read, Dislocations in Crystal, 1953, McGraw-Hill Book Co. New York,
C. Web sites dealing with the field of metallic materials and their crystal defects.

Other EEIGM courses directly linked to this course:

Upstream: Introduction to Materials Science and Engineering, Atomic diffusion , Deformable solid mechanics, Mechanics of Materials I, Materials electronic properties and ratio crystallography

Downstream: : Phase transformations, Materials Characterization, Metallic materials making process , Surface Treatment

<table>
<tr><td colspan="2">Teaching Unit:
PHYSICAL PROPERTIES OF MATERIALS</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: T. CZERWIEC</td></tr>
<tr><td colspan="2">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 32.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>15</td><td>15</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to understand the basics of the physical properties of materials (electronic, thermal and magnetic) in relation with the structure of materials.

Syllabus:

This module includes three parts: electrical properties, thermal properties and magnetic properties. Part 1, which is the most significant, is divided into three subsections. In the first, some theoretical concepts are presented (Drude model and quantum model of the free electron and energy bands) for introducing fundamental concepts (density of states, Fermi energy, energy bands) The concept of Brillouin zone is approached in order to enable a coupling between the electrical properties in metals and semiconductors and their crystallographic structures. The second part deals with applications to electrical conductivity in metals. The behavior of metals and metal alloys is studied as a function of temperature, and defects and of the material composition. A final section is devoted to semiconductor materials (intrinsic behavior extrinsic type of gap ...). In the third part theoretical concepts (electrostatic dielectric, polarization charges, electric dipoles, frequency responses of the dipoles ...) and applications (capacitors) are introduced The concepts of piezoelectricity, pyroelectricity and ferroelectricity are also discussed. The thermal part introduces the concepts of thermal capacity and thermal expansion coefficient through models of continuous and discontinuous areas. The concepts of Debye temperature and phonons are treated. In the last part, we introduce the notions of diamagnetism, paramagnetism and ferromagnetism through theoretical concepts (magnetostatic of magnétiuqes circles magnetic dipole moments, moments orbital kinetic and spin) and practical (hysteresis cycles).

Pedagogical procedures (organization, assessment, pedagogical resources):

* Prepared handout transcribing the course in detail, available on ARCHE
* Forward tutorials
* The Evaluation is mainly done in a conventional manner (2 tests based on problems) with the prepared handout. During these examinations, students must answer questions on the basis of the course for 10 minutes without he prepared handout.

A bonus is awarded by student groups on the basis of written responses to questions asked at the end of certain courses.

Student's expected work in autonomy:

The concepts covered in this course are difficult and a certain number have not been seen by foreign, FPA and admitted students. To fill this gap, students have access, via Arche, to the very complete documents of the IPM and APM courses delivered in the second year. Students must see or review these courses in order to best appreciate the difficult concepts addressed in PPM

Bibliographic references:

See the many references in the course material

Other EEIGM courses directly linked to this course:

Upstream: all physics courses

Downstream:

Teaching Unit: STRUCTURE / PROPERTY RELATIONSHIPS OF POLYMERS	Year/Semester of EEIGM studies: 3A - 1st semester				
	Course manager: **I. ROYAUD**				
EEIGM Department: Structural and functional properties of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 37.5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	18.75	16.25			2.5
	Autonomous work: 30				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8	☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to understand the physical phenomena specific to polymers (eg mechanical, thermal, optical, dielectric properties, main thermal transitions in polymers such as the glass transition, notions of molecular mobility), know the different classes of polymers in terms of morphology / microstructure, understand the structure / physical properties relationships in order to be able to optimize the choice of polymer materials for a given application and use properties.

Syllabus:

General information on Polymers (macromolecules)
- Solid state cohesion
- Rubber elasticity
- Glass transition
- Molecular mobility (linear viscoelasticity, dynamic mechanical and dielectric properties)
- Semi-crystalline polymers: crystallization, melting, structure / property relationships. Notions on the mechanical behavior at strong deformations (plastic deformation, damage mechanisms, break).

Pedagogical procedures (organization, assessment, pedagogical resources):

Educational resources: one handout on Polymers Physics
- TD: exercises from the book by Etienne S., David L., Introduction to the Physics of Polymers, 2002, Dunod and a project by active learning
- 4 additional tutoring sessions in TD (4x1h15 = 5h)
- Assessment: An intermediate test (1h15) + a final control (1h15) + an assessment by active learning

Student's expected work in autonomy:

Re-read the courses, learn about the subjects covered related to polymer physics, prepare the tutorials

Bibliographic references:

- Etienne S. David L., Introduction to the Physics of Polymers, 2002, Dunod
- Oudet C., Polymers, Structures and Properties, Materials Sciences, 1994, Masson
- Lauprêtre F., Polymer Materials: Macroscopic Properties and Molecular Interpretations, 2011, John Wiley & Sons

Other EEIGM courses directly linked to this course:

Upstream: Introduction to Physics of Materials

Downstream: Options 4A specialty Polymers

<table>
<tr><td rowspan="2">Teaching Unit:
MECHANICS OF MATERIALS 1 (MM1)</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: Z. AYADI</td></tr>
<tr><td>EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 30</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>13.75</td><td>13.75</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="5">Autonomous work: 15</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☒ C6 ☒ C7 ☒ C8</td><td colspan="5">☒ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to characterize the viscoelastic behavior in statics and dynamics. Model this behavior with a view of prediction. Understand and anticipate the failure of materials (failure facies, main parameters, approach and propagation and failure criterion). To be able to use an industrial Finite Element Analysis software to study a failure problem and analyze the results (compared to the real problem, to the assumptions, ...) An inductive approach to viscoelasticity and the fracture mechanics of materials by implementing the steps: observation, experiment, results, interpretation, assumptions, modeling, comparison of predictions to reality, conclusion

Syllabus:

Introduction - Main rheological behaviors - Schematizations of rheological behaviors - Uniaxial linear viscoelastic behavior - Constitutive law - Creep and relaxation functions for a viscoelastic material - Experiments characteristic of viscoelastic behavior - Principle of superposition of BOLTZMANN - Use of operational computation to solve a linear viscoelasticity problem - Models for uniaxial non-aging linear viscoelastic behavior - Study of viscoelastic behavior in dynamic regime II. Introduction - Why study fracture - Approaches to fracture mechanics – Main Factors influencing fracture - Failure mechanics at different scales - Failure modes - Failure mechanics by the linear elasticity approach - Stress intensity Factor and stress concentration factor - Critical stress intensity factor - Toughness - Special case of glass fracture - Crack propagation by fatigue. This content is supported by an industrial conference on industrial applications of fracture mechanics, fracture expertise as well as an introduction to fatigue.

Pedagogical procedures (organization, assessment, pedagogical resources):

Students are informed during the first lecture of the organization, progress and evaluation of the module 1 : Intermediate exam and 1 Final exam, during the exam the documents, programmable calculators and cell phones are not allowed. The non respect of these instructions constitutes fraud. Teachers involved in tutorials will rotate in the different exercises groups as far as possible. Arch educational platform: The course handout (with holes) , exercises and solutions are available on this teachning plateform.

Student's expected work in autonomy:

To participate in all the sequences of the module (lecture tutorials, exercises and numerical mechanics FEM) Review in the following order: understand the lecture, doing the main exercises and some other problems

Bibliographic references:

A list of books available in libraries is offered in the first lecture. Useful links on the arche teachning platform: other exercises, other lectures, ...

Other EEIGM courses directly linked to this course:

Upstream: RDM, MSD

Downstream: MM2,MM3,SDS

<table>
<tr><td rowspan="2">Teaching Unit:
CHEMICAL REACTION ENGINEERING</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: M-O. SIMONNOT</td></tr>
<tr><td rowspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 35</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>15</td><td>16.25</td><td></td><td></td><td>3.75</td></tr>
<tr><td colspan="6">Autonomous work: 35 or more</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to 1) establish material and energy balances in closed or open systems in which a chemical reaction takes place, 2) choose a type of reactor for a given objective and to dimension ideal chemical reactors in transient (closed, semi-closed) or permanent (continuous reactors) regimes, 3) study the hydrodynamics of the reactors by the method of the distribution of residence times and to represent non-ideal reactors (in simple cases) by assembling ideal reactors.

Syllabus:

Presentation of the module and its situation in the EEIGM curriculum and the Process (Chemical) Engineering discipline
Material balance in the presence of a chemical reaction (macroscopic or differential/closed or open, transient or permanent system). Reminder of the basics of kinetics and chemical thermodynamics.
Design of ideal simple reactors and then in combination (series/parallel).
Energy balance in ideal chemical reactors. Isothermal and adiabatic reactors.
Measurement of hydrodynamics by the residence time distribution method.
Modeling concepts of real reactors by association of ideal reactors, cascade mixer model.

Pedagogical procedures (organization, assessment, pedagogical resources):

Organisation: lectures, tutorials (in groups) (lectures can be given in English but in recent years they have been given in French, according to the choice of the students).
Assessment: 1 homework assignment (coeff. 0.5), 1 intermediate test (1.25 h - coeff. 1.5) and a final test (2.5 h - coeff. 3).
Teaching resources: course and TD handouts written in English, course slide presentations, support documents (mathematical reminders, examples, corrections of TDs and old tests, website addresses) available on the Arche digital platform. Books in the library.

Student's expected work in autonomy:

Absolute necessity of regular work (at the very rhythm of the classes and tutorials) to master the content of the courses, to study the examples, to prepare the exercises, to redo them, possibly to do others.

Bibliographic references:

Fogler HS, Elements of Chemical Engineering; Prentice Hall, 1992
Villermaux J., Génie de la Réaction Chimique 1993, Lavoisier Tec et Doc
Techniques de l'ingénieur

Other EEIGM courses directly linked to this course:

Upstream: mathematics, chemical kinetics, chemical thermodynamics, chemistry in aqueous solutions, heat transfer

Downstream: polymerization engineering, flows and transfers, separation engineering, process engineering, waste and effluent treatment, divided solids, eco-design, internships, projects

<table>
<tr><td rowspan="2">Teaching Unit:
PHASE DIAGRAMS</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: D. HORWAT</td></tr>
<tr><td rowspan="3">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 16.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>7.5</td><td>7.5</td><td></td><td></td><td>1.25</td></tr>
<tr><td colspan="5">Autonomous work: 17.5</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☒ C8</td><td colspan="4">☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to demonstrate and use the main mathematical expressions at the basis of phase transformation thermodynamics. The student will also be able to understand and use the origins of binary and ternary phase diagrams.

Syllabus:

Useful thermodynamics data. Stable, metastable and unstable equilibriums and conditions of transformations
Binary and ternary phase diagrams (origin and use)

Pedagogical procedures (organization, assessment, pedagogical resources):

1 written evaluations of 75 minutes. Duplicated lecture notes are provided. Slides and demonstrations can contain additional informations to the lecture notes.

Student's expected work in autonomy:

Preparation of some lectures by reading in advance the duplicated lecture notes and preparing questions for reversed pedagogy.

Bibliographic references:

Phase transformations in metal and alloys (Porter et Easterling)
Précis de métallurgie

Other EEIGM courses directly linked to this course:

Upstream: Thermodynamics, Atomic structures, Atomic diffusion, Structures and structural defects

Downstream: Materials Characterization, Project : metallic materials, Phase transformations II : kinetics, assembly and aditive manufacturing, Procédés d'élaboration des matériaux métalliques, Surface Treatments

<table>
<tr><td rowspan="2">Teaching Unit:
PROJECT MANAGEMENT</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: R. ALTMEYER</td></tr>
<tr><td>EEIGM Department: Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 3.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>2.5</td><td>1.25</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Competencies approach</td><td colspan="5">Autonomous work: 20</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☒ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to
• adopt a common language as well as a project management terminology
• use the basic principles and tools in project management
• to use this knowledge and to act independently within the framework of the 3rd Year Professional projects

Syllabus:

Objectives targeted within the discipline:
• Broaden the base of knowledge related to the engineering tasks
• Know the process of managing a project of any kind (industrial / associative / staff)
• Present the theoretical instruments for the development, management and evaluation of projects from an interdisciplinary perspective

Pedagogical procedures (organization, assessment, pedagogical resources):

2 lectures of 1h15 to give the keys to project management, to be applied in professional projects, 1 tutorial to take stock of the organization adopted in professional projects, 1 defense of 15-20 min to explain this organization at the end of the semester and 1 report at the end of the year

• Documentary resources: Copy of the projected PowerPoint available on ARCHE

Student's expected work in autonomy:

Bibliographic references:

L'analyse des besoins : la gestion de projet par étapes / Hugues Marchat, Éd. d'Organisation, 2006
• Comment manager un projet / Jean-Jacques Néré, Demos, 2000
• Les compétences pour gérer un projet : des fiches de fonctions / Jean Le Bissonnais, AFNOR, 2003
• Conduire un projet à l'usage des PME, PMI, TPE et des collectivités territoriales / Roger Aïm, Afnor, 2009
• Conduire un projet d'organisation : guide méthodologique : les 3 étapes de la démarche générale, les 15 outils de pilotage, les 7 compétences relationnelles, les 10 thèmes classiques, les 5 méthodes spécifiques, les 46 outils techniques / Henri-Pierre Maders, Elizabeth Gauthier, Cyrille Le Gallais, Éd. d'Organisation, 1998

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: Professional project

<table>
<tr><td rowspan="2">Teaching Unit:
FINANCIAL MANAGEMENT</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: S. FALL</td></tr>
<tr><td>EEIGM Department: Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 13.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>7.5</td><td>5</td><td></td><td></td><td>1.25</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 3</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☒ C6 ☐ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to analyze a balance sheet and an operating account. As part of a project, he must be able to anticipate the profitability of the project and set its budgetary limits.

Syllabus:

1) The balance sheet and the income statement
2) Functional and financial analysis of the balance sheet
3) Interim management balances: analysis of the result
4) The business plan or budget management

Pedagogical procedures (organization, assessment, pedagogical resources):

The course is organized around a handout given to students from which some case studies are presented. An evaluation at the end of the module makes it possible to assess the student's ability to analyze an operating account or a company's balance sheet as well as to project himself into the various essential accounting documents.

Student's expected work in autonomy:

Exercises and small case studies are treated in tutorials and practicals.

Bibliographic references:

Any accounting analysis document and the handout.

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: MATERIALS SELECTION IN MECHANICAL DESIGN	Year/Semester of EEIGM studies: 3A - 1st semester
	Course manager: **S. BRUYERE**
EEIGM Department: Development and research	**Hours/student:**
Teaching method: Academic	**In-person classes:** 7.5
Assessment: Competencies approach	Lecture: 6.25 / Tutorial: 1.25 / Lab work / Project / Test **Autonomous work:** 3
Generic EEIGM competencies	**Specific EEIGM competencies**
☐ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☒ **C6** ☒ **C7** ☒ **C8**	☒ **SC1** ☐ **SC2** ☐ **SC3** ☒ **SC4** ☒ **SC5** ☐ **SC6**

Educational objectives of the course:

At the end of the course, the student should know how to select materials in mechanical design. This teaching unit provid insights and understanding of the engineering factors to be considered in selecting and justifying materials for new or replacement applications. It creates an awareness of many other factors that enter into engineering decisions, including cost, eco conception, …

Syllabus:

This module describes the procedure for the selection of materials based on their intrinsic or technical properties, their functions, their shapes, processes for their implementation, their life-cycle, their costs. The optimization of these parameters is part of the design criteria. This task, in principle very tedious, is facilitated by the development in the market for databases and software selection assistance.

Pedagogical procedures (organization, assessment, pedagogical resources):

Courses handouts (6.25h) and Tutorials (1.25h) (in French and English for familiarization of technical vocabulary of Material selection in mechanical design) - Case studies in which the method is applied to material selection.
Assessment with a multiple-choice questionnaire and a case study.

Student's expected work in autonomy:

The class will be divided into teams consisting of no less than 3 (and no larger than 5) students who will work together on a Design project.

Bibliographic references:

ASHBY, M F. 'Materials Selection and Process in Mechanical Design.' Butterworth Heinemann, Oxford, 1999 ISBN 0-7506-4357-9
ASHBY, M.F. and CEBON. D. 'Case studies in Materials Selection.' First Edition, Granta Design, Cambridge, 1996, Second Edition, Butterworth-Heinemann, Oxford, 1999
Le logiciel CES Materials Selection, developpé par M. Ashby, est disponibles sur les ordinateurs personnels des élèves et sur ceux des salles informatiques de l'Ecole (EEIGM)

Other EEIGM courses directly linked to this course:

Upstream: Initiation à la physique des matériaux, Propriétés Physique des matériaux, Physique des polymères, Structure et défauts de structures, Mécanique des matériaux

Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
INDUSTRIAL CONFERENCES AND TOURS</td><td colspan="5">Year/Semester of EEIGM studies: 3A – 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: Z. AYADI and J. ZOLLINGER</td></tr>
<tr><td colspan="2">EEIGM Department:
Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 4,17</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>4.17</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment:</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Completing the training and bringing a different lignt by professionals. Narrow contact between students and profesionnals. Participation of the companies and the socio-economic environment in the training.
They also constitute an important opportunity to take advantage of internship or job offers and make the link between the courses at EEIGM and the industrial needs in materials engineering.

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

The conferences are usually scheduled on Wednesdays from 11h15 to 12h30. It is mandatory for the students to attend the conferences by which they are concerned. The tours are scheduled on Thursdays afternoon:

– 20 to 30 seats / tour
– Registration on Arche

Before the tour:

• Preparation of tour (informations about the company)
• Setting up thematic groups

After the tour :

• Report

Student's expected work in autonomy:

• Parts of the report
– presentation of the company: products, strategy, technology, etc.
– Work done by the engineers in this company ?
– Health and safety
– Input of EEIGM skills

Bibliographic references:

Arche: Direction of partnerships

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
FRENCH AS A FOREIGN LANGUAGE V</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: K. HENRY</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 37.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>37.5</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 6</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to communicate in most situations of daily life, will know the grammatical structures and the basic lexicon (for groups of level A1, A2 or B1). The student in a group of level B1.2 or B2 will be able to communicate on a fairly wide range of subjects with a good grammatical control and good command of the lexicon. He can give his opinion, start arguing, explain and clarify his words. The student, whatever his level, will also know the cultural environment better in which he lives and studies.

Syllabus:

Activities in the 4 skills (oral comprehension, written comprehension, oral expression and written expression) adapted to the group level, according to the objectives set by the CEFR. Priority is given to the oral. Grammar and lexical strengthening activities. Activities of discovery / strengthening of knowledge of French civilization and culture. Phonetics activities.

Pedagogical procedures (organization, assessment, pedagogical resources):

Assessment based on attendance, class participation, personal work provided, progression and a final test.
The materials used in class are authentic documents as well as extracts from the Internet or methods.

Student's expected work in autonomy:

Complementary exercises on handouts or on the internet; written production exercises; preparation of presentations.

Bibliographic references:

French websites for information or learning French; Collections of books to study French as a foreign language from the publishing houses "Clé international", "Didier", Hachette, Presses universitaires de Grenoble (PUG)

Other EEIGM courses directly linked to this course:

Upstream: Support Courses in French as a Foreign Language

Downstream: FFL VI

<table>
<tr><td rowspan="2">Teaching Unit:
ENGLISH V 15</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: N. BRIE</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 15</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>15</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 2</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="3">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="3">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should have a sufficient level in English to prepare for his/her international mobility; teaching contents and methods are adapted to the level of each group.

Syllabus:

Students who have done their first two years at EEIGM: 16,25 hours in the first semester: consolidation of acquired skills, practising oral expression, notions of technical, professional and scientific English. Communication class: personality test, body language, class-assessing Powerpoint presentations

Pedagogical procedures (organization, assessment, pedagogical resources):

"Authentic" documents (written, audio, video), scientific articles, on-line documents

Student's expected work in autonomy:

Use of the resources of the Foreign Language Learning Center

Bibliographic references:

Defined for each group at the beginning of the year

Other EEIGM courses directly linked to this course:

Upstream: IV

Downstream: VI

<table>
<tr><td rowspan="2">Teaching Unit:
ENGLISH V 26.25</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: N.BRIE</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 26.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>26.25</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should have a sufficient level in English to prepare for his/her international mobility; teaching contents and methods are adapted to the level of each group.

Syllabus:

New students (below B2 level): one group (A2/B1 level) will follow a 30-hour course to update and consolidate their knowledge and skills in view to prepare for FCE in 4th year. 2 other groups (B2/C1 and C1/C2 levels) will follow a 30-hour course to update and consolidate their knowledge and skills in view to prepare for FCE, CAE or CPE in the 2nd semester of the 3rd year

Pedagogical procedures (organization, assessment, pedagogical resources):

FCE/CAE/CPE past exams and practice tests
Continuous assessment: oral and written tests
"Authentic" documents (written, audio, video), on-line documents

Student's expected work in autonomy:

Use of the resources of the Foreign Language Learning Center

Bibliographic references:

Defined for each group at the beginning of the year

Other EEIGM courses directly linked to this course:

Upstream: IV

Downstream: VI

Teaching Unit: **SPANISH 5 BEGINNERS**	**Year/Semester of EEIGM studies:** 3A - 1st semester				
	Course manager: **C. SAVARD-CHAMBARD**				
EEIGM Department: European languages and cultures, SEHS	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 37.5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic		37.5			
	Autonomous work: 3 h per week				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☒ **SC6**				

Educational objectives of the course:

At the end of the course, the student should have acquired basic notions to understand and be understood in situations of everyday life. Levels to achieve A2 to B1 (self-assessment grid European Framework

Syllabus:

Acquisition of basic knowledge and skills necessary to understand and express oneself both orally and writing

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students)
Continuous assessment: evaluation of the 5 language skills
Studies of Spanish press articles and use of texts and audio recordings available on the Cervantes Institute web-site

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Prepare oral presentations on everyday life topics
Use of the resources of the library and language lab

Bibliographic references:

Class workbook: Campus Sur A1-A2 Libro del alumno y Cuaderno de ejercicios, Difusión, 2019
Grammar book: Competencia gramatical en uso, Nivel A2, Edelsa, Madrid, 2008
Bilingual dictionary Larousse
Vocabulary book: Maribel Molio, 60 fiches de vocabulaire espagnol, Studyrama, Paris, 2012
Conjugation book: Bescherelle, El arte de conjugar en español

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:** Spanish 6

<table>
<tr><td rowspan="2">Teaching Unit:
SPANISH 5 LV2 OR LV3</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: C. SAVARD-CHAMBARD</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>18.75 h B2 level and higher
26.25 h A2, B1 levels and Prepa DELE LV2-LV3</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 3 h per week</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to depending on the groups, prepare for the Spanish DELE examination (B2, C1 or C2 levels) or reason by oneself on current topics, personal or professional interest

Syllabus:

For students preparing the DELE: training written and oral tests
For other students: consolidation and enrichment of knowledge and skills on current topics and professional issues

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students)
Continuous assessment: past DELE examinations B2 level + 2 DELE mock exams
Continuous assessment: evaluation of the 5 language skills
Past DELE examinations
Class workbooks: 1/ and 2/ Al dí@: curso intermedio de español para los negocios, Libro del alumno y Cua-derno de ejercicios, SGEL, Madrid, 2010

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Training past DELE examinations
Prepare oral presentations on social or current topics
Use of the resources of the library and language lab

Bibliographic references:

Workbooks: 1/ 1/ Las claves del nuevo C1, Difusión, 2016; 2/ C de C1. Curso de español de nivel superior, Difusión, 2019; 3/ Preparación al Diploma de Español, Nivel B2, Edelsa, 2018
Grammar books: 1/ Las 500 dudas más frecuentes del español, Espasa Calpe, 2019; 2/ Competencia gramati-cal en uso Nivel B2, Edelsa, Madrid, 2014
Dictionaries: 1/ Le vocabulaire de l'espagnol, Hachette, Paris, 2010; 2/ Diccionario de la lengua española, Real Academia Española, Madrid, 2012
Vocabulary book: 100 fiches de vocabulaire espagnol, Studyrama, Paris, 2010
Conjugation book: Bescherelle, El arte de conjugar en español

Other EEIGM courses directly linked to this course:

Upstream: Spanish 4 Downstream: Spanish 6

<table>
<tr><td colspan="2">Teaching Unit:
GERMAN V 38</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: P. BEYER</td></tr>
<tr><td colspan="2">EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 37.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>37.5</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to practice German with the objective of reaching the level A1 ("Basic User") of the Common European Framework of Reference for Languages (CEFR).

Syllabus:

Introduction to the German language.
Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").
Introduction to the realities of the German speaking world.
Preparation for and help in finding the stay in a German speaking country.

Pedagogical procedures (organization, assessment, pedagogical resources):

Continuous assessment.
Use of course books, original documents and on-line resources.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

"Menschen A1", Hueber
"Studio [21] A1", Cornelsen

Other EEIGM courses directly linked to this course:

Upstream:

Downstream: German VI 38

Teaching Unit: GERMAN V 26	Year/Semester of EEIGM studies: 3A - 1st semester
	Course manager: **P. BEYER**
EEIGM Department: European languages and cultures, SEHS	Hours/student:
Teaching method: Academic	In-person classes: 26.25
Assessment: Classic	Lecture: — | Tutorial: 26.25 | Lab work: — | Project: — | Test: —
	Autonomous work: 5

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

At the end of the course, the student should be able to practice German with the objective of reaching the level A2 ("Basic User") of the Common European Framework of Reference for Languages (CEFR).

Syllabus:

Consolidation and enrichment of the language.
Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").
Introduction to the realities of the German speaking world.
Preparation for and help in finding the stay in a German speaking country.

Pedagogical procedures (organization, assessment, pedagogical resources):

Continuous assessment.
Use of course books, original documents and on-line resources.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

"Menschen A2", Hueber
"Studio A2", Cornelsen

Other EEIGM courses directly linked to this course:

Upstream: German IV

Downstream: German VI 28

<table>
<tr><td rowspan="2">Teaching Unit:
GERMAN V 19</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: P. BEYER</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 18.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>18.75</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 5</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="3">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="3">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to pass the Zertifikat Deutsch (ZD), an internationally recognized exam of German language ability (CEFRL levels B1+, B2, C1, C2).

Syllabus:

Consolidation and enrichment of the language.
Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").
In-depth knowledge of the realities of the German speaking countries.
Preparation for the Zertifikat Deutsch (ZD).
Preparation for and help in finding the stay in a German speaking country.

Pedagogical procedures (organization, assessment, pedagogical resources):

Working in groups according to the level.
Continuous assessment.
Mock exam (approx. additional 3,5h/student).
Use of course books, original documents and on-line resources.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

https://www.goethe.de/de/spr/kup/prf/prf.html
https://www.dw.com/de/deutsch-lernen/lernangebote-f%C3%BCr-das-niveau-b2/s-13217
"Fit fürs Zertifikat Deutsch", Hueber
"Mit Erfolg zum Zertifikat Deutsch", Klett
"Prüfungstraining DaF", Cornelsen
"Sicher!", Hueber
"Werkstatt", Praxis

Other EEIGM courses directly linked to this course:

Upstream: German IV

Downstream: German VI 16

3rd year

[SEMESTER 6]

TEACHING UNITS	ECTS	Lectures (hours)	*Lectures (numbers)*	Tutorials (hours)	*Tutorials (numbers)*	Lab work (hours)	*Lab work (numbers)*	*Tests (numbers)*	*Contrôles (séances)*	In-Person classes	Teachers
EEIGM Department: Engineering sciences	**7**	**13,34**	**10,67**	**38,75**	**31,00**	**27,00**	**18,00**	**5,00**	**4,00**	**107,25**	
Signal processing	2	7,50	*6,00*	15,00	*12,00*	0,00	*0,00*	3,75	*3,00*	26,25	C. DAUL
Computational Mathematics in Engineering & Science	3	5,84	*4,67*	23,75	*19,00*	20,00	*16,00*	1,25	*1,00*	54,00	Y. CHENY
Lab work: signal processing - image processing	1	0,00	*0,00*	0,00	*0,00*	7,00	*2,00*	0,00	*0,00*	7,00	S. RICHARD
Elective courses (Materials for Energy, Materials for mobilities, Materials for Health)	1	18,75	*15,00*	0,00	*0,00*	1,25	*1,00*	0,00	*0,00*	20,00	J-L. SIX (Health) - D. HORWAT (Energy) - I.ROYAUD/T. CZERWIEC(Mobility)
EEIGM Department: Structural and functional properties of materials	**4**	**13,75**	**11,00**	**13,75**	**11,00**	**14,00**	**4,00**	**2,50**	**2,00**	**44,00**	
Mechanics of Materials II	3	13,75	*11,00*	13,75	*11,00*	0,00	*0,00*	2,50	*2,00*	30,00	Z. AYADI
Lab work: Materials Characterization 2	1,0	0,00	*0,00*	0,00	*0,00*	14,00	*4,00*	0,00	*0,00*	14,00	J. ZOLLINGER
EEIGM Department: Elaboration and processing of materials	**11,0**	**52,50**	**42,00**	**50,00**	**40,00**	**24,50**	**7,00**	**8,75**	**7,00**	**135,75**	
Polymer Chemistry	3	18,75	*15,00*	16,25	*13,00*	0,00	*0,00*	2,50	*2,00*	37,50	J.L. SIX
Phase transformation and additive manufacturing	3	15,00	*12,00*	15,00	*12,00*	0,00	*0,00*	2,50	*2,00*	32,50	J. ZOLLINGER
Lab work: Elaboration and Processing of Materials 2	1,0	0,00	*0,00*	0,00	*0,00*	10,50	*3,00*	0,00	*0,00*	10,50	J-L. SIX
Divided solids	1,5	11,25	*9,00*	10,00	*8,00*	0,00	*0,00*	1,25	*1,00*	22,50	M-O. SIMONNOT
Separations engineering	1,5	7,50	*6,00*	8,75	*7,00*	0,00	*0,00*	1,25	*1,00*	17,50	V. VITZTHUM
Lab work: Process Engineering II	1	0,00	*0,00*	0,00	*0,00*	14,00	*4,00*	1,25	*1,00*	15,25	B. LAUBIE
EEIGM Department: Development and Research	**4**	**9,16**	**7,33**	**4,16**	**3,33**	**47,50**	**38,00**	**0,00**	**0,00**	**56,66**	
Professional project (ATI, GAIA, PDE)	2,5	0,00	*0,00*	0,00	*0,00*	37,50	*30,00*	0,00	*0,00*	37,50	V.VITZTHUM
Professional and Personal Project QUITUS	0,5	2,50	*2,00*	2,50	*2,00*	0,00	*0,00*	0,00	*0,00*	5,00	R. VILAIR
Project (associated to elective courses)	1	0,00	*0,00*	0,00	*0,00*	10,00	*8,00*	0,00	*0,00*	10,00	J. ZOLLINGER
Job interview simulation	0	2,50	*2,00*	1,66	*1,33*	0,00	*0,00*	0,00	*0,00*	4,16	R. VILAIR
Industrial conferences and tours	0	4,16	*3,33*	0,00	*0,00*	0,00	*0,00*	0,00	*0,00*	4,16	J. ZOLLINGER
EEIGM Department: European languages and cultures, SEHS	**4**	**0,00**		**32,50**		**0,00**		**0,00**		**53,75**	
French as a Foreign Language (FFL)	2	0,00	*0,00*	30,00	*24,00*	0,00	*0,00*	0,00	*0,00*	30,00	K. HENRY
English VI (Soutien)	0	0,00	*0,00*	26,25	*15,00*	0,00	*0,00*	0,00	*0,00*	26,25	N. BRIE
Spanish VI 16	2	0,00	*0,00*	16,25	*13,00*	0,00	*0,00*	0,00	*0,00*	16,25	C.SAVARD-CHAMBARD
Spanish VI 28		0,00	*0,00*	28,00	*16,00*	0,00	*0,00*	0,00	*0,00*	28,00	C.SAVARD-CHAMBARD
Spanish VI 38		0,00	*0,00*	37,50	*30,00*	0,00	*0,00*	0,00	*0,00*	37,50	C.SAVARD-CHAMBARD
German VI 16	2	0,00	*0,00*	16,25	*13,00*	0,00	*0,00*	0,00	*0,00*	16,25	P. BEYER
German VI 28		0,00	*0,00*	28,00	*16,00*	0,00	*0,00*	0,00	*0,00*	28,00	P. BEYER
German VI 38		0,00	*0,00*	37,50	*30,00*	0,00	*0,00*	0,00	*0,00*	37,50	P. BEYER
TOTAL Semester VI	**30,0**	**88,75**		**139,16**		**113,00**		**16,25**		**397,41**	

<table>
<tr><td colspan="2">Teaching Unit:
SIGNAL PROCESSING</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st and 2nd semesters</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: C. DAUL</td></tr>
<tr><td colspan="2">EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>6.25</td><td>15</td><td></td><td></td><td>3.75</td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 20</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student would be able to choose different instrumentation chain parts, adjust their parameters, and interpret the digitized signals.

Syllabus:

The teaching unit consists of three parts.
1) The first part deals with basic knowledge in signal processing for the modelling, in the frequential domain, systems whose behaviour can be described with differential equations in the temporal domain. Presented aspects: transfer function, band-pass of systems, Laplace transform, and Fourier transform.
2) In the second teaching unit part, this knowlegde in signal processing will be used for modelling and understanding the behaviour of the different components of an instrumentation chain allowing for an representative measurement of physical quantities. Points covered: operation of sensors, as well as amplification, filtering, transport and digitization of measured signals.
3) In the last part, image processing methods will be used to interpret digital images.

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization of teaching
- 1st part (modeling of linear systems): the work is done in autonomy and face-to-face (in class) remediation sessions can address, according to the student's needs, all the course points and all the exercises.
- 2nd part (instrumentation): lectures and tutorials all in class.
- 3rd part (digital signal processing): course with integrated computer-based practical work in class.

Evaluation : weighted average of two written tests in class
- 1st part (modeling of linear systems) : coefficient 1.
- 2nd and 3rd parts (instrumentation and digital signal processing) : coefficient 2

Teaching resources :
- 1st part (modeling of linear systems): thematic course sheets, multiple choice questions and corrected exercises
- 2nd part (instrumentation): handout of course and tutorials
- 3rd part (digital signal processing): KHOROS software

Student's expected work in autonomy:

- 1st part (modeling of linear systems): work on the course sheets and practice with the help of corrected and commented exercises.
- 2nd part (instrumentation) : work on the course and prepare the tutorials

Bibliographic references:

- Cottet Francis, Signal processing and data acquisition, 1997, Dunod
- Georges Ash, Les capteurs en instrumentation industrielle, 5th edition, Dunod, Paris, 1998

Other EEIGM courses directly linked to this course:

Upstream: Algebra III (2A, Fourier series, Partial differential equations of physics (2A, Laplace transform, Fourier transform, convolution integral)

Downstream: Metallic materials project (4A), TP measurement and data interpretation, TP Processes

Teaching Unit: COMPUTATIONAL MATHEMATICS IN ENGINEERING AND SCIENCES	Year/Semester of EEIGM studies: 3A - 2nd semester
	Course manager: **Y. CHENY**
EEIGM Department: Engineering sciences	Hours/student:
Teaching method: Academic	In-person classes: 54
Assessment: Classic	Lecture: 5 / Tutorial: / Lab work: 25 / Project: 22 / Test: 2
	Autonomous work:
Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to develop a discrete and iterative numerical calculation allowing for solving simple problems connected to linear ODE's or PDE's with a Python programming.

Syllabus:

A] Learning Python software independent work on computer based on thematic activities. While learning basic commands and functionalities of Python software the student gains knowledge with some bsic tools of scientific calculus: fixed point method, iterative calculus principles of algorithmic ...
B] Initiation to 4 numerical methods introduced during flash courses: finite difference method, Multistep algorithms for solving ODE's, Finite Volumes and Finite Elements methods to solve PDE's: Independent working based on the solution of canonical problems with accompanying questionning procedure and resource person.
C] in-depth study with autonomous work in a project team: students will build on their gained skills by solving a more complex problem with one of the 4 methods. Starting from a laconic subject, this complex problem will have to be clearly formulated mathematically before its transformation under algebraic form (link with courses in mechanics, physics, chemistry…).

Pedagogical procedures (organization, assessment, pedagogical resources):

One-off flash Courses to introduce or rebuild notions, always preceding of following individual works on computer with a well defined activity program. Scientific computation project, to be performed within a team.
Pedagogical ressources on Arche platform with multimedia library and useful links
Workbook incuding a Python tutorial, the subject of activities or tutorials to be made during the scheduled sessions, the specifications related to the scientic calculus project.
Continuous assessment (Individual reports on activities, Oral examination, Oral assessment during the project and from a written report.

Student's expected work in autonomy:

Each learning session is the opportunuity for the student to work independently with a computer, to discover and put into practice basic concepts on which scientif calculus relies.

Bibliographic references:

Quarteroni, A., & Valli, A. (2008). Numerical approximation of partial differential equations (Vol. 23). Springer Science & Business Media.

Other EEIGM courses directly linked to this course:

Upstream: Matrix algebra, Partial Differential Equations, Flows and Transfer, Computer science I, Computer science II

Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
LABORATORY WORK : SIGNAL PROCESSING AND IMAGE PROCESSING</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st and 2nd semesters</td></tr>
<tr><td colspan="5">Course manager: S. RICHARD</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 14</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td>14</td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 4</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☐ C1 ☐ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to use some software dedicated to the acquisition and treatment of numerical data, using tools from the fields of mathematics and signal processing.
The aim is to deal with practical metrology techniques related to material investigation and characterization. We do not focus on characterization processes themselves: the main aim of this laboratory work is to make the students sensitive to the issues relating to measurement (system calibration, sample preparation, etc.) and to the treatment of data delivered by investigation systems (i.e. statistic tools or signal and image processing tools for data interpretation).

Syllabus:

2 laboratory works based on morphological operations in image processing, Metallography, Granulometry, (using Matlab software).
2 laboratory works in signal processing, Thermal analysis, Data digitising (using Labview software)

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization : 4 laboratory works with 3.5 hour duration.
Pedagogical resources : photocopied course document downloadable from Arche web portal, quizzes
Assessment : 2 Written laboratory reports ; 2 image processing with Matlab and quizzes

Student's expected work in autonomy:

Written laboratory reports
Preparatory work about image processing vocabulary
courses review

Bibliographic references:

Georges Bonnier Eric Devin, "Couples thermoélectriques", Techniques de l'ingénieur ; Stéphane Durand, "Capteurs de déplacement", Techniques de l'ingénieur ; Georges Asch et all., "Les capteurs en instrumentations industrielles ", édition Dunod ; Pascal Dassonvalle, "Les capteurs", édition Dunod.
Georges Matheron and Jean Serra online courses ; Diane Lingrad, "Introduction au traitement d'images", 2ème édition, Vuibert, 2008 ; Michel Schmitt and Juliette Mattioli, "Morphologie mathématique", Presses des Mines, Paris, 2013 ; Laurent Najman and Hugues Talbot, "Morphologie mathématique 1 : approche déterministe", Lavoisier, 2008.

Other EEIGM courses directly linked to this course:

Upstream: Partial Differential Equations, Descriptive and inferential statistic, Statistical modeling, Signal processing

Downstream: Project : metallic materials, Process Engineering Practical Works

<table>
<tr><td rowspan="2">Teaching Unit:
OPTION MATERIALS FOR MOBILITY</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: I. ROYAUD</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 20</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>20</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work: 7</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to understand the challenges of the transport industries, biodegradable and biosourced materials and the energy performance of materials as well as sensors and signal processing in the field of mobility.

Syllabus:

(i) Introductory course to the Materials for Mobility Option - Issues, General, 1 lecture (ii) Module 2.1 - Course on biodegradable, biosourced, biopolymer polymers (Anne Jonquières, 10 lectures, 8 lectures) which addresses the issue the development of bio-sourced and/or biodegradable polymers. The first part of the course describes the main polymer materials of natural origin used in industry (natural rubber, cellulose and derivatives, starch, polyesters of bacterial origin and materials based on proteins), their strong specificities and their impact on their Implementation. The second part presents the different industrial approaches to produce plastics with less environmental impact from a perspective of innovation for sustainable development. The supposedly photo-biodegradable hydrocarbon polymers and the main biodegradable polymers developed are described, as well as their prospects and the associated technical and economic issues. (iii) Module 3.2 - Energy performance: Polymer alloys, composites, foam, foaming processes (Guo-Hua Hu, 5h, 4 lectures): This course presents polymer blends, a polymer that contains a mechanical reinforcement and/or functional and a polymer that contains air bubbles. It addresses the properties, production processes and industrial applications of these materials in relation to mobility. (iv) Module 3.3 - Mechatronics, smart mobility, sensors, signal processing (Yves Granjon and Christian Daul, 3.75h, 3 lectures): Measurement, transport and processing of heterogeneous information in mobile systems.

Pedagogical procedures (organization, assessment, pedagogical resources):

Module 2.1: several case studies and consultation of many site pages and videos of leading manufacturers in the field. The control will be done via case studies with documents. Module 3.2 : classic exam, Module 3.3: Case study supervised with an application serving as a guideline. A single grade will be given for the Materials for Mobility option in 3A: 1 single exam (1h15).

Student's expected work in autonomy:

Module 2.1: The student will be interested in the different current applications that involve biopolymers/biodegradable polymers (examples described in class or personal experience). Module 3.2: Research on examples of industrial applications of polymer blends and polymer foams. Module 3.3: File to read and preparation for the sessions.

Bibliographic references:

Initiation à la chimie et à la physico-chimie macromoléculaires, Volume 13 : les polymères naturels : structure, modifications et applications, Ouvrage collectif du Groupe Français d'Etudes et d'Applications des Polymères (le GFP : www.gfp.asso.fr), 2000. S. A. Ashter, Introduction to Bioplastics Engineering, Elsevier, Amsterdam, 2016.Cottet Francis, Traitement des signaux et acquisition de données, 1997, Dunod, Georges Ash, Les capteurs en instrumentation industrielle, 5ème édition, Dunod, Paris, 1998

Other EEIGM courses directly linked to this course:

Upstream: Lectures on metallic materials, physics, chemistry, composites, macromolecular chemistry, physics of polymers

Downstream: Industrial and/or research projects

<table>
<tr><td colspan="2">Teaching Unit:
THEME 1-ELECTIVE COURSE : MATERIALS FOR ENERGY</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: R. PRIVAT</td></tr>
<tr><td colspan="2">EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="2">Teaching method: Academic</td><td colspan="5">In-person classes: 8.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td>8.75</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☐ C8</td><td colspan="5">☒ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to describe the energy conversion processes of the industrial sector, analyze the different types of of energies involved in energetic conversions, to understand and describe electrical production processes starting from various sources (renewable or not, carbonated or not).

Syllabus:

A- General introduction (1 lecture)
B- Physics of energy conversion (3 lectures)
C- Electrical production processes from various sources of primary energies (3 lectures)

Pedagogical procedures (organization, assessment, pedagogical resources):

Classical teaching, written exam

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Chemical reaction engineering, Flow and transfer, Thermodynamics

Downstream: Option materials for energy other themes and 4th year lectures and project.

Teaching Unit: THEME 2 MATERIALS FOR ENERGY PRODUCTION (CONVERSION), STORAGE AND TRANSPORT_ELECTIVE COURSE MATERIALS FOR ENERGY	Year/Semester of EEIGM studies: 3A - 2nd semester
	Course manager: **D. HORWAT**
EEIGM Department: Engineering sciences	**Hours/student:**
Teaching method: Academic	**In-person classes:** 8.75
Assessment: Classic	Lecture: 8.75 / Tutorial / Lab work / Project / Test
	Autonomous work: 6

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☒ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to understand the challenges and concepts of conversion of solar energy into electricity or heat as well as the implementation, architecture and operation of the associated devices. He/she will also understand the physical concepts related to the transport of electricity as well as the logic underlining the structure of electrical conductor materials.

Syllabus:

A- Production/Conversion
Solar thermal (2 lectures) - Principles, devices and materials
Solar Photovoltaic (4 lectures) - Principles, devices and materials

B- Transport/regulation of energy
Notions about the physics of electricity transport (1 lecture) –
Structure and materials of electrical conductors (1 lecture) –
Conductor insulation (1 lecture) –

Pedagogical procedures (organization, assessment, pedagogical resources):

Classical teaching and test

Student's expected work in autonomy:

Work on understanding concepts, processes and origin of properties

Bibliographic references:

NREL chart of best efficiency cells, scientific articles

Other EEIGM courses directly linked to this course:

Upstream: Structure and structural defects, cristalline structures, Physical properties of materials, cristallography

Downstream: Theme 2 Materials for energy production (conversion), storage and transport_Option materials for energy (4th year), project materials for energy, semester 8

Teaching Unit: ELECTIVE COURSE MATERIALS FOR HEALTH. THEME 1	Year/Semester of EEIGM studies: 3A - 2nd semester
	Course manager: **J-L. SIX**
EEIGM Department: Engineering sciences	Hours/student:
Teaching method: Academic	In-person classes: 20
Assessment: Classic	Lecture: 18.75 / Tutorial: / Lab work: / Project: / Test: 1.25
	Autonomous work: 20

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to master the basic notions of the biological functioning of a cell, of different tissues constituting our organism; and the biomechanics of selected living tissues. Signal (light) and image processings will be applied to the skin to map surface cancers.

Syllabus:

-Living tissues and global functioning of the organism (7 lectures): Presentation of a living cell and its functioning. Description of epithelial, connective, muscular and nervous tissues. Introduction of the concept of immunity.
-Biomechanics/Mechanical behavior of living tissues (5 lectures): Presentation of the proposed models and behavior laws, of the developed experimental protocols to characterize the mechanical properties of living tissues. Description of non-invasive in vivo approaches and ex vivo tests performed on biological samples. Extension to the characterization of these living tissues in their physiological context.
-Signal and image processing applied to the biomedical field (3 lectures): mapping of different skin cancers by associating image processing algorithms of this tissue, with its properties of absorption, diffusion and reflection of light.

Pedagogical procedures (organization, assessment, pedagogical resources):

Resources: 1 course handout.
Evaluation: 1h15 test.

Student's expected work in autonomy:

At regular intervals, student has to review and learn lectures.

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Mechanics of materials 1. Mechanics of materials 2. Signal processing.

Downstream: Materials for health. Axis 2. Materials for health. Theme 3

Teaching Unit: MECHANICS OF MATERIALS 2 (MM2)	Year/Semester of EEIGM studies: 3A - 2nd semester				
	Course manager: **Z. AYADI**				
EEIGM Department: Structural and functional properties of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 30				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	13,75	13,75			2.5
	Autonomous work: 15				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☒ C6 ☒ C7 ☒ C8	☒ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should have acquired the basic knowledge to understand, analyze and solve a plasticity problem in order to predict the consequences on the process of shaping materials. Define the appropriate stress and strain measurements, the characteristic experiments, the information to be analysed, the parameters on which t the material behavior depend, the necessary elements to build an elastoplastic behavior law with hardening. To be able to use an industrial Finite Element Analysis software to study plasticity problem (compared to the real problem, to the assumptions,...). An inductive approach to plasticity in material mechanics by implementing the steps: observation, experiment, results, interpretation, assumptions, modeling, comparison of predictions with reality, conclusion

Syllabus:

Introduction of Mechanics of Continuous Media tools for the study of plasticity - implementation of the measurement of suitable strain tensor for plasticity - Large deformations - introduction of the measurement of stress tensor adapted to plasticity - Main mechanical tests - Experimental characterization of plasticity (Information to be used from the experiment, yield stress, hardening, ...) - Main parameters affecting the elastoplastic behavior - Criteria of plasticity - Load function - Example of construction of elastoplastic constitutive law - determination of the constitutive law parameters - Particular case of the plasticity of the beams.

Pedagogical procedures (organization, assessment, pedagogical resources):

Students are informed during the first lecture of the organization, progress and evaluation of the module 1 : Intermediate exam and 1 Final exam, during the exam the documents, programmable calculators and cell phones are not allowed. The non respect of these instructions constitutes fraud. Teachers involved in tutorials will rotate in the different exercises groups as far as possible. Arch educational platform: The course handout (with holes), exercises and solutions are available on this teaching platform.

Student's expected work in autonomy:

To participate in all the sequences of the module (lecture tutorials, exercises and numerical mechanics FEM) Review in the following order: understand the lecture, doing the main exercises and some other problems

Bibliographic references:

A list of books available in libraries is offered in the first lecture. Useful links on the arche teachning platform: other exercises, other lectures, ...

Other EEIGM courses directly linked to this course:

Upstream: RDM, MSD, MM1 Downstream: MM3,SDS

<table>
<tr><td colspan="2">Teaching Unit:
MATERIALS CHARACTERIZATION LAB COURSES</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st and 2nd semesters</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: J. ZOLLINGER</td></tr>
<tr><td colspan="2">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 28</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>☐</td><td>☐</td><td>28</td><td>☐</td><td>1.25</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:8</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should know the basic materials characterization techniques, ranging from physical principle to their potential applications.

Syllabus:

This lab course revolves around 8 stations, each dedicated to a technique: mechanical (tensile test, hardness, charpy), thermal (DSC, Dilatometry), structural (X-ray diffraction, Raman spectrometry, crystallization), chemical (SEM-EDS) will be discussed, each time for the different classes of materials such as polymers, ceramics and metals.

Pedagogical procedures (organization, assessment, pedagogical resources):

The practical work takes place over 3h30 slots, and students are invited to prepare for the work in advance by reading the documents available. This practical work will be assessed by a final test of 1h15. For each practical work, documentation is made available on the Arche page of the course and available in the practical work room.

Student's expected work in autonomy:

Preparation of sessions (reading of the subject and associated documents) and preparation of reports of the sessions in order to keep track of the work carried out to better prepare the final test.

Bibliographic references:

Cahn, R. W., Kramer, E. J., Lifshin, E., & Haasen, P. (Eds.). (1994). Characterization of Materials: Part II. VCH.
Documents available on the course site.

Other EEIGM courses directly linked to this course:

Upstream: All materials courses

Downstream: 4Y Materials Projects

Teaching Unit: POLYMER CHEMISTRY	Year/Semester of EEIGM studies: 3A - 2nd semester				
	Course manager: **J-L. SIX**				
EEIGM Department: Elaboration and processing of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 37.5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	18.75	16.25			2.5
	Autonomous work: 28				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to understand the differences between chain polymerizations (radical and ionics) and step polymerizations (polycondensation). He/she will know chemical, thermodynamical and kinetics aspects of all poylmerization techniques and would be able to list the advantages/drawbacks of each technique to obtain desired polymer.

Syllabus:

This teaching unit will be divided into 6 parts and illustrated during lectures and tutorial classes:
- Generalities
- Radical Polymerization
- Copolymerizations
- Ionic Polymerizations
- Stereospecific Polymerizations
-Polycondensations (step-polymerizations)

Pedagogical procedures (organization, assessment, pedagogical resources):

Pedagogical Resources: 1 handout
Assessment : 2 tests (1h15 each test)
The final mark will be the average of these two tests

Student's expected work in autonomy:

At regular intervals, student has to review and learn lectures and tutorials to avoid the confusion between each polymerization techniques that are characteristic with particular kinetics and issues

Bibliographic references:

Hamaide T., Fontaine L., Six JL., Chimie des Polymères. Exercices et Problèmes corrigés 2nde édition, 2014, Lavoisier
Fontanille M., Gnanou Y., Chimie et physico-chimie des polymères 3ème édition, 2014, Dunod

Other EEIGM courses directly linked to this course:

Upstream: Organic chemistry I, Organic chemistry II, Chemical kinetics, , Chemical thermodynamic, Organic chemistry praticals, Organic chemistry III.

Downstream: Pratical Experiments on Elaboration and processing of materials, Degradation and Stabilisation of Polymers, Composite materials with polymer matrix: Synthesis, processing and properties in use, Polymer reaction engineering , Biopolymers and Biodegradable Polymers, Biomedical Applications of Polymers, Functional Polymers

<table>
<tr><td colspan="2">Teaching Unit:
PHASE TRANSFORMATION AND ADDITIVE MANUFACTURING</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: J. ZOLLINGER</td></tr>
<tr><td colspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 32.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>15</td><td>15</td><td></td><td></td><td>2.5</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to understand the kinetics of phase transformations in metallic materials and apply them to a wide range of industrial processes, including welding and additive manufacturing

Syllabus:

The course is divided into three parts articulated around the kinetics of phase transformations:
- Basic knowledge: nucleation & crystal growth during solidification and in solid state transformations, kinetic modifications of the phase diagram
- Assembly: kinetic aspects of brazing and welding
- Additive manufacturing: out-of-equilibrium phenomena, selection of microstructures

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: Lectures and Tutorials
Resources: 1 course handout, course transparencies, 1 tutorial handout.
Evaluations: Two 1h15 tests.

Student's expected work in autonomy:

Reading of course documents, preparation of tutorials, reading of bibliographic references.

Bibliographic references:

Porter, D. A., Easterling, K. E., & Sherif, M. (2009). Phase transformations in metals and alloys (Revised Reprint). CRC press.
Kurz, W., & Fisher, D. J. (1989). Fundamentals of solidification.

Other EEIGM courses directly linked to this course:

Upstream: Atomic diffusion, Structures and structural defects, Phase diagrams

Downstream: Practicals of Preparation and processing of materials, Metallic Materials Projects.

Teaching Unit: **PRACTICAL EXPERIMENTS ON ELABORATION AND PROCESSING OF MATERIALS**	**Year/Semester of EEIGM studies:** 3A - 1st and 2nd semesters
	Course manager: **J-L. SIX**
EEIGM Department: Elaboration and processing of materials	**Hours/student:**
Teaching method: Academic	**In-person classes:** 21
Assessment: Classic	**Autonomous work:** 6

Lecture	Tutorial	Lab work	Project	Test
		21		1.25

Generic EEIGM competencies	**Specific EEIGM competencies**
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**

Educational objectives of the course:

At the end of the course, the student should understand the elaboration of metallic and polymeric materials using various industrial processes and the physical-chemistry of these materials.

Syllabus:

These practical experiments will be done during the third year of EEIGM. There will be:
A) 4 experiments on Polymers Chemistry and Polymers Physico-Chemistry:
• Anionic Polymerization and Radical Suspension Polymerization
• Emulsion Radical Copolymerization
• Size Exclusion Chromatography
• Viscosimetry of Polymeric Solutions
B) 2 experiments on Metallurgy
Preparation, treatment and properties of aeronautics aluminium alloys
Secondary hardening treatments in high performances steels.

Pedagogical procedures (organization, assessment, pedagogical resources):

Pedagogical Resources: 1 handout "Pratical Experiments on Polymer Chemistry and Polymer Physico-Chemistry" + 1 handout "Metallurgy"
Assessment: 1 test (1h15) "Pratical Experiments on Polymer Chemistry and Polymer Physico-Chemistry" + evaluation of practical reports on "Metallurgy"
The final mark will be the weighted average of these two tests (2/3 for polymers; 1/3 for metallic materials).

Student's expected work in autonomy:

With the notes taken during your practical experiments, you will remember and review

Bibliographic references:

Hamaide T., Fontaine L., Six JL., Chimie des Polymères. Exercices et Problèmes corrigés 2nde édition, 2014, Lavoisier
J. Barralis, G. Maeder, Précis de Métallurgie, Élaboration, structures-propriétés, normalisation, Edition 2005, Précis-Afnor Nathan

Other EEIGM courses directly linked to this course:

Upstream: Polymer Chemistry, Structure and structural defects, Phase transformations….

Downstream: Degradation and Stabilisation of Polymers, Composite materials with polymer matrix: Synthesis, processing and properties in use, Functional Polymers, Metallic Materials Projects….

<table>
<tr><td rowspan="2">Teaching Unit:
DIVIDED SOLIDS</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: M-O. SIMONNOT</td></tr>
<tr><td>EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 22.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>11.25</td><td>10</td><td></td><td></td><td>1.25</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: about 20 h</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to master the basic notions on the behaviour of granular solids, interpret the granulometric data which allow to qualify a powder and choose a measuring method, and finally understand the basics of processes which involve divided solids.

Syllabus:

This module covers both process engineering and materials development (ceramics, metals, polymers). It illustrates, with the help of some significant and industrially important cases, operations or elements of processes involving divided solids.

After a general introduction on divided solids, this course presents first the methods of characterization of divided solids taken individually or within a batch (powder, heap). The course focuses on particle size and morphology, detailing methods of particle size measurement, interpretation of distribution curves and means and medians. The modification of a population by grinding and selection is then studied. The next step is the characterization of surface properties and interactions with solutes, first adsorption from the gas phase or from the liquid phase, then colloidal suspensions. An overview of the behavior of dry granular systems is then given and we end with unit operations specific to powders, more specifically on powder mixing.

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: the module includes 9 lectures, 8 tutorials (in groups)
Evaluation: self-assessment tests on the Arche digital platform and a final test of 1h15 (classic evaluation).
Teaching resources: course handouts, additional documents, video links, addresses of training sites available on Arche, books in the library

Student's expected work in autonomy:

Work on the course before/after sessions - prepare/review exercises - do self-assessment tests - read additional resources

Bibliographic references:

Techniques de l'ingénieur
Ring T.A. Fundamentals of ceramic powder processing and synthesis. Academic Press, San Diego 1996
Cours en ligne http://nte.enstimac.fr/STP/co/STP_web.htm

Other EEIGM courses directly linked to this course:

Upstream: Descriptive and Inferential Statistics, Statistical Modelling, Chemical Reaction Engineering

Downstream: Ceramics 1: elaboration and shaping, Ceramics 2: properties and applications, Practical work in Process Engineering, Effluent and waste treatment, Fate of glass and composites, Projects, Training courses, Internships

Teaching Unit: **SEPARATIONS ENGINEERING**	**Year/Semester of EEIGM studies:** 3A - 2nd semester
	Course manager: **V. VITZTHUM**
EEIGM Department: Elaboration and processing of materials	**Hours/student:**
Teaching method: Academic	**In-person classes:** 17.5
Assessment: Classic	Lecture: 7.5 / Tutorial: 8.75 / Lab work: / Project: / Test: 1.25 **Autonomous work:** 5

Generic EEIGM competencies	**Specific EEIGM competencies**
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**

Educational objectives of the course:

At the end of the course, the student should be able to (partially) size the unit operations of liquid-liquid extraction, binary distillation and drying, and he will know how they work. To do this, he will be able to write the material balances and the energy balances, and to solve them.

Syllabus:

The most important part of the course lies in the writing of material balances, energy balances as well as in the coupling of these, applied to diffusional separation operations (liquid-liquid extraction, binary distillation and drying). In addition to the methodological aspect, these unit operations are described and application examples are discussed. Some elements of technology are also developed.

Pedagogical procedures (organization, assessment, pedagogical resources):

The course consists of 6 lectures and associated tutorials: 2 lectures on liquid-liquid extraction, 2 lectures on binary distillation and 2 lectures on drying. The module is assessed through a 1h15 test. The slides of the lectures are available.

Student's expected work in autonomy:

Reread the lectures before tutorials and prepare the exercises

Bibliographic references:

Techniques de l'ingénieur

Other EEIGM courses directly linked to this course:

Upstream: Thermochemistry, Heat transfers, Chemical Reaction Engineering

Downstream: Process Engineering lab work, Metallic materials elaboration process

Teaching Unit: PROCESS ENGINEERING PRACTICAL WORKS	Year/Semester of EEIGM studies: 3A - 1st and 2nd semesters
	Course manager: **B. LAUBIE**
EEIGM Department: Elaboration and processing of materials	**Hours/student:**
Teaching method: Academic	**In-person classes:** 29.25
Assessment: Classic	**Autonomous work:** 15

Lecture	Tutorial	Lab work	Project	Test
		28		1.25

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8	☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to identify the main Unit Operations of Process Engineering and explain how they work, formulate the corresponding phenomenological laws and the main steps of the sizing procedures.

Syllabus:

Application of the theories and methods of the Process Engineering courses: Chemical Reaction Engineering, Flow and Transfers, Separation Engineering, Divided solids.
Pilot plants : Residence Time Distribution - Kinetic study in a semi-industrial reactor - Distillation - Study of stirring and mixing process -Pumps - Flow rate meters and Pressure drop - Heat exchanger - Particle size distribution by sieving - Lost-wax casting - Melting flow index measurement

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: Eight 3.5-hours practical works - Work in group of 2 or 3 students.
Assessment: The writing of 4 practical reports,which are assessed (50% of the final grade), is compulsory. The marks also take into account the preparation homework and the behaviour of the student in the lab. The students are also assessed by an individual written exam (50% of the final grade) about the 4 other practical works.
Pedagogical resources: Workbooks are lent to the students in the lab and they are also available on ARCHE web-portal.

Student's expected work in autonomy:

The students must read the workbook before coming in the lab, and answer the theory questions.

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Heat transfer, Chemical reaction engineering, Flows and transfer, Laboratory work : measurement and data interpretation

Downstream: Separation process engineering, Divided solids, Solid and liquid waste management, Ecodesign

<table>
<tr><td rowspan="2">Teaching Unit:
PROFESSIONAL PROJECT (ATI, GAIA, PDE)</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 1st and 2nd semesters</td></tr>
<tr><td colspan="5">Course manager: V. VITZTHUM</td></tr>
<tr><td>EEIGM Department: Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td></td><td>75</td><td></td></tr>
<tr><td>Assessment: Competencies approach</td><td colspan="5">Autonomous work: 75</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☒ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to immerse him/herself in a completely new project problem, manage a project and play an expert role. He/she will be able to quickly acquire new knowledge, carry out the necessary literature research and synthesize documents, acquire new working methods, organize him/herself and plan his/her work in order to implement the actions and solutions necessary to achieve the objectives of specifications that he/she will have helped to set. He/she will be able to seek innovative solutions, reason on applied problems while taking into account the constraints, work in a team, communicate on a scientific and technical level with all the actors of the project (students, teachers, industrial partners, external experts).

Syllabus:

Students must choose a project topic among the three types of projects:
ATI: Transfer and Innovation Workshop. These projects are based on a real professional and / or industrial issue raised by an industrial partner. They first carry out documentary research, then, depending on the subject, the work gives rise to experiments or calculations carried out at school or in a research laboratory.
GAIA: The GAIA workshops are a joint educational program with ENSA (National School of Architecture), EEIGM and ENSGSI (National School of Systems and Innovation Engineering) which aims to promote cooperation between the University and the Companies around concrete projects. These challenges are part of the ATI system but further expand the number of partners involved in the project.
PDE: These projects aim to promote EEIGM, Materials Engineering and Science among school audiences and students (schoolchildren up to post-baccalaureate), the general public, local businesses and Former Students.
Support training:
Prior to these projects, students follow a 1h15 course in bibliographic research, and in parallel training in writing a scientific report, writing a bibliography and oral presentation.
The "project" groups are also monitored by the manager of the "Project Management" course in order to help them to apply the concepts seen in the lecture and to support them in the overall organization of the project.

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: collaborative work within a group of varying size (3 to 6) depending on the project, at the rate of half a day per week; it is headed by one or more tutors during regular meetings. An appointment is scheduled with the project management teacher.
Assessment: final oral defense (20% of the final mark), final report (20% of the final mark), project management (60% of the final mark) - Educational resources: Project Management course

Student's expected work in autonomy:

Autonomous work guided by the tutor during meetings whose frequency is defined by the tutors and students.

Bibliographic references:

De la gestion de projet au management par projet : maîtriser les risques d'une organisation transversale. (AFNOR, DL 2002), Muller, J.L. - Conduite et gestion de projets : principes et pratiques pour petits et grands projets, Chvidchenko I., Chevallier J., Cépaduès-éd, 1993
Toutes les ressources de l'université (articles scientifiques, Techniques de l'Ingénieur, bases de brevets etc.).

Other EEIGM courses directly linked to this course:

Upstream: Writing workshops, Orthodidacte, Project management, Financial management

Downstream: Research internship, Industrial internship

Teaching Unit: PROFESSIONAL AND PERSONAL PROJECT	Year/Semester of EEIGM studies: 3A - 1st and 2nd semesters				
	Course manager: **F. PAUL-CAVALLIER**				
EEIGM Department: Development and research	**Hours/student:**				
Teaching method: Active Learning	**In-person classes:** 5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Competencies approach	2.5	2.5			
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☒ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☒ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to:

- Identify the tracks of his/her professional project
- Prepare and choose his/her orientation
- Practice job interviews

Syllabus:

- MD1: Start a reflection on a project
  - Part 1: where to start
  - Part 2: how to organize
  - Part 3: what to do

TD 1: Use of tools
- CV + SWOT and Professional Projection
- Your research agents
- Your Linkedin or Viadeo account

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization

2 lectures (MD1 and MD2) with exercises in the form of online quiz (googleForm)
4 groups for tutorials
Several groups of 4 people for tutorials (optional)
Possible meeting by reservation for individual adjustments after each session

Resources

PPT for theoretical contributions
Mobile or laptop with internet connection for exercises and tutorials
PDF supports to carry out some exercises or to prepare oneself for job interviews
Interviews can be filmed

Evaluation

Attendance at compulsory lectures and tutorials (List of students / list of those present)
Assessment

Student's expected work in autonomy:

Prepare your CV and cover letter
Go into the materials produced online in depth
Identify one or more job advertisements
Search for company information
Prepare for job interviews

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
INDUSTRIAL CONFERENCES AND TOURS</td><td colspan="5">Year/Semester of EEIGM studies: 3A – 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: Z. AYADI and J. ZOLLINGER</td></tr>
<tr><td colspan="2">EEIGM Department:
Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="2">Teaching method: Active Learning</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td colspan="2" rowspan="2">Assessment:</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐C7 ☐ C8</td><td colspan="5">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Completing the training and bringing a different lignt by professionals. Narrow contact between students and profesionnals. Participation of the companies and the socio-economic environment in the training.
They also constitute an important opportunity to take advantage of internship or job offers and make the link between the courses at EEIGM and the industrial needs in materials engineering.

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

The conferences are usually scheduled on Wednesdays from 11h15 to 12h30. It is mandatory for the students to attend the conferences by which they are concerned. The tours are scheduled on Thursdays afternoon:

– 20 to 30 seats / tour
– Registration on Arche

Before the tour:

• Preparation of tour (informations about the company)
• Setting up thematic groups

After the tour :

• Report

Student's expected work in autonomy:

• Parts of the report
– presentation of the company: products, strategy, technology, etc.
– Work done by the engineers in this company ?
– Health and safety
– Input of EEIGM skills

Bibliographic references:

Arche: Direction of partnerships

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
FRENCH AS A FOREIGN LANGUAGE VI</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: K. HENRY</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 30</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>30</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 6</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to take the DELF B2 or DALF C1 exams, exams for which he will have received intensive preparation.
He will be able to understand and use the language with greater ease and spontaneity, on familiar or unfamiliar subjects, concrete or more abstract, even complex. The skills of comprehension and expression, both oral and written, will be strengthened.

Syllabus:

Discovery of the methodology and training for the DELF B2 or DALF C1 tests. Deepening of skills (CO, CE, EO, EE) to meet the expectations of the exam.

Pedagogical procedures (organization, assessment, pedagogical resources):

Distribution of students in groups according to the level obtained at the end of the previous semester and the targeted examination.
Assessment based on attendance, class participation, personal work provided to pass the exam (rendering of written productions, simulations of the oral test)
The materials used in class are examples of tests.
DELF/DALF mock exam during the semester.

Student's expected work in autonomy:

Complementary exercises: other tests; written production exercises; preparation of presentations.

Bibliographic references:

The www.ciep.fr site; books "Réussir le DELF B2" and "Réussir le DALF C1", Didier editions; "Preparation à l'examen du DELF B2", Hachette editions

Other EEIGM courses directly linked to this course:

Upstream: FFL V

Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
ENGLISH VI</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: N. BRIE</td></tr>
<tr><td colspan="2">EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 26.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>26.25</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☐ C2 ☐ C3 ☒ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to obtain his/her mandatory FCE, CAE or CPE Cambridge examination.

Syllabus:

One group (B1/B2 level) follows a 26.25-hour course : consolidation of vocabulary and grammar, improvement of the students' level in the four skills: written expression, oral expression, written comprehension, oral comprehension. This group will follow an intensive FCE preparation course in 4th year.
The other groups (B2/C1/C2 levels) follow a 26.25-hour intensive course preparing for the June session of the FCE, CAE or CPE examinations.

Pedagogical procedures (organization, assessment, pedagogical resources):

FCE/CAE/CPE past exams and practice tests for B2/C1/C2 levels
Authentic documents from the Anglo-Saxon media
Continuous assessment on FCE or CAE papers at B2/C1 levels

Student's expected work in autonomy:

FCE/CAE/CPE past exams and practice tests for B2/C1/C2 levels
Authentic documents from the Anglo-Saxon media
Continuous assessment on FCE, CAE or CPE papers at B2/C1/C2 levels

Bibliographic references:

Grammar for FCE/CAE/CPE
Vocabulary for FCE/CAE/CPE
FCE/CAE/CPE practice tests

Other EEIGM courses directly linked to this course:

Upstream: V 26.25 Downstream: VII

Teaching Unit: **SPANISH 6 BEGINNERS**	**Year/Semester of EEIGM studies:** 3A – 2nd semester				
	Course manager: **C. SAVARD-CHAMBARD**				
EEIGM Department: European languages and cultures, SEHS	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 37.5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic		37.5			
	Autonomous work: 3 h per week				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☒ **SC6**				

Educational objectives of the course:

At the end of the course, the student should have acquired basic notions to understand and be understood in situations of everyday life. Levels to achieve A2 to B1 (self-assessment grid European Framework

Syllabus:

Acquisition of basic knowledge and skills necessary to understand and express oneself both orally and writing

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students)
Continuous assessment: evaluation of the 5 language skills
Studies of Spanish press articles and use of texts and audio recordings available on the Cervantes Institute web-site

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Prepare oral presentations on everyday life topics
Use of the resources of the library and language lab

Bibliographic references:

Class workbook: Campus Sur A1-A2 Libro del alumno y Cuaderno de ejercicios, Difusión, 2019
Grammar book: Competencia gramatical en uso, Nivel A2, Edelsa, Madrid, 2008
Bilingual dictionary Larousse
Vocabulary book: Maribel Molio, 60 fiches de vocabulaire espagnol, Studyrama, Paris, 2012
Conjugation book: Bescherelle, El arte de conjugar en español

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:** Spanish 7

<table>
<tr><td rowspan="2">Teaching Unit:
SPANISH 6 LV2 OR LV3</td><td colspan="5">Year/Semester of EEIGM studies: 3A – 2nd semester</td></tr>
<tr><td colspan="5">Course manager: C. SAVARD-CHAMBARD</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>18,75 Niveaux B2 et + 26,25 Niveaux A2, B1et Prepa DELE (LV2-LV3)</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 3 h per week</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to depending on the groups, prepare for the Spanish DELE examination (B2, C1 or C2 levels) or reason by oneself on current topics, personal or professional interest

Syllabus:

For students preparing the DELE: training written and oral tests
For other students: consolidation and enrichment of knowledge and skills on current topics and professional issues

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students)
Continuous assessment: past DELE examinations B2 level + 2 DELE mock exams
Continuous assessment: evaluation of the 5 language skills
Past DELE examinations
Class workbooks: 1/ and 2/ Al dí@: curso intermedio de español para los negocios, Libro del alumno y Cua-derno de ejercicios, SGEL, Madrid, 2010

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Training past DELE examinations
Prepare oral presentations on social or current topics
Use of the resources of the library and language lab

Bibliographic references:

Workbooks: 1/ 1/ Las claves del nuevo C1, Difusión, 2016; 2/ C de C1. Curso de español de nivel superior, Difusión, 2019; 3/ Preparación al Diploma de Español, Nivel B2, Edelsa, 2018
Grammar books: 1/ Las 500 dudas más frecuentes del español, Espasa Calpe, 2019; 2/ Competencia gramati-cal en uso Nivel B2, Edelsa, Madrid, 2014
Dictionaries: 1/ Le vocabulaire de l'espagnol, Hachette, Paris, 2010; 2/ Diccionario de la lengua española, Real Academia Española, Madrid, 2012
Vocabulary book: 100 fiches de vocabulaire espagnol, Studyrama, Paris, 2010
Conjugation book: Bescherelle, El arte de conjugar en español

Other EEIGM courses directly linked to this course:

Upstream: Spanish 5 Downstream: Spanish 7

Teaching Unit: GERMAN VI 16	Year/Semester of EEIGM studies: 3A - 2nd semester
	Course manager: **P. BEYER**
EEIGM Department: European languages and cultures, SEHS	**Hours/student:**
Teaching method: Academic	**In-person classes:** 16.25

Lecture	Tutorial	Lab work	Project	Test
	16.25			

4Assessment: Classic	**Autonomous work:** 4

Generic EEIGM competencies	Specific EEIGM competencies
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☒ **SC6**

Educational objectives of the course:

At the end of the course, the student should be able to practice German with the level B1+ or B2 ("Independent User"), or C1 or C2 (Proficient User") of the Common European Framework of Reference for Languages (CEFR).

Syllabus:

Consolidation and enrichment of the language.
Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").
In-depth knowledge of the realities of the German speaking countries.
Possibly and depending on the level of the group, introduction to scientific, technical and/or commercial German.
Help in finding the stay in a German speaking country.

Pedagogical procedures (organization, assessment, pedagogical resources):

Working in groups according to the level.
Continuous assessment.
Use of course books, original documents and on-line resources.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

https://www.goethe.de/de/spr/kup/prf/prf.html
https://www.dw.com/de/deutsch-lernen/lernangebote-f%C3%BCr-das-niveau-b2/s-13217
"Begegnungen B1+", Schubert
"Erkundungen B2", Schubert
"Studio B2/C1", Cornelsen
"Ziel B2/C1", Hueber

Other EEIGM courses directly linked to this course:

Upstream: German V 19

Downstream: German VII

Teaching Unit: GERMAN VI 28	Year/Semester of EEIGM studies: 3A - 2nd semester
	Course manager: **P. BEYER**
EEIGM Department: European languages and cultures, SEHS	Hours/student:
Teaching method: Academic	In-person classes: 28
Assessment: Classic	Lecture: — / Tutorial: 28 / Lab work: — / Project: — / Test: —
	Autonomous work: 5

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

At the end of the course, the student should
be able to practice German with the level A2 ("Basic User") of the Common European Framework of Reference for Languages (CEFR).

Syllabus:

Consolidation and enrichment of the language.
Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").
Introduction to the realities of the German speaking world.
Help in finding the stay in a German speaking country.

Pedagogical procedures (organization, assessment, pedagogical resources):

Continuous assessment.
Use of course books, original documents and on-line resources.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

"Menschen A2", Hueber
"Studio A2", Cornelsen

Other EEIGM courses directly linked to this course:

Upstream: German V 26

Downstream: German VII

<table>
<tr><td rowspan="2">Teaching Unit:
GERMAN VI 38</td><td colspan="5">Year/Semester of EEIGM studies: 3A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: P. BEYER</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 37.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>37.5</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to practice German with the level A1 ("Basic User") of the Common European Framework of Reference for Languages (CEFR).

Syllabus:

Introduction to the German language.
Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").
Introduction to the realities of the German speaking world.
Help in finding the stay in a German speaking country.

Pedagogical procedures (organization, assessment, pedagogical resources):

Continuous assessment.
Use of course books, original documents and on-line resources.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

"Menschen A1", Hueber
"Studio [21] A1", Cornelsen

Other EEIGM courses directly linked to this course:

Upstream: German V 38 Downstream: German VII

4th year

[SEMESTER 7]

TEACHING UNITS	ECTS	Lectures (hours)	*Lectures (numbers)*	Tutorials (hours)	*Tutorials (numbers)*	Lab work (hours)	*Lab work (numbers)*	*Tests (numbers)*	*Contrôles (séances)*	In-Person classes	Teachers
EEIGM Department: Engineering sciences	**3**	**10,00**		**16,25**		**0,00**		**3,75**		**30,00**	
Mechanics of Materials III *	1,5	1,25	1,00	13,75	11,00	0,00	0,00	2,50	2,00	17,50	Z. AYADI
Industrial safety and security	1,5	8,75	7,00	2,50	2,00	0,00	0,00	1,25	1,00	12,50	V. VITZTHUM
EEIGM Department: Structural and functional properties of materials	**5**	**42,50**		**11,25**		**5,00**		**2,50**		**61,25**	
Composite materials: mechanical behavior	2,5	12,50	10,00	8,75	7,00	5,00	4,00	1,25	1,00	27,50	L. TERREI
Elective courses (Materials for Energy, Materials for mobilities, Materials for Health)	1	20,00	16,00	0,00	0,00	0,00	0,00	0,00	0,00	20,00	J-L. SIX (Health) - D. HORWAT (Energy) - I.ROYAUD/T. CZERWIEC(Mobilities)
Composite materials with polymer matrix: Synthesis, Processing and Properties in use *	1,5	10,00	8,00	2,50	2,00	0,00	0,00	1,25	1,00	13,75	I. ROYAUD
EEIGM Department: Elaboration and processing of materials	**6**	**51,25**		**6,25**	**5,00**	**0,00**		**5,00**		**62,50**	
Polymer Processing I *	1,5	6,25	5,00	6,25	5,00	0,00	0,00	1,25	1,00	13,75	G.H. HU
Ceramics *	2	15,00	12,00	0,00	0,00	0,00	0,00	2,50	2,00	17,50	D, HORWAT
Elective courses (Materials for Energy, Materials for mobilities, Materials for Health)	1	20,00	16,00	0,00	0,00	0,00	0,00	0,00	0,00	20,00	J-L. SIX (Santé) - D. HORWAT (Energie) - I.ROYAUD/T. CZERWIEC(Mobilités)
Glass and Glass-ceramics *	1,5	10,00	8,00	0,00	0,00	0,00	0,00	1,25	1,00	11,25	D. HORWAT
EEIGM Department: Ageing, durability, sustainability	**6**	**55**		**8,75**		**0**		**5**		**68,75**	
Ecodesign *	1,5	8,75	7,00	3,75	3,00	0,00	0,00	1,25	1,00	13,75	M.O.SIMONNOT
Solid and liquid waste management	1,5	12,50	10,00	0,00	0,00	0,00	0,00	1,25	1,00	13,75	B. LAUBIE
Degradation and Stabilisation of Polymers *	1	7,50	6,00	1,25	1,00	0,00	0,00	1,25	1,00	10,00	A.JONQUIERES
Elective courses (Materials for Energy, Materials for mobilities, Materials for Health)	1	20,00	16,00	0,00	0,00	0,00	0,00	0,00	0,00	20,00	J-L. SIX (Health) - D. HORWAT (Energy) - I.ROYAUD/T. CZERWIEC(Mobilities)
Corrosion *	1	6,25	5,00	3,75	3,00	0,00	0,00	1,25	1,00	11,25	D.RENAUX
EEIGM Department: European languages and cultures, SEHS	**4**	**18,75**		**35,00**		**0,00**		**1,25**		**55,00**	
Team management	1	13,75	11,00	0,00	0,00	0,00	0,00	1,25	1,00	15,00	R. VILAIR-A. GARNIER
Linguistic Stays and Certificates	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	P. BEYER
English VII Support	0	0,00	0,00	15,00	12,00	0,00	0,00	0,00	0,00	15,00	N. BRIE
Spanish VII	2	0,00	0,00	17,50	14,00	0,00	0,00	0,00	0,00	17,50	C.SAVARD-CHAMBARD
German VII		0,00	0,00	17,50	14,00	0,00	0,00	0,00	0,00	17,50	P. BEYER
Industrial conferences and tours	0	5,00	3,33	0,00	0,00	0,00	0,00	0,00	0,00	5,00	Z. AYADI
EEIGM Department: Development and Research	**4**	**0,00**				**30,00**					
Project (associated to elective courses)	4	0,00	0,00	0,00	0,00	30,00	10,00	0,00	0,00	30,00	J. ZOLLINGER
EEIGM Department: Materials specialisation	**2**	**15,00**								**15,00**	
Partner University Courses (Lulea)	2	15,00	12,00	0,00	0,00	0,00	0,00	0,00	0,00	15,00	
Partner University Courses (Barcelona)											
Partner University Courses (Saarbrucken)											
Partner University Courses (Brussels)											
TOTAL Semester VII	**30**	**192,50**		**77,50**		**35,00**		**17,50**		**322,50**	

<table>
<tr><td rowspan="2">Teaching Unit:
MECHANICS OF MATERIALS III</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: Z. AYADI</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 17.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>1.25</td><td>13.75</td><td></td><td></td><td>2.5</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☒ C6 ☒ C7 ☒ C8</td><td colspan="5">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☒ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should know the role of CAD software, master design communication tools and use Catia v5 CAD software for solid and surface design in materials mechanics

Syllabus:

Discovery of Catia.
Technical communication language of the design in mechanics of materials.
Solid design of parts on Catia and use of the drawing module. Study of the assembly module on Catia. Surface design.
Simulation and calculation of resistance of materials by finite elements on Catia

Pedagogical procedures (organization, assessment, pedagogical resources):

Presentation of the objectives, the course of the module and generalities on mechanical design with an introduction to CATIA.
The promotion is divided into working groups in the CAD rooms (1 student / workstation)
1 intermediate evaluation
1 individual assessment session on a computer station

Student's expected work in autonomy:

Autonomous exercises on Catia for improvement

Bibliographic references:

Catia tutorials available

Other EEIGM courses directly linked to this course:

Upstream: RDM, MM1, MM2, MC-CM

Downstream: projects and industrial internship

<table>
<tr><td rowspan="2">Teaching Unit:
INDUSTRIAL SAFETY AND SECURITY</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: V. VITZTHUM</td></tr>
<tr><td>EEIGM Department: Engineering sciences</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 12.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>8.75</td><td>2.5</td><td></td><td></td><td>1.25</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: around 20 h</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☐ C1 ☒ C2 ☐ C3 ☐ C4 ☐ C5 ☒ C6 ☒ C7 ☐ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should better understand the issue of safety and security in the working world and particularly in an industrial environment. He/she will have acquired knowledge of the regulations and should be able to continue training in order to manage safety issues as part of a competent team.

Syllabus:

Introduction (major accidents, Seveso directive, risk analysis methods, hazard modelling)
Analysis of accidents using the cause tree
Typical study of atmospheric dispersion of pollutants
Dust explosion study

Pedagogical procedures (organization, assessment, pedagogical resources):

Organisation: 7 courses, given by two lecturers from the school and two from outside (a professor from the ENSIC, Mr PERRIN, a safety specialist, and Mr MONNIER, from the INRS) and two TD. Students must also self-train using distance learning https://www.eformation-inrs.fr/formation/8.
Evaluation includes successful completion of the course (INRS certificate) and a final test.
The teaching resources include handouts and documents available on the digital platform Arche.

Student's expected work in autonomy:

Work on courses and tutorials, do distance learning, read documents in order to acquire essential notions to be able to assume your responsibilities as an engineer.

Bibliographic references:

Techniques de l'Ingénieur
Books in the library, in particular Safety of chemical processes -André Laurent

Other EEIGM courses directly linked to this course:

Upstream: basic modules in chemistry, physics, processes, materials

Downstream: projects, internships, professional future

<table>
<tr><td colspan="2">Teaching Unit:
COMPOSITE MATERIALS: MECHANICAL BEHAVIOR</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: L. TERREI</td></tr>
<tr><td colspan="2">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 22.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>12.5</td><td>8.75</td><td>5</td><td></td><td>1.25</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☒ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to determine analytically (Love-Kirchhoff's theory) and numerically (Abaqus®) the mechanical state (field of displacements, strains and stresses) of a not symmetric and unbalanced composite thin plate subjected to combined biaxial traction/compression, pure cutting, temperature loading (uniform), flexion, buckling and free vibrations (in these last three cases, only in the case of a crossed plate where 4 edges are in free supports) and who(which). The orthotropic materials' behavior will be supposed linear elastic. The student will beforehand have been made aware to the various families of existing composites on the market (materials for the reinforcements and the matrices, arrangement of the reinforcements, charges) as well as in their mechanical properties.

Syllabus:

Majorities on composite materials, Love-Kircchoff's theory, traction, flexion, free vibration, buckling, thermo-elasticity

Pedagogical procedures (organization, assessment, pedagogical resources):

The student has a duplicated lecture note said "with hole " (documents which resumes all the slides of the lecture but in a incomplete way so that the student remains active by filling and by annotating the latter), of a collection of exercises of TD.
The student is evaluated by an homework (coef 1) and a final control of 2 hours (coef 1).

Student's expected work in autonomy:

Every week, the student will have to work again the points of the course which were not assimilated in session and to prepare the questions of the next TD indicated by the teacher

Bibliographic references:

- Agarwal B. and al, Analysis and Performance of Fiber composites, Wiley, 2006
- Berthelot J.M., Matériaux composites, Masson
- Chawla K.K., Composite Materials, Springer Verlag, 1998
- Jones R., Mechanics of Composite Materials, Taylor & Francis, 1999

Other EEIGM courses directly linked to this course:

Upstream: MSD

Downstream: Elaboration des Matériaux Composites à Matrice Polymère, Devenir du Composites, Céramique, Bois

<table>
<tr><td colspan="2">Teaching Unit:
COMPOSITE MATERIALS WITH POLYMER MATRIX: SYNTHESIS, PROCESSING AND PROPERTIES IN USE</td><td colspan="5">Year/Semester of EEIGM studies: 4A FPA - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: I. ROYAUD</td></tr>
<tr><td colspan="2">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 13.75</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>10</td><td>2.5</td><td></td><td></td><td>1.25</td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 13.75</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to synthetize, design and develop composite materials with a polymer matrix by choosing the appropriate matrix, the type of reinforcement and the production process to be implemented in order to obtain specific and controlled properties. The association in a composite material of a continuous polymer matrix and reinforcements produces a synergistic effect between the properties of the different constituent elements which the student will take advantage of to contribute to the development of composites while respecting specifications typical of many applications in most common industries.

Syllabus:

I- Polymer chemistry for polymer matrix composites (A. Jonquières) :
Chemistry of the main thermoplastic (widely distributed, technical and high-performance) and thermosetting polymer matrices (unsaturated polyesters, polyepoxides, phenol-formaldehyde technical matrices; high-performance polyimide matrices; notions of gel effect and critical conversion rate) .
II- Processing and properties of polymer matrix composites (I. Royaud) :
Methods of elaboration of reinforcing fibers, Methods of elaboration of semi-products, pre-pregs and composites with thermoplastic and thermosetting matrices, focus on mechanical and physical properties vs processed final products.

Pedagogical procedures (organization, assessment, pedagogical resources):

Educational resources: 1 handout "Polymer chemistry for polymer matrix composites" (A. Jonquières) and 1 handout (I. Royaud) Processing and properties of polymer matrix composites.
A final test of 1h15 on the synthesis (37 min with A. Jonquières) and on the processing and the resulting physical properties (37 min with I. Royaud) of composites with a polymer matrix.

Student's expected work in autonomy:

Re-read and integrate the lectures, prepare the tutorials, obtain information on the subjects covered related to composites (matrix chemistry, use of composites, physical properties of composites) through personal research.

Bibliographic references:

- Chrétien G., Matériaux composites à matrice organique, 1986, Tec et Doc, Paris
- Cognard P., Les applications industrielles des matériaux composites, 2 volumes, Edition du Moniteur (1989)
- Gay D., Matériaux composites, 1991, Chapitre 5, Hermes, Paris
- Renard J. ed, Elaboration, microstructure et comportement des composites à matrice polymère, 2005, Hermès-Science, Paris
- Reyne, Technologie des composites, 1990, Hermès, Paris

Other EEIGM courses directly linked to this course:

Upstream: Macromolecular chemistry, Relations between Structures / Physical Properties of Polymers, Degradation and Stabilization of Polymers, Composite materials: mechanical behavior

Downstream: Polymerization Engineering, Biopolymers and Biodegradable Polymers, Functional Polymers

<table>
<tr><td rowspan="2">Teaching Unit:
ELECTIVE COURSE MATERIALS FOR MOBILITY-THEME 3: ELECTROMOBILITY/PERFORMANCE</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: T. CZERWIEC</td></tr>
<tr><td rowspan="2">EEIGM Department: Structural and functional properties of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 10</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Competencies approach</td><td>10</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work: 3</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☒ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to better understand the sustainable development objectives contained in the new forms of mobility. The evolution of the hydrogen sector in electromobility will be regularly reviewed. The student will also be introduced to the contribution of surface treatments in improving the performance of mobility devices. Finally, the student will be introduced to mechatronics and intelligent mobility.

Syllabus:

The electromobility/performance axis (15 lectures) is part of the materials for mobility option and a certain number of the modules (7 lectures) that make it up are taught in 3A. It consists of 3 modules (8 lectures):
Module 3.1 – Hydrogen and electromobility sector. Fuel cell (2.5 h) and electric vehicle (2.5 h): 2 lectures
Module 3.2 – Energy performance. Surface treatment to improve performance (1.25 h): 1 lecture
Module 3.3 – Mechatronics, smart mobility. Surface treatments for functional applications (1.25 h), artificial intelligence (2.5 h): 3 lectures

Pedagogical procedures (organization, assessment, pedagogical resources):

The course includes 8 lectures sessions. Copies of the slideshows presented, available on ARCHE. The evaluation is carried out by groups of students in various forms: writing of a summary note giving an update on a technique or a problem of the hydrogen sector or surface treatments.

Student's expected work in autonomy:

Drafting of the summary note mentioned above.

Bibliographic references:

ttps://www.economie.gouv.fr/presentation-strategie-nationale-developpement-hydrogene-decarbone-France
http://www.cea.fr › energies › essentiel-sur-hydrogene

Other EEIGM courses directly linked to this course:

Upstream: Physical properties of materials

Downstream: Industrial and/or research projects

<table>
<tr><td colspan="2">Teaching Unit:
MATERIALS FOR HEALTH. THEME 2</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: J-L. SIX</td></tr>
<tr><td colspan="2">EEIGM Department: Structural and functional properties of materials/Ageing, durability, sustainability</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 20</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>18.75</td><td></td><td></td><td></td><td>1.25</td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 20</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☒ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to master the polymerization and plasturgy processes used to produce polymeric biomaterials. Some additive manufacturing techniques used to elaborate ceramic or polymeric biomaterials or to build biotissues will be discussed.

Syllabus:

Presentation of the principles of industrial processes for the synthesis and formulation of polymers used in biomedical applications; of their scientific/technical challenges and of some industrial examples.
Presentation of the main used polymeric biomaterials forming processes, of their scientific/technical challenges and os some industrial examples.
Presentation of the main methods of additive manufacturing of biomaterials and biotissues, as well as recent advances in the field.

Pedagogical procedures (organization, assessment, pedagogical resources):

Resources: 1 course handout.
Evaluation: 1h15 test.

Student's expected work in autonomy:

At regular intervals, student has to review and learn lectures.

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Polymer reaction engineering. Polymer processing. Ceramics. Materials for health. Theme 2.

Downstream: Materials for health. Theme 3

Teaching Unit: POLYMER PROCESSING	Year/Semester of EEIGM studies: 4A - 1st semester				
	Course manager: **G-H. HU**				
EEIGM Department: Elaboration and processing of materials	**Hours/student:**				
Teaching method: Active Learning	**In-person classes:** 13.75				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	6.25	6.25			1.25
	Autonomous work: 12.5				

Generic EEIGM competencies	Specific EEIGM competencies
☒ **C1** ☒ **C2** ☒ **C3** ☒ **C4** ☒ **C5** ☒ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☐ **SC4** ☒ **SC5** ☐ **SC6**

Educational objectives of the course:

At the end of the course, the student should be able to master basic notions of polymer processing and the working principles of the main polymer processing technologies.

Syllabus:

1. What are the concrete applications for polymer materials? 2. What are the main processes for processing polymer materials? 3. How does the extrusion process work? 4. How does the injection molding process work? 5. What manufacturing defects can the extrusion and injection molding processes may face? What are their physical origins of these defects? How to solve them? 6. How do polymer processing technologies take into account the molecular, thermal and rheological characteristics of polymer materials?

Pedagogical procedures (organization, assessment, pedagogical resources):

1. The course includes 5 lessons of 75 min each and the same amount of tutorials. No practical work, however. 2. The handouts are provided as a support, 3. The evaluation is done via a standard examination without document whose subjects are based on the method: "SEE-I" which designates "State it, Elaborate, Exemplify, and Illustrate ".

Student's expected work in autonomy:

1. It is very strongly recommended to actively attend all the lessons and tutorials. 2. It is important to apply the "SEE-I" method during the active learning of this course.

Bibliographic references:

1. Agassant J.F., La mise en forme des matières plastiques, 2. Bost J., Matières plastiques (Tomes 1 et 2) , 3. Michaeli W., Extrusion des matières plastiques, 4. Rauwendaal C., Polymer extrusion, 1986, Hanser publishers

Other EEIGM courses directly linked to this course:

Upstream: 1. Transport and transfer phenomena, 2. Physics and rheology of polymers

Downstream: Industrial and / or research projects

Teaching Unit: CERAMICS	Year/Semester of EEIGM studies: 4A - 1st semester				
	Course manager: **D. HORWAT**				
EEIGM Department: Elaboration and processing of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 17.5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	15				2.5
	Autonomous work: 15				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☐ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to understand the concepts of physicochemistry that govern the development and characterization of ceramics, including their additive manufacturing and surface treatment methods, understand and apply the concepts and methods that influence the thermomechanical behavior of ceramics. The student will also be able to make technological choices in the field of elaboration, treatment, shaping of ceramics and associated objects. He will also know the main technical ceramics and the influence of their microsctructure on the properties of use. The student will also have an overview of technologies and challenges in the field of solar photovoltaics.

Syllabus:

1- General properties
2- Fragility of ceramics and glass, fracture dynamics and Weibull statistics
3- Traditional clays and ceramics
4- Plasters, Cements and Concrete
5- Elaboration and shaping of technical ceramics
6 - Surface treatments
7- Main technical ceramics
8- Context, devices and materials for photovoltaics
9- Additive manufacturing of ceramics

Pedagogical procedures (organization, assessment, pedagogical resources):

Classic course, course slides provided, 2 written tests of 1h15 each, without document

Student's expected work in autonomy:

Personal work to integrate the notions of physicochemistry, mechanical properties related to the microstructure

Bibliographic references:

Les céramiques industrielles : propriétés, mise en forme et applications »
G. Fantozzi, J.-C. Nièpce, G. Bonnefont, édition Dunod
Handbook of Advanced Ceramics, Materials, Applications, Processing, and Properties, Second Edition 2013
Ceramic Technology and Processing A Practical Working Guide 1st Edition - December 1, 2001

Other EEIGM courses directly linked to this course:

Upstream: Structure and structural defects, Atomistics, Chemical thermodynamics, Inorganic chemistry and inorganic materials, Glass and glass-ceramics

Downstream: optional lecture on high temperature ceramics

Teaching Unit: GLASS AND GLASS-CERAMICS	Year/Semester of EEIGM studies: 4A - 1st semester				
	Course manager: **D. HORWAT**				
EEIGM Department: Elaboration and processing of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 12.5				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	11.25				1.25
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☐ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to understand the concepts of physicochemistry that govern the development and characterization of mineral glasses, understand and apply the concepts and methods that influence the thermomechanical behavior of mineral glasses. The student will also be able to make technological choices in the field of the development, treatment, shaping of mineral glasses and associated objects. The student will also be able to influence the microstructure and properties of vitroceramics.

Syllabus:

Introduction - Definition of a glass - Composition and structure of mineral glasses - Elaboration and shaping of glass - History of glass as a material- Vitroceramics

Pedagogical procedures (organization, assessment, pedagogical resources):

Classic course, course slides provided, 1 written test 1h15 without document

Student's expected work in autonomy:

Personal work to integrate notions of physicochemistry

Bibliographic references:

Uhlmann DR., Kreidl NJ., Glass : Science and Technology, Academic Press Inc.
Annelise Faivre, Les verres et la transition vitreuse, Mat´eriaux & Techniques, EDP Science
MOOC Vitra : Arts et techniques du verre (CERFAV)
James E Shelby : Introduction to Glass Science and Technology, Rcs Paperbacks Series, 2nd Edition 2005
« Le verre: science et technologie » J. Barton, C. Guillemet, EDP sciences ed. (2005)

Other EEIGM courses directly linked to this course:

Upstream: Structure and structural defects, Atomistics, Chemical thermodynamics, Inorganic chemistry and inorganic materials

Downstream: End-of-Life Glass and Composite Materials, Fonctionnal Glasses

<table>
<tr><td colspan="2">Teaching Unit:
ELECTIVE COURSE MATERIALS FOR MOBILITY-THEME 1: CONCEPTION/ELABORATION</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: G-H. HU</td></tr>
<tr><td colspan="2">EEIGM Department: Elaboration and processing of materials</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes: 37.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>37.5</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 9</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should able to understand the rheological behavior of polymers in the molten state, model the flow of molten polymers in simple geometries, understand the mixing mechanisms in viscous systems and apply them to the development of polymer matrix composites. He will also be able to make the link between his theoretical knowledge and the technological tools used for the development of metallic materials and the necessary compromises and consequences on the finished products.

Syllabus:

The design/development axis consists of two mobility-oriented modules (29 lectures).
Module 1.1 – Design and Elaboration course (shaping polymers (10h), polymers for lightening (5h) and Elaboration of more environmentally friendly steels made by manufacturers from Arcelor Mittal and Lisi Automotive (12.5h) The "polymer processing" course (8 lectures) presents the rheology of polymers in the molten state, the flow of molten polymers in simple geometries, industrial processes for shaping polymer materials, the mechanisms and mixing tools for highly viscous systems. The "Polymers for lightening" course (4 lectures) presents the challenges, principles and industrial strategies around the use of polymer materials to lighten transport equipment.
Module 1.2 – Transport industries including presentations by industrials (Airbus, Safran, ESA, Coventia, Arcelor Mittal (8.25 h: 7 lectures) as well as courses on high and ultra-high temperature ceramics and ceramics with composite matrix (2.5 h: 2 lectures)

Pedagogical procedures (organization, assessment, pedagogical resources):

Module 1.1: For “Processing polymers”: Handouts are provided as support. The assessment is carried out via a classic examination without documents. For: "Polymers for lightweighting": Handouts are provided as support. The evaluation is carried out in the form of mini-projects linked to the design of polymer parts for the reduction of transport equipment.
Module 1.2: The production lines and the choice of tools according to the final part application are described by an industrial who has worked in the steelworks then in customer relations for the cold heading and hot forging trades before to integrate R&D. Assembly methods are covered by an industrial specialist in solutions for the automotive market. The assessment is carried out in the form of a MCQ.

Student’s expected work in autonomy:

Research on examples of industrial applications related to mobility.

Bibliographic references:

1. Agassant J.F., Processing plastics, 2. Bost J., Plastics (Tomes 1 et 2) , 3. Michaeli W., Extrusion of plastics , 4. Christopher W. Macosko, Rheology: Principles, Measurements, and Applications, 1994. ISBN: 978-0-471-18575-8, 5. Ica Manas-Zloczower, Mixing and Compounding of Polymers: Theory and Practice. 2nd Edition. 2009

Other EEIGM courses directly linked to this course:

Upstream: Plastics engineering 1, structure and structural defects, phase transformation, Structure-Properties relationship of polymers

Downstream: Industrial and/or research projects

Teaching Unit: **ELECTIVE COURSE MATERIALS FOR HEALTH. THEME 3**	**Year/Semester of EEIGM studies:** 4A - 1st semester				
	Course manager: **J-L. SIX**				
EEIGM Department: Elaboration and processing of materials	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 40				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	38.75				1.25
	Autonomous work: 40				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to understand why polymeric, metallic, ceramic or carbon materials have been used in the biomedical field, taking into account the specifications imposed by the targeted applications.

Syllabus:

After having defined a biomaterial, the general concepts of biocompatibility and biodegradation will be presented. The fields of use of the different classes of biomaterials will be discussed, as well as economic data. The post-implantation fate of biomaterials will be introduced by focusing on the consequences of the different chemical and physical degradations of the material on the evolution of its properties.
Many biomaterials will be illustrated (total hip prosthesis, external prosthesis made of carbon material, non-biodegradable or bioresorbable ceramic prostheses, ocular implants, systems for drug delivery, catheters, materials for dentistry, materials for tissue engineering, …).

Pedagogical procedures (organization, assessment, pedagogical resources):

Resources: 1 course handout.
Evaluation: 1h15 test + a personal synthesis work

Student's expected work in autonomy:

At regular intervals, student has to review and learn lectures.

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Elaboration of inorganic materials, Corrosion, Polymer chemistry, Structure / properties relationships of Polymer. Ceramics. Degradation and stabilisation of polymers. Materials for health. Theme 1. Materials for health. Theme 2

Downstream:

Teaching Unit: ECODESIGN	Year/Semester of EEIGM studies: 4A - 1st semester				
	Course manager: **M-O. SIMONNOT**				
EEIGM Department: Ageing, durability, sustainability	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 13.75				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	8.75	3.75			1.25
	Autonomous work: about 10				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☐ C8	☒ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to master the basic concepts of environmental assessment that govern the choices for the ecodesign of products, processes and services. He/she will be able to carry out a life cycle analysis of a simple system, according to the stages of the ISO 14040 standard and to use the professional software SimaPro. He/she will also be able to understand with a scientific approach the environmental issues in companies and to communicate on these aspects.

Syllabus:

After a brief presentation of the essential concepts on which environmental analysis is based, the concepts of regulations, environmental management systems, industrial ecology and ecodesign are described. The course then focuses on life cycle assessment (LCA), theory, examples and demonstrations of the SimaPro software.
The course also includes a presentation session by an invited speaker, to illustrate the importance of these appraoches in an industrial environment. Finally, a tutorial is proposed (in three sessions) on the implementation of LCA using the SimaPro software. This course is based int the notions seen in the course "treatment of waste and effluents" and, in the same way, the main regulatory guidelines are covered throughout the module.

Pedagogical procedures (organization, assessment, pedagogical resources):

The module includes 5 lectures given by Marie-Odile SIMONNOT + 1 lecture givenn by an external speaker (in 2020 and 21: Mr FRANCO from Pocheco-Ouvert company, Lillen, by videoconference. It include trhree sessions of tutoroals whose objective is to make the LCA of a simple system: one session of preparation if the study and twi sessions un comuter room, where the students use SimPro. The evaluation is in the form of a 1h15 test.
Pedagogical resources: couses and numerous documents available on the Arche platform - books in the school library (and more generally in the libraries of the university) - SimaPro software freely available via Virt'UL.

Student's expected work in autonomy:

Thorough reading of the course and the notes taken in class, thus of additional documents (on Arche or searched personally). Learning by heart the basic definitions given in the coure. Revisions/deepening of the tutorial.

Bibliographic references:

Many documents are available on Arche and books are available in the school library. For instance:
Jolliet O, Saade M, Crettaz P, Analyse du cycle de vie, comprendre et réaliser un écobilan, Presses Polytechniques et Universitaires Romandes, Lausanne 2002
Baumann H., Tillman A.M. 2004 The hitch hiker's guide to LCA, Studentlitteratur, Lund (Sweden)
Also chapters of the "Techniques de l'ingénieur " are accessible via the digital working environment (ENT).

Other EEIGM courses directly linked to this course:

Upstream: all the modules about processes and materials

Downstream: module "treatment of waste and effluents" - projects - internships

Teaching Unit: SOLID AND LIQUID WASTE MANAGEMENT	Year/Semester of EEIGM studies: 4A - 1st semester				
	Course manager: **B. LAUBIE**				
EEIGM Department: Ageing, durability, sustainability	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 13.75				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	12.5				1.25
	Autonomous work: 10				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☐ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☐ C8	☒ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course, the student should be able to define basic concepts required to manage solid and liquid wastes, and describe and justify treatment choices made in the industry.
He will also be able to use environmental and technical terms in a good purpose. He will therefore be able to have a critical look at environmental ("green") communication.

Syllabus:

The course is divided into 5 chapters:
- Environmental chemistry (2.5h)
- Waste, recovery and characterization (2.5h)
- Management and treatment of solid wastes (2.5h)
- Treatment of urban and industrial effluents (3h)
- Material recycling (3h)

Besides technical and scientific aspects, the main European regulations are explained.

Pedagogical procedures (organization, assessment, pedagogical resources):

The teaching unit is based on dense course materials projected during the lessons. They are explained, supplemented and summarized by the two teachers. Before the beginning of the lessons, they are available on the e-platform Arche, with additional documents.
Short exercises are proposed to illustrate the different concepts.
The final test (sometimes joined with Ecodesign) usually contains questions on basic concepts and exercises based on real waste treatment scenario.

Student's expected work in autonomy:

The student should regularly read his notes taken during the lessons and learn concepts explained by the teachers.

Bibliographic references:

A lot of books are available in the EEIGM's library (Chimie de l'environnement, 2001, Blieffert et Perraud, DeBoeck Université. Le traitement des déchets, 2009, Moletta, Tec&Doc Lavoisier…)
The database "Techniques de l'Ingenieur" is also a very rich source of information (Approche systémique des déchets G2000, Traitements thermiques des déchets G2050 et 51,…).
ADEME's website gives a lot of informative explanations on waste management.

Other EEIGM courses directly linked to this course:

Upstream: Separation engineering and Divided solids Downstream: Ecodesign

<table>
<tr><td colspan="2">Teaching Unit:
DEGRADATION AND STABILISATION OF POLYMERS</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: A. JONQUIERES</td></tr>
<tr><td colspan="2">EEIGM Department: Ageing, durability, sustainability</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 10</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>7.5</td><td>1.25</td><td></td><td></td><td>1.25</td></tr>
<tr><td colspan="2">Assessment: Competencies approach</td><td colspan="5">Autonomous work: 10</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to

- Identify the causes of a polymer chemical degradation on the basis of first-hand informations
- Define a strategy for its prevention and reasonably implement an appropriate combination of stabilising agents
- Stabilise a polymer efficiently for its processing or its intended uses
- Appraise a physical degradation on the basis of different characterisations and specify its consequences on the material physical properties

Syllabus:

- The consequences of chemical and physical degradation on polymer properties
- The different types of chemical and physical degradations
- The different mechanisms involved in polymer material degradation
- The industrial strategies for polymer stabilisation with the reasoned use of various stabilising agents (i.e. thermal, photochemical, fungicide, bactericide, and fireproof stabilising agents)

Pedagogical procedures (organization, assessment, pedagogical resources):

Pedagogical ressources : 1 handout "Chemical degradation and stablisation of polymers" (6.25h lectures including case studies/A. Jonquieres) and 1 handout "Physical degradation of polymers: physical aging" (1.25h lectures/1.25h TD/I. Royaud).

A final test on chemical degradation and stabilisation of polymers on the basis of case studies (50 min with A. Jonquières) and on physical degradation of polymers (25 min with I. Royaud)

Student's expected work in autonomy:

The student will have to practice the different concepts seen in lectures and tutorials on different case studies

Bibliographic references:

- J. Verdu, Vieillissement chimique des plastiques : aspects généraux, Les Techniques de l'Ingénieur, Traité Plastiques et Composites, Volume AM 3 151, 2002.
- J. Ecole J., La stabilisation des polymères, Nathan, Encyclopédie technique pratique, 1991, 75 pages.
- J. Verdu et B. Fayolle,Vieillissement Physique des matériaux polymères, Les Techniques de l'Ingénieur, A3150, Cor108, 2005.
- M. Biron, Vieillissement et durabilité des polymères à usage industriel : plastiques, élastomères et leurs composites, Tech Tendances, Etudes Technologiques, Innovation 128, Paris, Boston, Tokyo, 2001. ISBN : 2-906024-42-2.
- W.L. Hawkins, Polymer Degradation and Stabilization, Springer, 1984.

Other EEIGM courses directly linked to this course:

Upstream: Polymer chemistry. Polymer physics

Downstream: Composite materials with polymer matrix: Synthesis, processing and properties in use. Polymer reaction engineering. Biopolymers and biodegradable polymers. Biomedical applications of polymers. Functional polymers.

<table>
<tr><td rowspan="2">Teaching Unit:
CORROSION</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: D. RENAUX</td></tr>
<tr><td>EEIGM Department: Ageing, durability, sustainability</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 11.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>6.25</td><td>3.75</td><td></td><td></td><td>1.25</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to identify and assess classical mechanisms and damages provoked by corrosion and to propose anticorrosion treatment solutions.

Syllabus:

Thermodynamic aspects: corrosion diagramms
Kinteic aspects: charge transfer (Tafel's law), diffusion (Fick's law)
Corrosion mechanisms
Methods for analyses of corrosion phenomena (SEM, EDS, spectroscopic methods), normalized tests (climatic chamber, salt spray test)
Corrosion prevention by the use of alloys (stainless steel) and by a suitable conception of metallic pieces
8Protection by metallic coatings, by surface electrochemical conversion, by addition of corrosion inhibitors, by surface chemical conversion

Pedagogical procedures (organization, assessment, pedagogical resources):

Students make use of a document draft for the course and a document draft for the turoial classes.

Student's expected work in autonomy:

Preparation of tutorial classes.

Bibliographic references:

D. Landolt, Traité des Matériaux : 12-Corrosion et Chimie de surfaces des métaux, Presses Polytechniques et Universitaires romandes.

Other EEIGM courses directly linked to this course:

Upstream: Chemistry in Aqueous Solution - Kinetics Downstream:

Teaching Unit: ELECTIVE COURSE MATERIALS FOR MOBILITY-THEME 2: DURABILITY/SAFETY	Year/Semester of EEIGM studies: 4A - 1st semester				
	Course manager: **I. ROYAUD**				
EEIGM Department: Ageing, durability, sustainability	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 23.75				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	23.75				
	Autonomous work: 8				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☒ **C4** ☒ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

At the end of the course, the student should be able to understand the challenges of biosourced materials and surface treatments in terms of durability and safety of materials in the field of mobility.

Syllabus:

This axis is divided into two modules (19 lectures).
Module 2.1 – Biosourced materials for mobility itself consists of two courses:
-The course on biodegradable, biosourced, biopolymers (Anne Jonquières, 10h, 8 lectures) is treated in 3A (see specific syllabus sheet for the 3A program)
- The course on biosourced rubbers, application to tires (green tires and recovery of used tires), (Guo-Hua Hu, 5 h). This course presents the scientific and technical challenges of material recovery from used rubbers (particularly tires), the chemistry of biosourced rubbers as well as new chemistries and processes for vulcanization and devulcanization of rubbers.
Module 2.2 – Surface Treatments and Corrosion
In this module we will present thermal barrier coatings and matrix nanocomposite coatings.
ceramics (1.25 h, David Horwat). Certain aspects of surface and corrosion treatments to improve safety and durability in mobility (5 h, Thierry Belmonte and Thierry Czerwiec, 2.5 h, Delphine Renaux)

Pedagogical procedures (organization, assessment, pedagogical resources):

For module 2.1: The course on green tires includes 4 lectures; handouts are provided; the assessment is carried out in the form of mini-projects linked to the design of rubbers that are more easily recyclable or biodegradable.
For module 2.2: students will have copies of the slideshows presented, available on ARCHE. The evaluation is carried out by groups of students in various forms: study of specific cases of surface treatments, analysis of articles.
Evaluation to be harmonized with the 3 other axes of the Option, a single mark for the 3 axes will be given for the Materials for Mobility option. In 4A: this mark will be the average of 2 classic tests and 1 project.

Student's expected work in autonomy:

For Module 2.1: Research on examples of industrial applications of rubbers related to mobility.
For module 2.2 Very little extra-curricular work is required of the students. A different approach, allowing them to pragmatically exploit their knowledge, is implemented to assess the new skills acquired in this module.

Bibliographic references:

See the references given in the course materials.

Other EEIGM courses directly linked to this course:

Upstream: Lectures in metallic materials, physics, chemistry, polymers and composites

Downstream: Industrial and/or research projects

<table>
<tr><td rowspan="2">Teaching Unit:
THEME 1 - MATERIALS FOR ENERGY
ELECTIVE COURSES: ISSUES OF ENERGY AND MATERIALS FOR ENERGY COURSE</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: R. PRIVAT</td></tr>
<tr><td>EEIGM Department: Structural and functional properties of materials/Elaboration and processing/Ageing, durability, sustainability</td><td colspan="5">Hours/student: .</td></tr>
<tr><td rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>8.75</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">Autonomous work:</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☒ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to describe the energy conversion processes present in the industrial world, analyze the types of energy involved in energy conversions, understand and describe the processes of electrical production from different sources (renewable or not, carbon-based or not).

Syllabus:

Electricity production processes from different primary energy sources - industrial intervention on nuclear power
Role of materials in thermal energy storage (Z Acem)
Role of materials in electrical energy storage - batteries (L. Speyer)
Materials for energy harvesting (D. Horwat)

Pedagogical procedures (organization, assessment, pedagogical resources):

Classical exam

Student's expected work in autonomy:

In-depth study of the elements presented in class, analysis of documents such as articles, videos or radio programs.

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Chemical reaction engineering, thermodynamics, heat transfer, flows and transfers

Downstream: All disciplines of the Materials for Energy option

<table>
<tr><td colspan="2">Teaching Unit:
THEME 2-ELECTIVE COURSE MATERIALS FOR ENERGY</td><td colspan="6">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="6">Course manager: D. HORWAT</td></tr>
<tr><td colspan="2">EEIGM Department: Structural and functional properties of materials/Elaboration and processing/Ageing, durability, sustainability</td><td colspan="6">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="6">In-person classes: 41.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>41.25</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="6">Autonomous work: 20</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☐ C5 ☐ C6 ☒ C7 ☐ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to understand challenges, concepts, and devices for energy production/conversion, transport, regulation and storage.

Syllabus:

A- Production / Conversion

- Fossil fuels (3 lectures)
- Heater, heat exchangers, materials
- Nuclear (5 lectures)
- Principles
- Materials for nuclear energy conversion: Manufacturing strategies and consequences on components properties, Ageing under irradition, thermal, corrosive environments
- Wind energy (3 lectures)

Principles and materials

- Fuel cells and hydrogen (6 lectures)
- Principles and electrochemical and electrocatalysis basics (L. Speyer 1 lecture)
- Materials and processes: Low temperature fuel cells (L. Speyer 1 lecture), Intermediate and high temperature fule cells (D. Horwat – 2 lectures)
- Hydrogen: Transport, storage, conversion (2 lectures)
- Micro harvesting (D. Horwat – 2 lectures)

B- Energy transport and regulation (7 lectures)

- Transport – insulation - regulation
- Principles and materials for thermal insulation (Z. Acem 2 lectures)
- Thermal regulation - smart windows: low emissivity, thermochromism, photochromism, electrochomism (D. Horwat – 2 lectures)

C- Storage (7 lectures)

- Capacitors - supercapacitors
- Principle: Dielectrics for electrical energy storage (S. Hilpert - 1 lecture)
- Materilas and processes: inorganic (S. Hilpert - 1 lecture), organic (I. Royaud - 1 lecture)
- Batteries
- Electrochemical principles (L. Speyer 1 lecture)
- Materials et processes: inorganic (L. Speyer 1 lecture), organic (I. Royaud - 1 lecture)a
- Heat accumulators
- Materials: bulk accumulators, phase change materials (D. Horwat 1 lecture)

Pedagogical procedures (organization, assessment, pedagogical resources):

Classic teaching, written exam and submission of a report

Student's expected work in autonomy:

personnal work to understand concepts, processes and origin of properties

Bibliographic references:

Scientific articles

Other EEIGM courses directly linked to this course:

Upstream: Structure and structural defects 3A, Physical properties of materials 3A, Electrochemistry 2A, Cristalline structures 2A, Polymers structure/properties relationships 3A, Chemistry in aqueous solutions 2A, Flow an transfer 3A, Theme 2_Materials for energy production(conversion) storage and transport (3rd year), Ceramics 4A, Glass and glass ceramics 4A

Downstream: Project materials for energy, Semester 8

<table>
<tr><td colspan="2">Teaching Unit:
THEME 3 - AGEING AND RECOVERY OF MATERIALS FOR ENERGY (ELECTIVE COURSE: MATERIALS FOR ENERGY)</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: M-O. SIMONNOT</td></tr>
<tr><td colspan="2">EEIGM Department: Ageing, durability, sustainability</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 15</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>15</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 15</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☒ C2 ☒ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should better understand the fate and end-of-life of installations and materials used in the energy sector.

Syllabus:

A- The nuclear sector: dismantling of installations and waste management (7 lectures)
B- Recycling of non-nuclear materials (batteries, fuel cells, renewable energy, etc.) (4 lectures)
C- Life cycle analysis and carbon footprint of these sectors (4 lectures)

Pedagogical procedures (organization, assessment, pedagogical resources):

Classical exam

Student's expected work in autonomy:

In-depth study of the elements presented in class, analysis of documents such as articles, videos or radio broadcasts

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Chemical reaction engineering, thermodynamics, flows and transfers

Downstream: All disciplines of the Materials for Energy option

<table>
<tr><td rowspan="2">Teaching Unit:
MATERIALS PROJECT</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: J. ZOLLINGER</td></tr>
<tr><td>EEIGM Department: Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic

Assessment: Competencies approach</td><td colspan="5">In-person classes: 29.25</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>1.25</td><td></td><td></td><td>28</td><td></td></tr>
<tr><td colspan="6">Autonomous work: 4</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☐ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☒ C6 ☒ C7 ☒ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to identify key experiences, elaborate an experimental design, realize and analyze experiments to answer a scientific problem (either in the research or in the expertise field) in materials science.

Syllabus:

The students have 8 sessions to solve a scientific problem in materials science using all the equipment (experimental and numerical) at their disposal. The students present their work during the last session.

Pedagogical procedures (organization, assessment, pedagogical resources):

A characteristic of this teaching unit is that there is no obligation of results! The proposed subjecst might be research related with no ensurance that the work will bring outcomes. However, the scientific approach, the voluntarism, curiosity and application of the knowledge gained during the previous semester allow the students to achieve great scientific studies in the field of metallurgy. The teaching unit is made of one session to organize the projects, of seven lab sessions and of one session for presenting their results. Assessment is performed based on the behaviour during the lab work, the quality of the report and of the oral presentation.

Student's expected work in autonomy:

4h of work are required for writing a report and prepare an oral presentation. Extra hours during the project would definitively bring an added-value to the realized work.

Bibliographic references:

Project dependent

Other EEIGM courses directly linked to this course:

Upstream: All the materials teaching units

Downstream: trainings

<table>
<tr><td rowspan="2">Teaching Unit:
TEAM MANAGEMENT</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: A. GARNIER AND P. TISSERANT</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 16</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Competencies approach</td><td>16</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work:</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to develop his/her relational reflexivity, implement management tools and develop the efficiency of his/her team.

Syllabus:

Develop your leadership - Make your teams grow up (conduct an individual interview, follow-up and feedback, build or modify a job description, recruit, animate) - Manager in a difficult situation (feedback, conflict management, stress, support for change) - Acquire basic knowledge on gender equality, sexual harassment, religious expression, LGBT phobia and the consequences at work in the following 3 fields: law, social psychology and management.

Pedagogical procedures (organization, assessment, pedagogical resources):

Theoretical contributions - evaluation by questionnaire and role plays

Student's expected work in autonomy:

Bibliographic references:

Les méthodes en sociologie - L'observation (questionnement) par Henri Peretz
Les techniques de Questionnement – tout sur l'art de questionner par Lionel Bellenger/ Marie-Josée Couchaere
Agir sur ses émotions : tristesse, peur, colère par Stéphanie Ahusseau
Les responsables porteurs de sens par Vincent Lenhardt
Liberté et Cie par Isaac Getz
Systémique et entreprise. Mettre en œuvre une stratégie de changement par Jacques Antoine Malarewicz
Que dites-vous après avoir dit bonjour ? (Communication efficace) par Eric Berne
Manager avec les couleurs par Brigitte Bossuat

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

<table>
<tr><td colspan="2">Teaching Unit:
LINGUISTIC STAYS AND CERTIFICATES</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: P. BEYER</td></tr>
<tr><td colspan="2">EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to attest:
- the linguistic stay(s) he/she accomplished as an EEIGM student, as well as
- the levels reached in the languages he/she studied at the EEIGM by external certifications.

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

Validation of linguistic stays and certificates in accordance with the internal rules of the EEIGM:

Two linguistic stays:
- in an English speaking country and
- in a German or a Spanish speaking country.

Students entering the EEIGM in Nancy in semester V must complete only one linguistic stay.
A linguistic stay consists of four non-stop weeks (written report + oral presentation; required levels are: English B1+, German A2, Spanish B1).
All linguistic stays must be validated at the latest in semester VII, as a condition for the student's departure for a partner university.

Certificates for two of the following languages, English being mandatory:
- English: Certificates of Cambridge (FCE, CAE, CPE), or at least TOEIC Reading and Listening Level 850 plus TOEIC Speaking and Writing Level 320;
- German: Certificates of the Goethe Institute (ZD B1+, B2 and upper levels), DSH-2, TestDaf or Abitur;
- Spanish: Certificates of the Cervantes Institute (DELE B2 and upper levels) or Bachillerato;
- French as a Foreign Language: DELF B2, DALF C1 and upper levels.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: English VI, German VI, Spanish VI or FFL VI

Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
ENGLISH VII</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: N.BRIE</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 18</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>18</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 5</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to obtain his/her mandatory FCE Cambridge examination

Syllabus:

This group concerns French and foreign students who entered the EEIGM in 3rd year with a weak level in English : they follow an 18-hour intensive FCE preparation course (9 sessions of two hours) in view of taking the FCE in December. The course is based on FCE practice tests and FCE past papers.

Pedagogical procedures (organization, assessment, pedagogical resources):

FCE/CAE past exams and practice tests for B1/B2 level
"continuous assessment" (oral presentations and reports) or FCE papers at B2 level

Student's expected work in autonomy:

Use of the resources of the Foreign Language Learning Center

Bibliographic references:

Grammar for FCE
Vocabulary for FCE
FCE practice tests

Other EEIGM courses directly linked to this course:

Upstream: English VI 18, English VI 30 Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
SPANISH VII</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: C. SAVARD-CHAMBARD</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 17.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>17.5</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 2h-3h per week</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to, depending on the groups, prepare the semester study in Valencia or Barcelona, the Spanish DELE examination (B2 and C1 levels) or acquire new knowledge on personal, professional or scientific topics.

Syllabus:

For students going to Barcelona or Valencia: consolidation of knowledge on everyday life, professional and scientific Spanish
For students preparing the DELE: training written and oral tests (DELE intermediate or advanced level)
For other students: conversation classes, presentations of cultural topics, dialogues on everyday life situations, writing CV and cover letters

Pedagogical procedures (organization, assessment, pedagogical resources):

ELE method and tuition in small groups (maximum 18 students)
Studies of advertisements, tourists guides and extracts of scientific books
Review of general and daily press
Continuous assessment: past DELE examinations B2 and C1 levels
Continuous assessment: evaluation of the 5 language skills
Past DELE examinations

Student's expected work in autonomy:

Assimilation of knowledge and expertise
Training past DELE examinations
Prepare oral presentations on current topics and lectures on scientific subjects
Use of the resources of the library and language lab

Bibliographic references:

Workbooks: 1/ Campus Sur B1, Libro del alumno y Cuaderno de ejercicios, Difusión, 2019; 2/ Preparación al Diploma de Español Nivel C1, Edelsa, 2017; 3/ Preparación al Diploma de Español Nivel B2, Edelsa, 2018. Grammar books: 1/ Universo gramatical para estudiantes franceses, Edinumen, Madrid, 2016; 2/ Las 500 dudas más frecuentes del español, Espasa Calpe, 2019. Dictionaries: 1/ Le vocabulaire de l'espagnol, Hachette, Paris, 2014; 2/ Diccionario de la lengua española, Real Academia Española, Madrid, 2019. Vocabulary book: Maribel Molio, 60 fiches de vocabulaire espagnol, Studyrama, Paris, 2017. Conjugation book: Bescherelle, El arte de conjugar en español

Other EEIGM courses directly linked to this course:

Upstream: Spanish 5 and 6 beginners, LV2 or LV3 Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
GERMAN VII</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: P. BEYER</td></tr>
<tr><td>EEIGM Department: European languages and cultures, SEHS</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 17.5</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>17.5</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 5</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to practice German with the objective of reaching one of the following levels of the Common European Framework of Reference for Languages (CEFR):
- level B2 ("Independent User"), C1 or C2 ("Proficient User") for Upstream Unit German VI 16,
- level B1 ("Independent User") for Upstream Unit German VI 28,
- level A2 ("Basic User") for Upstream Unit German VI 38.

Syllabus:

Consolidation and enrichment of the language.
Training reception ("listening" and reading"), production ("speaking" and "writing") as well as interaction ("taking part in a discussion").
In-depth knowledge of the realities of the German speaking countries.
Possibly and depending on the level of the group, introduction to scientific, technical and/or commercial German.

Pedagogical procedures (organization, assessment, pedagogical resources):

Working in groups according to the level.
Continuous assessment.
Use of course books, original documents and on-line resources.

Student's expected work in autonomy:

Diverse application exercises, including reception and production.

Bibliographic references:

https://www.goethe.de/de/spr/kup/prf/prf.html
https://www.dw.com/de/deutsch-lernen/lernangebote-f%C3%BCr-das-niveau-b2/s-13217
"Begegnungen B1+", Schubert
"Erkundungen B2", Schubert
"Menschen A2/B1", Hueber
"Studio A2/B1/B2/C1", Cornelsen
"Ziel B2/C1", Hueber

Other EEIGM courses directly linked to this course:

Upstream: German VI 16, German VI 28, German VI 38 Downstream:

Teaching Unit: **INDUSTRIAL CONFERENCES AND TOURS**	**Year/Semester of EEIGM studies:** 4A – 1st semester
	Course manager: Z. AYADI and J. ZOLLINGER
EEIGM Department: **Development and research**	**Hours/student:**
Teaching method: Active Learning	**In-person classes:**
Assessment:	**Autonomous work:**

Lecture	Tutorial	Lab work	Project	Test

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☐C7 ☐ C8	☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Completing the training and bringing a different lignt by professionals. Narrow contact between students and profesionnals. Participation of the companies and the socio-economic environment in the training.
They also constitute an important opportunity to take advantage of internship or job offers and make the link between the courses at EEIGM and the industrial needs in materials engineering.

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

The conferences are usually scheduled on Wednesdays from 11h15 to 12h30. It is mandatory for the students to attend the conferences by which they are concerned. The tours are scheduled on Thursdays afternoon:

– 20 to 30 seats / tour
– Registration on Arche

Before the tour:

• Preparation of tour (informations about the company)
• Setting up thematic groups

After the tour :

• Report

Student's expected work in autonomy:

• Parts of the report
– presentation of the company: products, strategy, technology, etc.
– Work done by the engineers in this company ?
– Health and safety
– Input of EEIGM skills

Bibliographic references:

Arche: Direction of partnerships

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
PARTNER UNIVERSITY COURSES</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: V. VITZTHUM</td></tr>
<tr><td>EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 15</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td>15</td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☐ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to identify the language skills necessary to follow and understand courses taught in a language other than French during the 2nd semester at one of the universities of the consortium. Each module being associated with a different theme, the scientific expectations at the end of the module will depend on the module chosen.

Syllabus:

Students must choose from five modules taught in Nancy by professors from partner universities in the official language of the university (English for Lulea, Brussels and Moscow, Spanish for Barcelona and German for Saarbrücken).
Lulea: Mechanical phenomena in Fiber Composites (J. VARNA)
Barcelone : Failure analysis in materials technology (A. MATEO & J. CALVO)
Sarrebruck : Kontinuumsmechanik (P. SHARMA) & Surface design and 3D Analysis (T. FOX)
Bruxelles (en alternance, une année sur deux) : How metallurgy will make cars and planes safer and lighter: steel alive and 3D printing (S. GODET) ou Cements and concretes (M-P. DELPLANCKE)

Pedagogical procedures (organization, assessment, pedagogical resources):

Each course consists of 12 sessions of 1h15. The evaluation methods are defined by the teachers at the start of the course.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

4th year

[SEMESTER 8- LULEÅ]

The students must choose courses for a total of 30 ECTS. They must select 4 courses amongst the following.
The "spring" semester includes two periods called "Quarters":

- Quarter 3 : 17th January to 26 th March 2021 (the last week is exam week)
- Quarter 4 : 28th March to 5th June 2021 (the last week is exam week)

Students must select 2 courses per quarter. It is not acceptable to choose 4 courses during the same quarter.
Non Swedish students must attend compulsory Swedish courses in the third quarter (no ECTS credits granted).

MODULES	**ECTS**
Semestre d'études à Luleå (Suède)	**30**
Metal Working (Q3)	7.5
Composite Materials (Q3)	7.5
Surface Engineering (Q3)	7.5
Material Modelling (Q3)	7.5
Advanced processing and Cyberlab (Q3)	7.5
Bio Composites (Q3)	7.5
Nanostructured Materials and Nanotechnology (Q4)	7.5
Aerospace Materials (Q4)	7.5
Advanced Materials Characterisation Techniques (Q4)	7.5
Materials Selection and Eco-Design (Q4)	7.5
Composites Manufacturing and Lightweight Design (Q4)	7.5
Swedish for International Students 1 (mandatory)	0
Swedish for International Students 2 (mandatory)	0

Teaching Unit: METAL WORKING	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. FOROUZAN**				
EEIGM Department: Materials specialisation	**Hours/student:** 200				
Teaching method: Active Learning	**In-person classes:** 70				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	14			50	6
	Autonomous work: 130				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☒ **SC6**				

Educational objectives of the course:

Divided in three categories below, after finishing this course the student should be able to: Knowledge and understanding: Evaluate the behaviour of metals during metal working with regard to both material- and process depending parameters. Describe the characteristics, basic concepts and definitions of different metal working methods. Draw conclusions about the microstructure's dependence on the metal working method. Predict challenges related to different metal working processes. Show knowledge of simple empirical and semi-empirical methods for different metal working techniques, as well as exemplify when FEM modeling can be used for metal working. Skills and abilities: Have the ability to make an engineering in-depth reasoning, verbally and / or in writing, about different metal working techniques. Be able to interpret the impact of various metal working methods on the final product in an engineering way. Have developed their ability to use simpler computer-based simulation tools. Judgement and approach: Be able to appreciate the relevance of process simulation. Critically review the production economy in proposed metal working methods. Identify process losses in different metal working methods

Syllabus:

The course includes metal working of products with the main focus on profile- and flat rolling. The course deals with material engineering issues, including metallurgy, from slabs to metal working and heat treatment of products. The following parts are included in the course: *Production and treatment of slabs*: History, ingot- and continuous casting, treatment, heating, blooms and billets requirements, different cast structures, micro- and macrosegregation and inclusions, casting defects. *Rolling*: overview principles, rolling mills, rolling mill deformation, flatness and profile, flatness errors, rolling terminology, rolling rolls, rolling wear. *Profile rolling* : Principles, rolling mills, roller pairs, rolling methods and profile series, rolling terminology, profile fill, dimension measurement, rolled products,

Flat-rolling : Sheet rolling, hot-rolling, cold-rolling, post-treatments of flat products. In addition, the course also includes: *forging, tube making, wire drawing, ring rolling, post-treatment of long products*. Introduction to simpler empirical and semi-empirical methods of metal working. Introduction to FEM: Knowledge of the possibility of using FEM modeling for metal working

Pedagogical procedures (organization, assessment, pedagogical resources):

Each course occasion´s language and form is stated and appear on the course page on Luleå University of Technology's website. Lectures, exercises, seminar tasks and study visit. Examination: To pass the course the seminar assignment must be approved. A written exam has to be passed and will be graded - Written exam (5,5 ECTS) – Seminar task (2 ECTS).

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Bhaduri, A., 2018. Mechanical properties and working of metals and alloys (Vol. 264). Berlin: Springer.
Ginzburg, V.B., 2004. Metallurgical design of flat rolled steels. CRC press.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
COMPOSITES MATERIALS</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester
Course manager: R. JOFFE</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student: 200</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning

Assessment: Classic</td><td colspan="5">In-person classes: 126</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>16</td><td>6</td><td>80</td><td>20</td><td>4</td></tr>
<tr><td colspan="6">Autonomous work: 74</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☒ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student is supposed to - have achieved knowledge about relationships between structure and constituents of composites and their macroscopic properties - understand the significant mechanisms steering the behaviour of composites and how they are affecting elastic properties and strength - be able to estimate properties of composites with different micro- and meso structure and to perform optimal material selection - be able to apply methods for calculation of composite structures and to analyse their mechanical performance - be able to do mechanical properties measurements and to analyse test results - be able to use simulation tools/software to design material with desired properties - be able to write research reports on the subject

Syllabus:

The course considers the methods of analysis and properties of fiber and particle reinforced composites with polymeric, ceramic or metal matrices. Properties of constituents and manufacturing methods are analyzed. The significance of geometrical aspects, interfaces and statistical effects is considered. Mechanism based models are presented with the aim to determine thermo-mechanical properties, analyze load-transfer and failure mechanisms in composites. Methods to analyze laminated structures are developed and used in simulation exercises

Pedagogical procedures (organization, assessment, pedagogical resources):

Lectures combined with seminars - Mandatory home works and laboratory work with reports
Examination: To pass the Course both home works and lab reports must be approved and graded. A written exam has to be passed and will be graded - Written exam (3,7 ECTS) – Laboratory work (3 ECTS) – Home work assignment (0,8 ECTS)

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Course notes "Composite Materials" in digital form.

Other EEIGM courses directly linked to this course:

Upstream: Mécanique des Solides Déformables Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
SURFACE ENGINEERING</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: F. AKHTAR</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student: 200</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 94</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>28</td><td></td><td>20</td><td>40</td><td>6</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 106</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="3">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="3">☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

The aim for this course is to provide the student with:
basic knowledge about different methods of surface modification and surface treatment
in-depth understanding of how different material structures affects the surface properties
knowledge of different physical laws and chemical reactions which affects the physical and mechanical properties of material surfaces
in-depth understanding of tribological processes and knowledge of other aspects of the surface performance
basic knowledge of different analytical techniques for surface analysis and characterisation of their performance

Syllabus:

Different methods for modification of material surfaces and surface treatment. Atomistic and microstructural description of surfaces together with morphological and surface topographical description of surfaces. The effect of surface energy, surface tension and wetting on the physical and mechanical properties of surfaces. Friction in sliding as well as rolling under dry and lubricated conditions. Different types of wear such as adhesive wear, abrasive wear, surface fatigue, fretting and erosive wear. Impact of corrosion on wear processes. Different methods for characterisation of surfaces especially from a tribological point of view. Surface engineering for friction and wear control

Pedagogical procedures (organization, assessment, pedagogical resources):

Lectures and laboratory project work. The laboratory project work is obligatory.
Examination: Written exam with differentiated grades, approved laboratory project work. Written exam (5,2 ECTS) – Laboratory work (2,3 ECTS)

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Batchelor, A.W., Loh Nee Lam. & Chandrasekaran, M. (2011). Materials degradation and its control by surface engineering [Elektronisk resurs]. (3rd ed.) London: Imperial College Press.

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

<table>
<tr><td rowspan="2">Teaching Unit:
MATERIAL MODELING</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: R. JOFFE</td></tr>
<tr><td>EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 200</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>16</td><td></td><td>80</td><td>25</td><td>6</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 73</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="5">☒ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to:
- understand the multi-scale nature of materials and the need to use a hierarchical approach to model them; - be familiar with a number of models which are formulated for different scales present in any material; - have knowledge of concept of modelling of the material properties based on a unit cell consisting of atoms; - be able to choose and apply models derived from an atomistic structure to predict basic material properties; - have good understanding of the link between nano-, micro- and macro- material scales and be able to demonstrated it by defining input and output parameters required by different models.

Syllabus:

- Multi-scale nature of materials (nano-, micro-, macro-) - Link between different size scales - Hierarchical approach in material modelling - Atomistic method in materials modelling, aspects of different approaches will be presented, such as: total energy calculations, molecular dynamics simulations ab intio methods - General overview of numerical techniques in materials modelling Application of the numerical techniques to solve material modelling problems will be addressed during the course and some of the commercial software packages will be discussed

Pedagogical procedures (organization, assessment, pedagogical resources):

Lectures, seminars, laboratory work.
Approved written exam and mini-projects. Written exam (4,5 ECTS) – Laboratory work (3 ECTS)

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Course literature consists of textbook chapters and scientific papers distributed during the course.

Other EEIGM courses directly linked to this course:

Upstream: Solid state physics (F7006T or equivalent), Applied mathematics (M0026M or M7018, or equivalent)

Downstream:

Teaching Unit: ADVANCED PROCESSING AND CYBERLAB	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: J. VOLPP				
EEIGM Department: Materials specialisation	Hours/student: 200				
Teaching method: Active Learning	In-person classes: 176				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	16		80	40	40
	Autonomous work: 24				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8	☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

At the end of the course, the student should be able to:
- know a comprehensive picture of traditional materials processing techniques
- know a complementary picture of selected advanced materials processing techniques
- be able to compare the different techniques with each other due to certain criteria
- in a team present and write a report for a selected advanced processing method
- comprehensively understand laser welding as the demonstrator technique
- in a teamwork plan and perform laser welding trials
- deeply understand and feel sensitive to the process physics of laser welding
- know the background of mathematical modelling
- apply mathematical modelling and conduct well organized laboratory experiments
- handle laboratory equipment by distance through lab web conference communication
- communicate via Web-conferencing in a local plus in a remote team
- create and derive theories; draw generalizing conclusions; create suitable solutions

Syllabus:

Subject knowledge Survey on traditional materials processing techniques (cutting, forming, joining, etc.); Selected examples of advanced processing techniques (laser processing, adhesive bonding, EDM, etching, etc.); Theory and practice of laser welding Instrument knowledge Mathematical modelling; CyberLab remote experiment technique Application of engineering instruments along with personal skills Mathematical modelling of laser welding; Laser welding laboratory experiments; CyberLab remote laser welding; CyberLab remote marking.

Pedagogical procedures (organization, assessment, pedagogical resources):

Teaching: Theory through self learning and few lectures; modelling and experiments through practical exercises and laboratory training in teams, including remote laboratory via videoconferencing.
Examination: Succesfull written exam on survey of materials processing techniques along with attendance of 70 % of the lectures and 100 % of the exercises will give a pass grade. Higher grades can be achieved through strong engagement or highly valuable advices/conclusions. Mathematical exercices on materials processing (1,5 ECTS) – Laboratory work (3 ECTS) – Project work (1,5 ECTS) – Classtest (1,5 ECTS)

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Benedict, Gary F. Non-traditional Manufacturing Processes. Duley, W. Laser Welding. Hand-out notes.

Other EEIGM courses directly linked to this course:

Upstream: Courses in physics (mechanics, thermodynamics, atomic physics, optics), materials science, materials processing A or equivalent. Recommended is also materials processing B and laser material processing

Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
NANOSTRUCTURED MATERIALS AND NANOTECHNOLOGY</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester
Course manager: F. AKHTAR</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student: 200</td></tr>
<tr><td colspan="2" rowspan="2">Teaching method: Active Learning</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td>5</td><td></td><td></td><td>100</td><td>65</td></tr>
<tr><td colspan="5">Autonomous work: 30</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to understand the basic principles for nanostructured materials and relative merits of different techniques for the production of nanostructures.

Syllabus:

The course will cover nanostructured materials and phenomena occurring when the length scale of the constituents are in the nanometer range. Emphasis will be put on interface phenomena since nanostructured materials contain a large fraction interfaces. The course will give examples and potentials for the future of nanotechnology. Generally applicable techniques for the preparation of bulk nanostructured materials, thin films, patterned nanostructures such as sol-gel, thin film and self-assembling techniques will be discussed as well as high spatial resolution techniques for the characterisation of nanostructures.

Pedagogical procedures (organization, assessment, pedagogical resources):

Teaching: Lectures, seminars and presentation at final seminar-exam
Examination: Written report and seminar-exam Project work (5 ECTS) – Seminars (2,5 ECTS)

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Relevant scientific literature collected through literature search, lecture notes.

Other EEIGM courses directly linked to this course:

Upstream: Phase Transformations or similar Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
AEROSPACE MATERIALS</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: P. FERNBERG</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student: 200</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>23</td><td></td><td></td><td>120</td><td>10</td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 47</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to - have deep knowledge about structure and behaviour of high performance materials used in aerospace industry - be able to evaluate properties of composites, ceramic materials and alloys to perform optimal material selection for use in harsh environments and service conditions - will know and understand the most important degradation mechanisms that initiate and evolve due to thermal and mechanical loads and lead to material fatigue and reduced durability - be able to do produce long fiber composites, to measure their mechanical properties, to observe and to quantify damage modes and to analyse their effect on properties - be able to apply composite material degradation models, to perform fracture mechanics analysis in alloys and to predict time dependent material behaviour - be able to perform numerical simulations of structures using commercial software to design optimized structures - have good skills in analysing research papers and writing research reports

Syllabus:

The material classes analyzed in this course are high performance materials like light weight alloys, superalloys, ceramics and different types of composites including materials modified on nanoscale. Methodology will be given to determine properties of these multiscale materials on all considered length scales. The properties most important for design in the aerospace applications are performance at high mechanical loads, extreme temperatures and material aging and fatigue due to extreme environmental effects. Processing methods will be considered in relation to desired material performance. Durability and damage tolerance will be accessed by analyzing degradation, creep and damage mechanisms. Methodology for structural analysis will be given and training performed.

Pedagogical procedures (organization, assessment, pedagogical resources):

Teaching: Lectures combined with seminars Mandatory home works and laboratory work with reports
Examination: To pass the Course both home works and lab reports must be approved and graded. A written exam has to be passed and will be graded – Written exam (2,2 ECTS) – Project (4,5 ECTS) – Home work assignment (0,8 ECTS)

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

The course folder, Aerospace Materials. Research papers.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
ADVANCED MATERIALS CHARACTERISATION TECHNIQUES</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester
Course manager: F. AKHTAR</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student: 200</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>12</td><td></td><td>67</td><td>60</td><td></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Autonomous work: 61
Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

The aim of this course is to provide sufficiently detailed understanding of some of the most important materials characterization techniques. Active student participation through discussions is also stimulated.

Syllabus:

After fulfilling the course the students will have achieved knowledge about some of the most important materials characterization methods and choose the most suitable technique for a certain application. Techniques covered throughout the course are electron microscopy, atomic for microscopy, thermal analysis, XRD, spectroscopic methods and a number of other methods.

Pedagogical procedures (organization, assessment, pedagogical resources):

Teaching: Lectures and laboratory work.
Examination: Approved seminar, assignment and lab reports. Seminar (2,5 ECTS) – Assignments (2,5 ECTS) – Laboratory work (2,5 ECTS)

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Brandon, D. and Kaplan, W.D. (2008). Microstructural Characterization of Materials, 2nd ed. Chichester, Wiley

Other EEIGM courses directly linked to this course:

Upstream: Basic knowledge in materials engineering (metallic and polymeric materials, solid estate physics).

Downstream:

Teaching Unit: MATERIAL SELECTION & ECO DESIGN	Year/Semester of EEIGM studies: 4A - 2nd semester
	Course manager: **E. VUORINEN**
EEIGM Department: Materials specialisation	**Hours/student:** 200
Teaching method: Active Learning	**In-person classes:**

Lecture	Tutorial	Lab work	Project	Test
		80	100	

Assessment: Classic	**Autonomous work:** 20

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8	☒ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☐ SC6

Educational objectives of the course:

The aim for this course is to provide the student with - basic knowledge about different methods for materials selection - experience from case-studies with the methodology for systematic selection of materials, design and manufacturing methods for components or products - basic knowledge about the connections between environment, energy and materials selection with regard to their manufacturing methods and for different products during their life-cycle. - knowledge about methods for design of processes and products with regard to sustainable development - ability to make environmentally sound selections of materials with regard to manufacturing methods and life-cycle aspects.

Syllabus:

The course is divided into a theoretical part (50%) and a project part (50%). In the theoretical part the methodology for materials selection, and the influence of product-design and manufacturing methods on the meterials selection are enlightened. The possibilities and limitations with material databases are shown. Environmental aspects on manufacturing methods. Recycling and life-cycle analyses are exemplified. Methods for design of processes and products with regard to reuse and recycling are exemplified. Methods for recovery of materials and environmental aspects on use and production of energy are treated. The project part of the course will train the student in the materials selection methodology. In some but not all of the projects, environmental considerations have to be regarded in the selection of materials.

Pedagogical procedures (organization, assessment, pedagogical resources):

Teaching: Lectures and exercises, study visit(s) to relevant goals. Every student takes part in one or two case-projects Examination: Written report(s) of the case-studies as well as written tests of the different parts of the course have to be approved. Project (4,5 ECTS) Test (3 ECTS)

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Materials Selection in Mechanical Design, 4:th edition. M.F. Ashby. Butterworth - Heinemann 2011.

Other EEIGM courses directly linked to this course:

Upstream: Basic knowledge of materials science and engineering.

Downstream:

Teaching Unit: BIOCOMPOSITES	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **K. OKSMAN**				
EEIGM Department: Materials specialisation	**Hours/student:** 200				
Teaching method: Active Learning	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	16		50		3
	Autonomous work: 131				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☒ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

The student will after the course have knowledge about biocomposites in which the reinforcement or matrix polymer is based on renewable material. The goal is that student will have fact knowledge of different raw materials used in biocomposites, understand their hierarchical structure, be able to list the most important components, be able to identify different type of fibers, understand differences between fibers and polymers which can be used, be able to list the most important properties and know definitions biopolymers and nanomaterial. The student should be able describe different manufacturing methods and understand how and why biocomposites are used in different applications. The student should also be able to analyze composites mechanical properties and explain differences between different materials compositions. The student should have developed understanding of interaction between the fibers and materials polymer, how the addition of fibers is affecting properties in relation to the matrix polymer.

Syllabus:

Raw materials: Reinforcement consisting of wood, natural fibers and bionanomaterials, fiber properties and how these materials bare made and their composition. Matrix: thermoplastics, thermosets, biopolymers, polymer structure, composition, important properties. Composite material: traditional wood composites, new formable wood composites and bionanocomposites. Processing methods: such as extrusion, injection molding, compression molding, resin injection methods and casting. Testing and properties: mechanical properties moisture stability, thermal stability compatibility, density, weather stability and durability. Applications for biocomposites: such as construction materials, vehicles packaging and in medical. Laboratory where students will manufacture biocomposites using twin-screw extrusion, prepare test samples using injection molding and test the most important properties of the composites.

Pedagogical procedures (organization, assessment, pedagogical resources):

Realization: Teaching will be done as lectures, 3 assignments which can be made in small groups of two students, and one laboratory is made in larger groups approx. 4 students. The laboratory is about manufacturing of biocomposite or wood composites using a twin-screw extruder and make test samples with injection molding. The goal is that students will get knowledge how the addition of biofibers is made and how they affect the properties.
The students will help with preparation of raw materials, suggest extrusion parameters and help with the calibration of the processing equipment. Materials properties such as tensile testing, density, viscosity and microstructure (adhesion between fibers and matrix) are studied and the results from different groups are collected to given to all students. The labb-report need to contain description of the laboratory, materials used and test as well as the results. In the course usually an inspiration seminar about biocomposites is included.
Examination: Approved laboratory work and report, assignments, and written exam. Written exam (4 ECTS) – Assignments (1,5 ECTS) – Laboratory work (2 ECTS)

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Wood thermoplastic composites, eds. K. Oksman and M. Sain, Woodhead Publisher 2007.
Wood Handbook, lecture handouts.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: SWEDISH FOR INTERNATIONAL STUDENTS 1	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **K. MERKLE-SODERHOLM**				
EEIGM Department: European languages and cultures, SEHS	**Hours/student:**				
Teaching method: Active Learning	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	12				3
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☒ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

At the end of the course, the student should have gained basic language skills. The student must:
handle everyday language situations so that the student can present themselves and their background in Swedish
be able to read and understand simple Swedish texts
be able to make use of basic knowledge about the structure of the Swedish language

Syllabus:

The course includes:
basic vocabulary, phrases and grammar such as word order of principal clauses, the present tense and pronouns.
basic vocabulary
time expressions
pronunciation training
listening comprehension
basic everyday phrases

Pedagogical procedures (organization, assessment, pedagogical resources):

Teaching and learning is done by short walkthroughs and practical exercises designed to make the student try and develop their abilities in Swedish. The student must:
be able to recount everyday events both in speech and in writing
perform oral and written assignments both individually and in groups
perform listening comprehension exercises
acquire knowledge of basic grammar
perform reading comprehension exercises
Active participation during lessons as well as home studies are a requirement for the student to attain the knowledge required for a passing grade.
Examination written exam

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Levy Scherrer, Paula & Lindemalm, Karl (2014). Rivstart A1+A2.Textbok. Natur och kultur: Stockholm. ISBN 978-91-27-4342-0 (chapters1-3).

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: SWEDISH FOR INTERNATIONAL STUDENTS 2	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: K. MERKLE-SODERHOLM				
EEIGM Department: European languages and cultures, SEHS	Hours/student:				
Teaching method: Active Learning	In-person classes:				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	23				3
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☒ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

At the end of the course, the student should have gained basic language skills. The student must:
handle everyday language situations so that the student can present themselves and their background in Swedish, both in speech and in writing
tell something about their interests in Swedish
be able to read and understand simple Swedish texts
be able to make use of basic knowledge about the structure of the Swedish language

Syllabus:

The course includes:
basic vocabulary, phrases and grammar such as word order of principal clauses, verb groups and some common tenses, pronouns as well as adjectives in singular and plural
time expressions
pronunciation training
exercises in listening comprehension and reading comprehensions

Pedagogical procedures (organization, assessment, pedagogical resources):

Teaching and learning is done by short walkthroughs and practical exercises designed to make the student try and develop their abilities in Swedish. Active participation during lessons as well as home studies are a requirement for the student to attain the knowledge required for a passing grade.
Examination : Written exam

Student's expected work in autonomy:

The students are expected to carry out comprehensive work in autonomy including preparation for all course activities (lectures, lessons, etc)

Bibliographic references:

Levy Scherrer, Paula & Lindemalm, Karl (2014). Rivstart A1+A2.Textbok. Natur och kultur: Stockholm. ISBN 978-91-27-4342-0 (chapters1-3).

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

[SEMESTER 8- BARCELONA]

Syllabus for the exchange students (description with the hyperlink of the code)

Idioma	Código	Asignatura	Tipología	ECTS
CAST	295em021	Manufactura Moderna de Materiales metálicos	Obligatoria	6
CAST	295em022	Integridad Estructural y Análisis de Fallos	Obligatoria	6
OPTATIVAS, CURSAR UN MÍNIMO DE 18 CRÉDITOS				
CAST	295em125	Nuevos Retos en aditivación y degradación de materiales plásticos	Optativa	6
CAST	295em121	Tecnología de materiales compuestos	Optativa	6
ENG	295ii023	Management of Technology	Optativa	6
CAST	295em122	Materiales Biomédicos	Optativa	6
CAST	295em126	Tecnología de Unión de Materiales	Optativa	6
CAST	295em131	Materiales con aplicaciones en el transporte y en la energía	Optativa	6
				30

Syllabus for the double degree (description with the hyperlink of the code)

Compulsory courses

Idioma	Código	Asignatura	Tipología	ECTS	comentarios
ENG	295ii023	Management of Technology	Obligatoria	6	
CAST	295em021	Manufactura Moderna de Materiales metálicos	Obligatoria	6	
CAST	295em022	Integridad Estructural y Análisis de Fallos	Obligatoria	6	
ENG	295ii024	Sustainability and Circular Economy	Obligatoria	6	
		Optativas	Optativa	6	A escoger entre el listado adjunto
				30	

Elective courses

Idioma	Código	Asignatura	Tipología	ECTS
CAST	295em125	Nuevos Retos en aditivación y degradación de materiales plásticos	Optativa	6
CAST	295em121	Tecnología de materiales compuestos	Optativa	6
CAST	295em131	Materiales con aplicaciones en el transporte y energía	Optativa	6
CAST	295EM122	Materiales Biomédicos	Optativa	6
CAST	295em126	Tecnología de Unión de Materiales	Optativa	6

<table>
<tr><td colspan="3">Teaching Unit:
MANAGEMENT OF TECHNOLOGY</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="3"></td><td colspan="5">Course manager: J. O. NADAL</td></tr>
<tr><td colspan="3">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="3" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>34</td><td>20</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Assessment: Classic</td><td colspan="5">Autonomous work: 96</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

Upon completion of the course, the student should be able to:
- Inventorate and evaluate internal and external, consolidated and emerging technologies, and make a proposal for their management.
- Plan and manage RDI projects.

Syllabus:

Technology evaluation: level of development; Comparison of alternatives; Technology forecasting; Possible customers and uses
Business models: Project Management concepts; Phase-gate methods; Standard project management; Agile methods
Technology project management: Project Management concepts; Phase-gate methods; Standard project management; Agile methods

Pedagogical procedures (organization, assessment, pedagogical resources):

The teaching of the course is based on different methodologies (Master classes, seminars, workshops, projects) prioritizing active learning and "learning by doing" through exercises and team projects.
Class assignments of blocks 1, 2 and 3: 20% each
Course project: 40%

Student's expected work in autonomy:

Bibliographic references:

- Nicholas, John M.; Steyn, Herman. Project management for engineering, business and technology. 5th ed. Abingdon, Oxon: Routledge, 2017. ISBN 1138937347.
- Kotter, John. Leading change. Boston: Harvard Business Review, cop. 2012. ISBN 9781422186435.
- Çetindamar, Dilek; Phaal, Robert; Probert, David. Technology management : activities and tools. London: Palgrave, [2017]. ISBN 9781137431851.
- Armstrong, Paul. Disruptive technologies : understand, evaluate, respond. London: Kogan Page, [2017]. ISBN 9780749477288.
- Hiatt, Jeffrey M.; Creasey, Timothy J. Change management : the people side of change : an introduction to change management from the editors of the Change Management Learning Center. 2nd ed. Loveland: Prosci Learning Center, [2012]. ISBN 193088561X.
- Flanding, Jens P.; Grabman, Genevieve M.; Cox, Sheila Q. The technology takers : leading change in the digital era. Bingley: Emerald Publishing, [2019]. ISBN 9781787694644

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: **Manufactura Moderna de Materiales Metálicos**	**Year/Semester of EEIGM studies:** 4A - 2nd semester
	Course manager: **J. M. CABRERA MARRERO**
EEIGM Department: Materials specialisation	**Hours/student:**
Teaching method: Academic	**In-person classes:**

Lecture	Tutorial	Lab work	Project	Test
42	6	6		

Assessment: Classic	**Autonomous work:** 96
Generic EEIGM competencies	**Specific EEIGM competencies**
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**

Educational objectives of the course:

El objetivo general de la asignatura es proporcionar las bases necesarias para comprender los procesos de manufactura tradicionales de los materiales metálicos (moldeo, laminación, forj,a extrusión, estirado, tecnicas pulvimetalúrgicas y soldadura). El estudiante asimismo comprenderá la interacción de los distintos procesos con las microestructuras de partida y las obtenidas así como la correlación con las propiedades mecánicas finales. Al final del curso se dedicarán algunas sesiones a delinear procesos de conformado metálico modernos.

Las competencias genéricas que alcanzará el estudiante serán a) capacidad para entender a racionalizar el proceso de manufactura de piezas metálicas, b) capacidad para desarrollar técnicas de fabricación y conocimiento de técnicas de caracterización, c) capacidad de trabajar en equipo en el pre-proyecto y d) capacidad de comunicación escrita y oral técnica

Syllabus:

Solidificacion y Moldeo: El proceso de solidificación. Nucleación y Crecimiento. Tipos de Crecimiento. El subenfriamiento constitucional. Solidificación de aleaciones binarias. Solidificación aleaciones autécticas. Solidificación en molde. Concepto de Colabilidad. Defectología de Solidificación. Moldeo. Alimentación y Llenado. Reglas de Moldeo. Tipos de Molde

Elementos de Teoría de Plasticidad: Tensiones y tipos de tensiones. Deformaciones y Tipos de deformaciones. Estados de Tension. Estados de Deformación. Modelización de la Deformación Plástica. Deformacion en frío. Deformación en caliente. Efecto de velocidad de deformacion y Temperatura. Ensayos Experimentales

Fundamentos de Operaciones de Conformado: Introducción. El ensayo de Traccion. Frío vs Caliente. Mecánica del conformado. Método SLAB. Método de Energia de Deformación Uniforme. El trabajo redundante. Determinación de tensión de fluencia. Efecto de la temperatura. Efecto de la velocidad de deformación. Efecto de la fricción. Efectos microestructurales

Laminación: Introducción y notas históricas. Laminación en caliente vs en frío. Mecánica básica de la laminación. Equipos de laminación Otros procesos de laminación. Problemas y defectos de productos laminados. Control termomecánico durante la laminación

Forja: El proceso de Forja. Métodos de Forja. Tipos de equipos. Mecánica de la Forja. El fibrado. Defectos de forja

Extrusión y Estirado: Definición de Extrusión. Tipos de Extrusión. Equipos. Mecánica de la Extrusión. Matrices de Extrusion. Defectología. Definición de Estirado. Tipos de Estirado. Boquillas de Estirado. Mecánica del Estirado. Defectos

Conformado de chapa: Introducción. Características de chapas para los procesos de conformado: coeficiente de endurecimiento y coeficiente de anisotropía. Tipos de procesos. Importancia de la recuperación elástica. El proceso de embutición. Defectología. Curvas FLD. Nuevos aceros de alto límite elástico. Estampación en caliente

Soldadura: Definición. Metalurgía física de la soldadura. La zona afectada térmicamente. Tipos de procesos. Soldaduras en estado sólido. Soldaduras sólido - líquido (brazing y soldering). Soldaduras de fusion. Soldadura por resistencia eléctrica. Soldadura oxiacetilénica. Soldaduras por arco eléctrico: electrodo recubierto, TIG, MIG, MAG.

Defectos de soldadura. Soldabilidad metalurgica. Soldabilidad en aceros.

Pulvimetalurgia: Introducción a la Pulvimetalurgia. Fases del Proceso. La materia Prima. La compactación. La sinterización: en fase sólida y en fase líquida. Atmósferas de protección. Tratamientos Térmicos.

Procesos Modernos: Conformado incremental: simétrico y asimétrico. Hidroconformado. Procesos de Deformación Plástica Severa

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

- Dieter, George Ellwood. Mechanical metallurgy. 3rd ed. New York [etc.]: McGraw Hill Book Company, cop. 1986. ISBN 0070168938.
- Groover, Mikell P. Fundamentos de manufactura moderna : materiales, procesos y sistemas. México [etc.]: Prentice Hall, 1997. ISBN 9688808466.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: Integridad Estructural y Análisis de Fallos	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. C. CANER**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	42	6	6		
	Autonomous work: 96				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☒ SC6				

Educational objectives of the course:

El objetivo de este curso es combinar conocimientos teóricos y práctico de la fatiga y la fractura en materiales, componentes y estructuras, así como métodos para evaluar la integridad estructural. El curso da especial relevancia al análisis de grietas y entallas en el diseño estructural y en la estimación de vida en servicio. Se aportará un conocimiento profundo en el campo de la mecánica de la fractura, prestando especial relevancia a su implementación para analizar la funcionalidad mecánica de un material bajo diferentes condiciones de servicio. Otro objetivo fundamental de este curso es la descripción de los procedimientos generales, técnicas y precauciones a seguir en la investigación y análisis de fallos de materiales. Las etapas de la investigación de un proceso de fallo en servicio serán discutidas y las caracterísiticas de las causas de rotura mas comunes serán descritas.

Syllabus:

Introducción: Integridad estructural como campo de conocimiento. Enfoques de diseño mecánico. Fundamentos de Elasticidad y Plasticidad. Comportamiento elástico, elastoplástico, viscoelástico y viscoplástico.

Fundamentos de fractura: Resistencia a la rotura teórica. Concentradores de tensiones. Tensión local. Energía disponible para la fractura. Condición de fractura. Factor de intensidad de tensiones y tenacidad de fractura. Modos de fractura. Estabilidad de fractura. Fractura en modo mixto. Zona plástica en los tres modos de fractura. Tenacidad de fractura y microestructura. Transición dúctil-frágil. Descohesión y clivaje. Fractura dúctil: modelo de McClintok. Fractura en materiales compuestos laminares.

Fractura cohesiva, fractura distribuida y el método de efecto de tamaño: Planteamiento de Hillerborg. Propiedades de la curva de reblandecimiento. Determinación experimental de las propiedades de grietas cohesivas. Fractura cohesiva comparada con fractura elástica efectiva. Localización de deformación. Conceptos básicos de fractura distribuida. Modelos uniaxiales y triaxiales de fractura distribuida. Fractura cohesiva comparada con fractura distribuida. El método de efecto de tamaño. Determinación de propiedades de fractura por el método de efecto de tamaño.

Fatiga e integridad estructural: Daño por fatiga: deformación cíclica, nucleación y crecimiento de grietas. Métodos de diseño de fatiga. Fallo asociado a fatiga. Crecimiento del grieta asistido por el medio ambiente: fragilización por hidrógeno, corrosión bajo tensión y corrosión-fatiga. Fluencia: deformación y ruptura. Fatiga-fluencia.

Ensayos no destructivos: Partículas magnéticas. Líquidos penetrantes. Ultrasonidos. Radiografías. Corrientes inducidas. Otras técnicas

Fallos en componentes estructurales: Técnicas de análisis de fallos. Diagnóstico inicial. Examen visual. Macro-examen. Micro-examen. Microscopía electrónica. Análisis químico. Causas de fallos en componentes metálicos, poliméricos y cerámicos.

Pedagogical procedures (organization, assessment, pedagogical resources):

40% Examen Final + 40% Exámenes Parciales + 20% Actividades dirigidas.
Si nota acumulada de Exámenes Parciales es superior a 5, el examen final es opcional

Student's expected work in autonomy:

Bibliographic references:

- Suresh, Subra. Fatigue of materials. 2nd ed. Cambridge: Press Syndicate of the University of Cambridge, 1998. ISBN 0521578477.
- Alcalá, J.; Llanes, L. M.; Mateo García, Antonio Manuel; Salán, M. N. Fractura de materiales [en línea]. Barcelona: Edicions UPC,2002 [Consulta: 20/05/2020]. Disponible a: ttp://hdl.handle.net/2099.3/36175. ISBN 8483015927.
- Broek, David. Elementary engineering fracture mechanics. 4th rev. ed. The Hague [etc.]: Martinus Nijhoff, 1986. ISBN 9024725801.
- Bazant, Zdenek P. Scaling of structural strenght. 2nd ed. Oxford: Elsevier, 2005. ISBN 0750668490.
- Bazant, Zdenek P.; Cedolin, Luigi. Stability of structures : elastic, inelastic, fracture and damage theories. Singapore [et al.]: WorldScientific Publishing, cop. 2010. ISBN 9789814317023.
- Brooks, Charlie R.; Choudhury, A. Failure analysis of engineering materials. New York [etc.]: McGraw-Hill, cop. 2002. ISBN0071357580.
- ASM handbook. 10th ed. Materials Park, Ohio: AMS International, 1990-.
- Bazant, Zdenek P.; Planas, Jaime. Fracture and size effect : in concrete and other quasibrittle materials. Boca Raton: CRC PRess,cop. 1998. ISBN 084938284X.
- Hertzberg, Richard W.; Hertzberg, Jason L.; Vinci, Richard P. Deformation and fracture mechanics of engineering materials. 5th ed.New York [etc.]: John Wiley & Sons, cop. 2013. ISBN 9780470527801

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: SUSTAINABILITY & CIRCULAR ECONOMY	Year/Semester of EEIGM studies: 4A - 2nd semester
	Course manager: C. A. VALDERRAMA ANGEL
EEIGM Department: Materials specialisation	Hours/student:
Teaching method: Academic	In-person classes:
Assessment: Classic	Lecture: 36 / Tutorial: 18 / Lab work: / Project: / Test:
	Autonomous work: 96

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☐ SC6

Educational objectives of the course:

At the end of the course the student will be able to: • Distinguish between the concepts of the use of resources and efficiency in terms of sustainable development and the linkage of thermodynamics science and environmental impact.• Perform a sustainable assessment of a technological system by using the exergy analysis. • Demonstrate a good knowledge and understanding of the tools used for sustainability analysis with emphasis on carbon footprint, Life cycle assessment and Life cycle costing.• Evaluate the technological, environmental and economic feasibility of a system through the life cycle perspective.

Syllabus:

1. Introduction to Circular Economy: Definition and principles. Key characteristics and enabling factors of a circular economy. Resource, environmental, economic and social benefits of circular economy. Circular economy in the European and global context. Revalorisation of waste to energy, products. Description of the main routes of characterization of wastes/raw materials to quantify their energetic or material valorisation potential.
2. Sustainability exergy analysis: Sustainability and exergy. Preliminary quantification methods: Sustainable Resource Utilization Parameter, Exergy Efficiency, The Environmental Compatibility. Novel accounting methods (LCA perspective).
3. Methodologies of economic and environmental evaluation (LCA/LCC): LCA target audience and applications. LCA framework, goal and scope. Inventory analysis, allocation Impact assessment. Carbon footprint methodology. LCC as complement of LCA. LCC methodology. Key concepts of LCC.
4. Social life cycle assessment (S-LCA): Introduction. Categories of Sustainability Assessment. Social assessment methods. S-LCA Methodologies. Goal and Scope. Inventory analysis. Impact Assessment. Interpretation. Tools used in the S-LCA.
5. Waste processing technologies for the production of energy: Introduction to waste to energy (WtE) conversion. WtE conversion plants in the framework of Circular Economy Policy. WtE technology options: co-processing, anaerobic digestion, landfill gas collection, thermal treatment of municipal solid waste (MSW), pyrolysis / gasification, incineration. Types of feedstock for WtE systems and their characteristics. WtE systems, engineering and technology: Pre- processing and treatment of municipal solid waste (MSW) prior to incineration, Municipal solid waste (MSW) combustion plants, Waste firing in large combustion plants, WtE systems for district heating. Environmental impacts of WtE conversion plants. Pollution control systems for waste to energy technologies.
6. Solid waste processing technologies for the production of products: Solids wastes are generated in large extension in the industrial and urban cycles and processing routes to recover added values or by-products will be developed. Definition of treatment flow-sheets identification of treatment or processing technologies, development of associated mass and energy balance will be defined. Routes of valorisation for different industrial applications will be selected and requirements of quality will be provided.
7. Water regeneration and recycling technologies: Water in the context of circular economy. Current water resources and uses. Alternative hydric resources. Water regeneration and recycling. Water treatment technologies. Membrane-based technologies. Innovative hybrid systems. Industrial wastewater valorisation and reuse. Potential circularity in water sector. Industrial symbiosis.
8. Urban Energy Sustainability and Smart Cities: Cities are complex entities, in which numerous actors and diverse scenarios are superimposed. Urban energy sustainability should be aimed at improving the balance of raw material flows and the production of waste/pollutants, which will unfailingly improve urban habitability, as well as favour the global goals of sustainable development. Indicators for Urban Energy Sustainability are presented. Smart energy systems are analysed and the concept of Smart Cities is presented

Pedagogical procedures (organization, assessment, pedagogical resources):

1. Lectures, participative sessions and problem solving sessions
2. Homework and assignments
3. Project
4. Mid-term and final Exam

Student's expected work in autonomy:

Bibliographic references:

- Hunkeler, David; Lichtenvort, Kerstin; Rebitzer, Gerald. Environmental life cycle costing [on line]. Pensacola, Fla.: SETAC, 2008 Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=570462.ISBN 9781420054736.
- Klinghoffer, Naomi B.; Castaldi, Marco J. Waste to energy conversion technology [on line]. Oxford: Elsevier Science & Technology, 2013 Available on:https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1574937. ISBN 9780124051904.
- Dinçer, Ibrahim; Rosen, Marc A. Exergy : energy, environment, and sustainable development [on line]. Amsterdam ; Boston: Elsevier, 2007 Available on: https://www.sciencedirect.com/science/book/9780080445298. ISBN9780080531359.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: NUEVOS RETOS EN ADITIVACION Y DEGRADACION DE MATERIALES PLASTICOS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **O. SANTANA PEREZ**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	28	6	14		
	Autonomous work: 102				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☒ **SC5** ☐ **SC6**				

Educational objectives of the course:

1. Estudiar los principales requerimientos para ecodiseño y economía circular en materiales poliméricos.
2. Conocer las principales familias de termoplásticos tanto de origen fósil como biobasados, sus características relevantes y retos planteados relacionados con la ecodiseño y economía circular: estructura, propiedades especiales y aspectos tecnológicos.
3. Introducir las principales familias de elastómeros, sus características relevantes y retos planteados relacionados con la ecodiseño y economía circular en este tipo de materiales.
4. Conocer los principales mecanismos de degradación termo-oxidativa, UV.
5. Conocer los principales aditivos de estabilización frente a la degradación-descomposición y los retos que se derivan a partir del ecosideño y economía circular.
6. Dar a conocer iniciativas europeas y aspectos tecnológicos relacionados con la revalorización de materia polimérica reciclada.

Syllabus:

Termoplásticos: Descripción de las principales familias de materiales termoplásticos tanto de origen fósil como bio-basados: Poliolefinas, Polímeros base Estireno, Polímeros Acrílicos, Poliesteres termoplasticos: alifáticos y aromáticos, Poliamidas, Polímeros halogenados, Bioplásticos.
Ecodiseño: Principales aspectos sobre el ecodiseño y economía circular aplicado en la concepción de piezas de materiales plásticos.
Mecanismos de degradación y deterioro en polímeros: Principales mecanismos de degradación (en condiciones aeróbicas y anaerobicas) y deterioro frente al fuego de materiales poliméricos.
Aditivación y compounding en materiales plásticos: Descripción de los principales aditivos de estabilización/modificación. Mecanismos de acción. Antioxidantes. Anti-UV. Plastificantes/Lubricantes. Agentes clarificares/nucleantes. Ignifugantes. Anti-estáticos. Pigmentos y colorantes.
Avances en economía circular en materiales plásticos: Seminarios/conferencias dictados por ponentes especialistas en los tópicos: Procesado reactivo como vía de revalorización de materias plásticas recicladas. Iniciativas europeas en la revalorización de materias plásticas recicladas. Elastómeros y economía circular: aspectos tecnológicos. Nuevas tendencias en la adivinación de materiales plásticos bajo requerimientos de economía circular.

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

- Brydson, J. A.. Plastics materials. 7th ed. Oxford: Butterworth-Heinemann, 1999. ISBN 0750641320.
- Gächter, R.; Müller, H.. Plastics additives handbook : stabilizers, processing aids, plasticizers, fillers, reinforcements, colorants for thermoplastics. 3rd ed. Munich, [etc.]: Hanser, 1993. ISBN 3446175717.
- Murphy, John. Additives for plastics handbook [en línea]. 2nd ed. Kidlington, Oxford: Elsevier Advanced Technology, 2001. Disponible a: https://www.sciencedirect.com/science/book/9781856173704. ISBN 1856173704.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: TECNOLOGIA DE MATERIALES COMPUESTOS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **M. L. MASPOCH**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	28	6	14		
	Autonomous work: 102				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

1. Conocer los principales tipos de matrices orgánicas, de segundas fases.
2. Conocer las propiedades de la interfase y cómo se puede modificar
3. Conocer los principales procesos de procesamiento de materiales compuestos con fibras.
4. Aprender a diseñar un material compuesto laminado con el objetivo de optimizar su vida útil en condiciones reales de servicio.
5.Conocer los principales compuestos de matriz inorgánica, particularmente sus fases y propiedades, de cara al diseño microestructural óptimo de ellos según los requisitos de la aplicación.

Syllabus:

Introducción: Definición, Clasificación, Ejemplos de aplicaciones, Compuestos naturales, La madera
Compuestos con fibras: Tipos de fibras, Tipos de matrices poliméricas, Interfases fibra matriz, Factores clave que determinan las propiedades de un compuesto.
Compuestos con partículas: Partículas rígidas: tipos de partículas, función de cada tipo de partícula, efectos sobre las propiedades mecánicas y sobre el comportamiento a la fractura y la propagación de grietas. Incorporación. Partículas elastoméricas: preparación de estos compuestos, ejemplos y aplicaciones. Efecto sabre las propiedades mecánicas y
sobre la tenacidad.
Espumas: Definiciones por tipo de celda y tamaño. Métodos de preparación. Ejemplos y aplicaciones. Propiedades y función del tamaño de las celdas.
Nanocompuestos: Clasificación y tipos de nanocargas en matrices poliméricas. Métodos de preparación de nanocompuestos de matriz orgánica. Relación estructura y propiedades. Ejemplos de aplicaciones.
Procesado de compuestos: Moldeo manual y por proyección. SMC y BMC. Moldeo por compresión. Saco de vacío, infusión y RTM. Autoclave. Pultrusión y arrollamiento de filamentos. RIM, RRIM y SRIM
Micro y Macromecánica de materiales compuestos con fibras largas: Propiedades mecánicas unidireccionales de materiales compuestos con fibras largas a partir de propiedades conocidas de la fibra y matriz. Propiedades mecánicas en laminados: estimación de las constantes elásticas en el plano medio. Diseño mecánico de laminados.
Análisis de fallos en laminados: Modelos de fallos. El modelo de "Ply discount". Predicción de vida útil de laminados.
Materiales compuestos de matriz inorgánica: Definición. Tipo de composites de matriz metálica y cerámica, y características microestructurales. Procesos de fabricación. Concepto de transferencia de carga. Fuerza de unión interfacial. Micromecánica, propiedades térmicas y físicas de los compuestos. Caso de estudio: materiales duros y superduros - carburos cementados, compuestos de diamantes y nitruros de boro cúbico policristalinos.

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

- Chawla, Nikhilesh; Chawla, Krishan K. Metal Matrix Composites. New York: Springer, 2006. ISBN 9786610459636.
- Barsoum, Michel W. Fundamentals of ceramics. New York: Taylor & Francis, cop. 2003. ISBN 9780750309028.
- Wachtman, J. B.; Cannon, W.; Matthewson, M. Mechanical properties of ceramics. 2nd ed. Hoboken, NJ: John Wiley & Sons, cop.2009. ISBN 9780471735816.
- Tecnología de los composites/plásticos reforzados. Barcelona: Hanser, DL 1992. ISBN 8487454046.
- Friedrich, Klaus; Fakirov, Stoyko; Zhang, Zhong. Polymer composites : from nano-to-macro-scale. New York: Springer, 2005. ISBN0387241760.
- Hull, Derek. Materiales compuestos. Barcelona [etc.]: Reverté, cop. 1987. ISBN 8429148396.
- Composite materials technology : processes and properties. Munich [etc.]: Hanser, cop. 1990. ISBN 3446156844.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
Materiales con Aplicaciones en el Transporte y la Energía</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: A. MATEO</td></tr>
<tr><td>EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>28</td><td>6</td><td>14</td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work: 102</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Transportation is an engineering field where the correct selection of materials is vital for the performance of vehicles. The students should understand the specific requirements of critical components in vehicles, translate them into materials' properties and select among the existing materials the ones able to fulfil the specifications.
Concerning Energy, the three main topics are:
Materials for energy conversion
Materials for energy storage
Materials for fuel production

Syllabus:

Materiales para aplicaciones automovilísticas : Els materials amb aplicacions automobilístiques es divideixen en dos grans blocs: Materials per la carroceria o BIW (Body in white), principalment acers d'alta resistència i aluminis
Materials pel motor: cada part, tant interna com externa del motor té uns requeriments en servei que porten a la selecció d'un determinat material i procés de fabricació. Es detallaran per Bloc motor, Pistons i anelles de retenció, Vàlvules, Cigonyal i arbre de lleves.
Materiales para aplicaciones aeronáuticas
Materiales para el transporte ferroviario
Materiales para el transporte marítimo

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

- Warren, Nigel. Metal corrosion in boats : the prevention of metal corrosion in hulls, engines, rigging and fittings. 3th ed. Nova York:
Adlard Coles Nautical, 2006. ISBN 9781574092370.
- Davies, Geoffrey. Materials for automobile bodies [en línea]. Amsterdam [etc.]: Elsevier, Butterworth Heinemann, cop. 2003
[Consulta: 06/10/2020]. Disponible a: https://www.sciencedirect.com/science/book/9780750656924. ISBN 9780750656924.
- Yamagata. Nou llibre.
- Benini, Ernesto. Advances in gas turbine technology. Rijeka: InTech, [2014]. ISBN 9789533076119.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
MATERIALES BIOMEDICOS</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: M. PONS</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>28</td><td>6</td><td>14</td><td></td><td></td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 102</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

El objetivo de la asignatura es que el estudiante adquiera conocimiento de las aplicaciones de biomateriales en medicina y, por tanto, sea capaz de relacionar propiedades y respuesta biológica de los biomateriales y aplicar criterios de selección más adecuados para cada aplicación. Además, se describen las diferentes técnicas de caracterización biológica in vitro e in vivo de biomateriales, así como
la interpretación de los resultados obtenidos mediante las diferentes técnicas. El objetivos específicos son:
- Revisar los diferentes tipos de biomateriales, sus características y biocompatibilidad.
- Conocer los principios básicos de la caracterización biológica in vitro e in vivo para evaluar la biocompatibilidad de los biomateriales.
- Conocer las principales aplicaciones de biomateriales en medicina.

Syllabus:

Evaluación de la interacción célula / biomaterial: Interacción célula / biomaterial, biocompatibilidad, Tipos de cultivos celulares: cultivo primario, cultivo secundario, cocultivos, Respuestas celulares básicas: adhesión, proliferación, diferenciación y apoptosis, Evaluación de la citotoxicidad de un biomaterial: ensayos de medida de la actividad metabólica (LDH, MTT) y ensayos basados, en el principio de exclusión celular (inmunofluorescencia, ELISA), Evaluación de la interacción bacterias / biomaterial, Evaluación de la interacción sangre / biomaterial
Materiales biomédicos para aplicaciones cardiovasculares: Enfermedades cardiovasculares; endotelización y trombogenicitat, Stents cardiovasculares, Válvulas cardíacas, Injertos cardiovasculares
Materiales biomédicos para aplicaciones dentales y ortopédicas: Biomateriales para sustitución ósea: metales y cerámicas inertes, Implantes dentales. Prótesis de cadera y de rodilla. Materiales de osteoisíntesis: placas y tornillos. disco intervertebrales, Biomateriales para regeneración ósea: biocerámicas y biovidres, Biomateriales para la reparación y regeneración condral. Ingeniería de tejidos aplicados a la cirugía ortopédica y maxilofacial
Materiales biomédicos para aplicaciones oftalmológicas, piel, adhesivos y suturas: Biomateriales para aplicaciones oftalmológicas: Anatomía del ojo; lentes de contacto blandas y duras; lentes intraoculares; implantes de córnea
Biomateriales para aplicaciones para sustitución de piel: Estructura de la dermis; implantes permanentes y reabsorvibles; ingeniería de tejidos aplicada a la regeneración de piel ; Adhesivos, sellantes y suturas: Mecanismos de adhesión; composición y características de los materiales adhesivos; adhesivos para tejidos blandos; adhesivos para tejidos duros; suturas naturales y sintéticas
Biomedical materials for the controlled release of drugs: Control de la liberación de un fármaco, entre la efectividad y la toxicidad ; Control de la liberación por la difusión ; Sistemas de control de la liberación por penetración de agua en el dispositivo ; Dispositivos controlados químicamente

Pedagogical procedures (organization, assessment, pedagogical resources):

Nfinal=0,40*Nex final+0,40*Nex parcial+0,10*Laboratorio+0,10*Trabajo

Student's expected work in autonomy:

Bibliographic references:

- Ratner, Buddy D. [et al.] (eds.). Biomaterials science : an introduction to materials in medicine. 3rd ed. Amsterdam: Elsevier/Academic Press, 2013. ISBN 9780123746269.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: TECNOLOGIA DE UNION DE MATERIALES	Year/Semester of EEIGM studies: 4A - 2nd semester
	Course manager: **A. MATEO**
EEIGM Department: Materials specialisation	**Hours/student:**
Teaching method: Academic	**In-person classes:**
Assessment: Classic	Lecture: 28 / Tutorial: 6 / Lab work: 14 / Project: / Test:
	Autonomous work: 102
Generic EEIGM competencies	**Specific EEIGM competencies**
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Los procesos de unión de materiales son el objetivo fundamental de la asignatura.
Como objetivos específicos podemos citar:
- Conocimiento de las principales tecnologías de soldadura de metales
- Comprensión de los cambios metalúrgicos en el material soldado y su influencia en las propiedades mecánicas
- Comprensión de los aspectos básicos de la adhesión, evaluación de la adhesión y de los aspectos esenciales que determinan la efectividad de las uniones adhesivas
- Conocimiento de los principales tipos de adhesivos

Como objetivos generales en la formación de los estudiantes:
- Dotarlos de la capacidad de trabajar en equipo.
- Potenciar el desarrollo de análisis crítico y método científico
- Colaborar en la capacidad de transmitir conocimientos tanto de forma oral como escrita.
- Que se acostumbren al uso de la consulta de bibliográfica y de material técnico para favorecer su capacidad de autoenseñanza

Syllabus:

1. FUNDAMENTOS DE LA SOLDADURA
Definiciones. Importancia de la soldadura. Clases de soldadura. Física de la soldadura.
2. PROCESOS DE SOLDADURA
Arco eléctrico / Resistencia /Oxiacetilénica / Soldadura en estado sólido / Metales de aportación. Fundentes / Posiciones de las piezas en la soldadura. Preparación de las piezas a soldar. / Coste de la soldadura. / Soldadura automática. / Oxicorte
3. DEFECTOS DE SOLDADURA
Deformaciones y tensiones internas en la soldadura. / Defectos de la soldadura.
4. UNIÓN MEDIANTE ADHESIVOS
Aspectos generales sobre la adhesión y los adhesivos / Contacte entre les fases / Mecanismos de adhesión / Pretratamiento de les superficies
5. PROPIEDADES MECÁNICAS DE LAS UNIONES ADHESIVAS
Ensayos para evaluar la resistencia a la separación de uniones adhesivas / Ensayos no destructivos
6.TIPOS DE ADHESIVOS
Componentes de las formulaciones de adhesivos

Pedagogical procedures (organization, assessment, pedagogical resources):

Se realizarán dos exámenes parciales, con un peso mínimo de 25% de la nota final.
Los informes de prácticas, problemas y trabajos dirigidos tendrán un peso mínimo de 20% de la nota final.
Habrá también un examen final y un examen de re-evaluación.

Student's expected work in autonomy:

Bibliographic references:

- Messler, Robert W. Principles of welding : processes, physics, chemistry, and metallurgy. New York: Wiley-VCH, cop. 2004. ISBN
0471253766.
- Ruiz Rubio, Alfonso. Inspección radiográfica de las uniones soldadas. Bilbao: Urmo, 1971. ISBN 8431401664.
- Kinloch, A. J. Adhesion and adhesives : sciences and technology. London [etc.]: Chapman and Hall, 1987. ISBN 041227440X.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

4th year

[SEMESTER 8- VALENCIA]

MODULES	ECTS
Semestre d'étude à Valence (Espagne)	**30**
Biomateriales poliméricos (obligatoire)	4,5
Inspección y diagnóstico de fallos en servicio (obligatoire)	4,5
Soldadura y técnicas de unión (obligatoire)	4,5
Biomateriales estructurales (obligatoire *à choisir entre les 2*)	4,5
Materiales para diseño de máquinas (obligatoire *à choisir entre les 2*)	4,5
Ciencia y Tecnología de Polímeros.	6
Dirección de Proyectos	4,5
Ecodiseño. Integración del factor ambiental en el diseño de productos	4,5
Emprendimiento y gestión de la innovación y la tecnología	4,5
Tecnología de Fabricación	4,5
Toma de decisiones y ética	4,5
Negociación y toma de decisiones	4,5
....Other (*)	

(*) Total number of credits for the whole semester (30 ECTS) could be completed with other courses offered by the University (https://www.upv.es/titulaciones/MUII/menu_1014870c.html) (see the full list of courses below in the page under the title “Module 13: optatividad”. Please verify that are taught in semester B, or some laboratory work (up to 2 ECTS) after approval by the EEIGM coordinator.

Teaching Unit: BIOMATERIALES POLIMERICOS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **L. TERUEL BIOSCA**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	54		
	Autonomous work: 80				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☒ **SC1** ☒ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

En esta asignatura se pretende proporcionar al futuro Ingeniero Industrial una panorámica de las principales características de los materiales sintéticos y naturales utilizados en aplicaciones biológicas, fundamentalmente en el campo de la medicina. Se abordan diferentes aspectos relativos a su selección, interacción con el entorno biológico, los métodos de preparación y procesado y la evaluación de sus propiedades. Se pretende introducir al estudiante en el desarrollo, evaluación y aplicación de materiales poliméricos que tienen como fin ser implantados de manera temporal o permanente en sistemas biológicos para reparar, sustituir o regenerar tejidos vivos y sus funciones.
Los objetivos específicos de la asignatura se agrupan en:
1) Diseño de biomateriales: Identificar los criterios fisiológicos y estructurales que el biomaterial debe cumplir, según el tejido en que se vaya a implantar y las funciones a desempeñar. Saber seleccionar la composición química apropiada para asegurar las propiedades mecánicas y estabilidad necesarias el tiempo suficiente, e inducir la respuesta tisular adecuada para la aplicación.
Conocer diferentes formas de modular sus propiedades y mejorar el desempeño biológico.
2) Caracterización de biomateriales: Conocer las propiedades importantes de los materiales de uso en medicina y las técnicas para determinarlas. Saber predecir cualitativamente las propiedades de un biomaterial, dadas sus propiedades estructurales y composición.
3) Interacción con el entorno biológico: Conocer las respuestas moleculares, celulares y tisulares ante un biomaterial implantado. Saber identificar cuándo es biocompatible y estimar las posibles causas de reacción del tejido a cuerpo extraño. Conocer la importancia de la esterilización, los distintos métodos y cuándo aplicar uno u otro.

Syllabus:

1. Generalidades (7 horas) (1. Introducción a los materiales de uso en medicina (2 horas) - 2. Organización celular de los tejidos. Biocompatibilidad y biodegradabilidad (4 horas) - 3. Esterilización (1 hora))
2. Polímeros como biomateriales (12 horas) (1. Estructura y propiedades (7 horas) - 2. Superficies poliméricas (5 horas))
3. Práctica 1. Técnicas de caracterización de biomateriales poliméricos (3 horas)
4. Familias de polímeros importantes (9 horas) (1. Hidrogeles (5 horas) - 2. Polímeros biodegradables (4 horas))
5. Práctica 2. Hinchamiento (3 horas)
6. Dosificación controlada de fármacos (5 horas)
7. Ingenieria tisular (3 horas)
8. Práctica 3. Preparación de soportes para ingeniería tisular (3 horas)

Pedagogical procedures (organization, assessment, pedagogical resources):

El alumno realizará dos pruebas escritas de respuesta abierta (1º y 2º parcial), que corresponderán al 60% de la nota final (30% cada una de ellas). Para superar la asignatura es necesario obtener más de 4 puntos sobre 10 en cada una de las pruebas escritas.
Las pruebas escritas pueden y deben recuperarse en un examen específico al final del cuatrimestre, pudiendo también presentarse los alumnos que deseen subir nota. En su caso, se elegirá la mejor nota.
Con una nota inferior a 4 en la calificación global de las pruebas escritas, la calificación otorgada será la que resulte teniendo en cuenta los pesos de cada parte (pruebas escritas, prácticas de laboratorio y trabajo), hasta un valor máximo de 4 puntos.
Un alumno con nota media superior a 5, con nota en la prueba escrita inferior a 4, tendrá una nota final de 4.
El alumno realizará también un trabajo en grupo que entregará a final de curso; corresponderá al 20% de la nota final.
La evaluación de las prácticas de laboratorio corresponderá al 20% restante. Se evaluará los resultados obtenidos en el trabajo experimental, presentados en una memoria.
Las prácticas de laboratorio y el trabajo no podrán recuperarse.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: INSPECCION Y DIAGNOSTICO DE FALLOS EN SERVICIO	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **M. A. PEREZ PUIG**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	54		
	Autonomous work: 74				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☒ **C7** ☒**C8**	☐ **SC1** ☐ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Inspección mediante ensayos no destructivos (Penetrantes, Magnéticos, Ultrasondos, radiología industrial).
El alumno conocera las diferentes tecnicas no destructivas para analizar los fallos en servicio de piezas reales. Se trabajará con toda la metodologia y tecnicas de caracterizacion para analizar y evitar estos fallos en servicio.
Asi mismo se trabajará con la morfología de fallos y fractografía y técnicas de microscopía óptica.
Asignatura con alta dosis de practicas en ensayos no destructivos.

Syllabus:

1. Liquidos penetrantes
2. Particulas magneticas
3. Ultrasonidos
4. Radiografia Industrial
5. Corrientes inducidas

Pedagogical procedures (organization, assessment, pedagogical resources):

Prueba escrita de respuesta abierta 40%
Portafolio 20%
Trabajo académico 20%
Pruebas objetivas (tipo test) 20%

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: SOLDADURA Y TECNICAS DE UNION	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: A. C. CARCEL GONZALEZ				
EEIGM Department: Materials specialisation	Hours/student:				
Teaching method: Academic	In-person classes:				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	56,6		2,6
	Autonomous work: 75,25				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8	☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Esta asignatura aporta formación especializada sobre ingeniería de la soldadura y otras técnicas de unión, de interés en actividades de ingeniería relacionadas con el diseño, cálculo y construcción de grandes equipos, instalaciones y/o estructuras metálicas de edificios, vehículos y máquinas a partir de componentes de menor tamaño: chapas, perfiles estructurales, tuberías, etc. A partir de una introducción a los fundamentos físico químicos y metalúrgicos que permiten conseguir uniones por soldadura, la asignatura tiene un enfoque claramente aplicado, orientado al conocimiento de las diferentes técnicas de soldeo, a la selección de materiales y al diseño práctico, de acuerdo con las normas EN/ISO/AWS actualmente en uso por las empresas constructoras, de uniones, procedimientos de soldadura WPS y procedimientos de inspección y control de calidad.

Syllabus:

1. INTRODUCCIÓN A LA INGENIERIA DE LA SOLDADURA.(1. Soldadura y técnicas de unión. Tipos de uniones. Evolución histórica. Campos de aplicación. Reglamentación y normativa de aplicación a la práctica profesional de la ingeniería.)
2. SOLDADURAS DE FUSIÓN Y SOLDABILIDAD (1. Absorción de gases. Efectos del arco eléctrico. Efectos de los gases. Protección. Tratamientos de eliminación de H. - 2. Transformaciones metalúrgicas. Estructuras del cordón. Transformaciones en la ZAC. Soldabilidad de aceros y aleaciones de aluminio.- 3. Tensiones residuales y agrietamiento. Agrietamiento en caliente y en frío.Tratamientos de Alivio de tensiones.)
3. TECNICAS DE SOLDADURA. (1. Técnicas de soldadura en estado sólido. Aplicaciones - 2. Soldaduras de fusión. Fuentes energéticas. Energía aportada y densidad de potencia. Materiales de aporte. Automatización Parámetros de control - 3. Uniones híbridas. Soldadura blanda y fuerte. Materiales de aporte. Uniones con adhesivos. - 4. Soldadura de plásticos. Unión mediante solventes. Uniones térmicas)
4. INGENIERIA DE LA SOLDADURA (1. Cálculo y diseño de uniones bajo cargas estáticas y de fatiga. Diseño y comprobación de uniones en ángulo. - 2. Diseño de uniones. Selección de materiales base y materiales de aporte para uniones soldadas. - 3. Procedimientos de soldadura WPS. Normativa AWS / EN/ ISO. Secuencias y parámetros de soldeo. Ensayos WPQR. Cualificación del personal)

Pedagogical procedures (organization, assessment, pedagogical resources):

El sistema de evaluación incluye las siguientes técnicas y/o pruebas:
Observación: Seguimiento regular de las clases presenciales y entrega en plazo de tareas y asignaciones durante el curso:
10% de la calificación global
Trabajos académicos : Se realizarán dos trabajos académicos de carácter práctico sobre seleccción de materiales, cálculo de uniones y diseño de procedimientos de soldadura (WPS) aplicados a casos reales. Cada trabajo tiene un peso del 20% de la calificación global.
Prueba Test sobre conceptos, con cuatro opciones de respuesta : 30% de la calificación global.
Prueba escrita : Resolución de problemas prácticos: 20% de la calificación global.
Debe obtenerse una calificación mínima de 5 puntos sobre 10 para superar la asignatura, de los cuales un mínimo de 2.5 puntos deben obtenerse en las pruebas de tipo test y prueba escrita. Los alumnos que no alcancen una calificación global de curso >5 podrán recuperar las pruebas de test y/o prueba escrita en una prueba fina de recuperación.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: BIOMATERIALES ESTRUCTURALES	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **V. AMIGO BORRAS**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	58		4
	Autonomous work: 86				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☒ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

En esta asignatura se pretende proporcionar al futuro Ingeniero Industrial, especializado en materiales, una panorámica de los principales usos de los materiales de aplicación médica, los conocimientos básicos acerca de su interacción entre el entorno biológico, los métodos de preparación y propiedades de éstos. Los objetivos específicos de la asignatura pueden agruparse en: Materiales para implantes. Biocompatibilidad de aleaciones y cerámicas. Materiales con memoria de forma. Comportamiento mecánico y biomecánico. Modos de fallo in vivo. Diseño, fabricación y ensayos de productos implantables.

Syllabus:

1. Biocerámicas (1. Cerámicas Bioinertes - 2. Cerámicas bioabsorbibles y reactivas)
2. Biometales (1. Aceros inoxidables - 2. Aleaciones base cobalto - 3. Aleaciones de titanio - 4. Otras aleaciones metálicas)
3. Corrosión y desgaste (1. Corrosión - 2. Fricción y desgaste - 3. Fijación y respuesta del huésped)
4. Aplicaciones de los materiales cerámicos y metálicos (1. Aplicaciones dentales - 2. Aplicaciones ortopédicas y traumatológicas)

Pedagogical procedures (organization, assessment, pedagogical resources):

Prueba escrita de respuesta abierta 60% - Portafolio 15% - Trabajo académico 15% - Mapa conceptual 10%
Dos pruebas parciales escritas, que pueden recuperarse con la prueba final que servirá tanto para el apto como para aumentar
la nota si el alumno así lo considerara. En cada una de ellas debe obtenerse una calificación mayor de 3,0 tanto en las pruebas parciales como de recuperación. En el caso de no alcanzarse, la nota final será de 3,0 excepto si el promedio de las actividades fuera inferior.. Las prácticas de laboratorio e informáticas se evaluarán mediante la entrega del portafolio correspondiente que podrá recuperar el alumno hasta el día de las pruebas de recuperación final. El trabajo académico se realizará en grupo de tres personas. Los alumnos deben entregar la resolución escrita del caso y las transparencias para la exposición oral del mismo. La evaluación del caso se realizará preferiblemente tras la exposición oral de los distintos grupos. Esta actividad podrá ser recuperada por los alumnos hasta el día de las pruebas de recuperación final. Se entregarán once mapas conceptuales correspondientes a los temas de los bloques de la asignatura que serán evaluados y recuperados de manera continuada.
Es necesario obtener puntuación en cada una de las actividades programadas por lo que ningún alumno puede alcanzar el APTO sin obtener puntuación en todos y cada uno de los grupos de actividades de evaluación.

Student's expected work in autonomy:

Bibliographic references:

Biomaterials - Bhat, Sujata V.
Biomaterials science : an introduction to materials in medicine
Biotribology - J. Paulo Davim
Materials for medical devices
Biomateriales - Sastre, Roberto
Biomaterials in orthopaedic surgery - Rodríguez-González, Federico Angel
Titanium and titanium alloys : fundamentals and applications

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: MATERIALES PARA DISEÑO DE MAQUINAS	**Year/Semester of EEIGM studies:** 4A - 2nd semester
	Course manager: J. F. MORENO BALLESTER
EEIGM Department: Materials specialisation	**Hours/student:**
Teaching method: Academic	**In-person classes:**

Lecture	Tutorial	Lab work	Project	Test
24	12	54,5		0,5

Assessment: Classic	**Autonomous work:** 70

Generic EEIGM competencies	**Specific EEIGM competencies**
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☒ **SC1** ☒ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**

Educational objectives of the course:

Criterios de selección de materiales. Materiales para diseño de máquinas. Procesos de fabricación y tratamientos. Comportamiento en servicio. Ensayos y modelos.

Syllabus:

1. Seleccion de materiales
2. Materiales metálicos
3. Polimeros, compuestos y adhesivos
4. Procesos de fabricacion y Tratamientos
5. Comportamiento en servicio y Ensayos

Pedagogical procedures (organization, assessment, pedagogical resources):

Prueba escrita de respuesta abierta 40% - Proyecto 20% - Portafolio 15% - Pruebas objetivas (tipo test) 25%
Las pruebas escritas de respuesta abierta así como las pruebas objetivas de tipo test, pueden ser tanto de teoría como de problemas.
Una nota media igual o superior a 5,00 supondrá el aprobado siempre que se haya obtenido al menos una calificación de 3,00 en cada uno de los actos de evaluación. Con una nota inferior a 3,00 en al menos uno de los actos de evaluacion, la calificación otorgada será la media obtenida hasta un máximo de 4,90 puntos.
Las dos pruebas escritas de respuesta abierta y las dos pruebas objetivas de tipo test pueden recuperarse con la prueba final.
La prueba de recuperación pueda servir también para aquellos alumnos que deseen mejorar su calificación, aunque no necesiten recuperar la prueba.
El portafolio y el proyecto podrán volver a elaborarse para su recuperación.
Las pruebas escritas de respuesta abierta así como las pruebas objetivas de tipo test se realizarán en las fechas establecida por la ETSII para el primer y segundo parcial. La prueba final se realizará en la fecha establecida por la ETSII.
El portafolio y el proyecto se entregarán en la fecha establecida por la ETSII para el segundo parcial. En caso de volver a elaborarse cualquiera de ellos para su recuperación, se entregarán en la fecha establecida por la ETSII para la prueba final.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: CIENCIA Y TECNOLOGIA DE POLIMEROS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **S. ALVAREZ BLANCO**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30	18	72		
	Autonomous work: 106				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8	☒ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Los polímeros son materiales con unas características particulares que les diferencian de los compuestos formados por moléculas sencillas, lo que justifica su estudio en una asignatura específica. Su estructura peculiar les dota de propiedades características que no se presentan en otros materiales. Ello, unido a su gran versatilidad y facilidad de procesado, ha dado lugar a la utilización masiva de los polímeros en un sinnúmero de aplicaciones en los sectores más variados. Debido a ello, la investigación en ciencia de materiales de naturaleza polimérica es actualmente una línea de investigación prioritaria, apareciendo con frecuencia nuevos materiales poliméricos y nuevas aplicaciones para estos compuestos.

Por ello poseen gran interés en la formación de un ingeniero químico, ya que muchos de los materiales con los que se va a enfrentar un ingeniero químico durante el ejercicio de su profesión son poliméricos. En esta asignatura se proporciona a los alumnos un conocimiento avanzado de dichos materiales, tanto desde el punto de vista de las reacciones y reactores de polimerización, como de sus propiedades y aplicaciones, haciéndose hincapié en las aplicaciones más novedosas de estos compuestos.

Syllabus:

1. Ingeniería de las reacciones de polimerización (1. Introducción: tipos de polímeros, peso molecular y estructura. Técnicas de polimerización - 2. Polimerización por radicales libres: cinética, control del peso molecular y efecto de la temperatura - 3. Polimerización catiónica: cinética, control del peso molecular y efecto de la temperatura - 4. Polimerización aniónica: cinética, control del peso molecular y efecto de la temperatura - 5. Polimerización por coordinación: cinética, control del peso molecular y efecto de la temperatura - 6. Polimerización por pasos: cinética, control del peso molecular y diseño de reactores)
2. Procesado y propiedades de los polímeros (1. Procesos de transformación y aditivos - 2. Relación entre estructura y propiedades)
3. Diseño con polímeros (1. Solubilidad e hinchado de retículos poliméricos - 2. Tratamientos superficiales de polímeros. Teorías de adhesión - 3. Materiales compuestos. Nuevas aplicaciones. Tendencias noveles de investigación. Funciones de la matriz y de los constituyentes estructurales o refuerzos - 4. Diseño con materiales isótropos y anisótropos. Aspectos relevantes del proceso de diseño con materiales anisótropos - 5. Micromecánica. Aspectos de rigidez y de resistencia en composites con fibras distribuidas mono, di y tridimensionalmente. Esfuerzos térmicos y esfuerzos de curado - 6. Nanopartículas como constituyente estructural. Modelos empíricos para materiales con refuerzos de naturaleza no fibrosa. - 7. Procesado de materiales compuestos)

Pedagogical procedures (organization, assessment, pedagogical resources):

Trabajo académico 20% - Prueba escrita de respuesta abierta 80%

El alumno realizará dos pruebas escritas (una por parcial) de respuesta abierta, que corresponderán al 80% de la nota final (40% cada una). Los alumnos deberán entregar dos trabajos académicos en cada uno de los parciales. El peso total de los trabajos será un 20 % de la nota final. Es necesario, para mediar, obtener una calificación de al menos 4 en cada una de las dos pruebas escritas.

Se realizará un examen de recuperación de las pruebas escritas parciales al final del cuatrimestre. Si un alumno se presenta al examen final para subir nota, la nota del examen final sustituirá a la del parcial. No obstante, si el alumno considera que no va a mejorar la nota, podrá abandonar el examen durante los primeros 15 minutos. Para los trabajos no habrá recuperación.

Cuando no se llegue al mínimo de 4 en una o ambas pruebas escritas, la nota máxima que se podrá obtener será de 4.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: DIRECCION DE PROYECTOS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: P. ARAGONES BELTRAN				
EEIGM Department: Materials specialisation	Hours/student:				
Teaching method: Academic	In-person classes:				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	59,5		5,5
	Autonomous work: 77				

Generic EEIGM competencies	Specific EEIGM competencies
☒ C1 ☒ C2 ☒ C3 ☐ C4 ☒ C5 ☒ C6 ☒ C7 ☒ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

Una de las atribuciones profesionales del Ingeniero Industrial es dirigir proyectos en el ámbito de la Ingeniería Industrial. Esta asignatura contribuye a que el alumno adquiera conocimiento de los procesos básicos de la disciplina Dirección de Proyectos y las competencias fundamentales del Director y su equipo, de acuerdo con lo expresado en la Norma UNE-ISO 21500 y en los estándares de las dos asociaciones profesionales más importantes del mundo: Project Management Institute (PMI) y la International Project Management Association (IPMA). En la asignatura se trabajarán procesos básicos de Dirección de Proyectos como son: gestión de partes interesadas, gestión de la integración y del alcance del proyecto, definición de objetivos y las técnicas de planificación, seguimiento y control de los proyectos, el análisis de viabilidad económica, equilibrio entre recursos y costes, identificación y análisis de riesgos del proyecto.
También se trabajarán las competencias técnicas definidas por IPMA, las competencias de comportamiento del Director de Proyectos (liderazgo, compromiso y motivación, creatividad, negociación, conducta ética y apreciación de valores, trabajo en equipo, conflictos y crisis) y las competencias contextuales (orientación a proyectos; programas y carteras; seguridad, higiene y medioambiente.). Cuando el alumno supere la asignatura, junto con el resto de asignaturas del Máster, será capaz de dirigir proyectos en el ámbito de la Ingeniería Industrial.

Syllabus:

1. CONCEPTOS BÁSICOS DE DIRECCIÓN DE PROYECTOS (1. Definiciones de Proyecto, Programas y Carteras - 2. Concepto de Dirección de Proyetos, Carteras y Programas - 3. Procesos de la Dirección de Proyectos - 4. Éxito en la Dirección de Proyectos - 5. Áreas y Competencias de la Dirección de Proyectos - 6. Alcance y objetivos del Proyecto - 7. Fases del proyecto - 8. Análisis de Partes Interesadas)
2. PLANIFICACIÓN, PROGRAMACIÓN Y CONTROL DE PROYECTOS (1. Estructuras de Descomposición del Proyecto (EDP) - 2. Planificación y programación de proyectos (Gestión del Tiempo) - 3. Asignación y planificación de recursos - 4. Método PERT/CPM y Diagramas de Gantt - 5. Conceptos de seguimiento, control y gestión de cambios - 6. Técnica del Valor Acumulado)
3. ESTUDIO ECONÓMICO DEL PROYECTO (1. Presupuesto de inversión y Activo - 2. Financiación del proyecto y Pasivo - 3. Presupuesto de explotación - 4. Viabilidad económica del proyecto-empresa - 5. Project Finance - 6. Indicadores financieros)
4. CONTROL E INFORMES, DOCUMENTOS Y COMUNICACIONES DEL PROYECTO (1. Documentación para la Gestión del proyecto: Acta de constitución, planes del proyecto, registro de partes interesadas, registro de riesgos, aprobación de cambios, informes de avance, cierre y lecciones aprendidas - 2. Gestión de la información: recopilación, selección y almacenamiento. Sistema de gestión de la documentación. Estructura. Herramientas comerciales - 3. Procedimientos y plan de comunicaciones)
5. GESTIÓN DE ADQUISICIONES (1. Procesos de gestión de adquisiciones - 2. Tipos de contratos en Dirección de Proyectos - 3. Proceso de preparación y evaluación de ofertas - 4. Ley de Contratos del Sector Público: conceptos básicos)
6. RIESGOS Y OPORTUNIDADES DEL PROYECTO (1. Planificación de la gestión de riesgos - 2. Identificación de riesgos y oportunidades del proyecto - 3. Análisis y evaluación de riesgos del proyecto)
7. TOMA DE DECISIONES: MÉTODO AHP (1. Conceptos básicos de Análisis Multicriterio de Decisiones - 2. Proceso Analítico Jerárquico (AHP) - 3. Aplicaciones y casos prácticos)

Pedagogical procedures (organization, assessment, pedagogical resources):

La evaluación comprenderá cuatro partes:
PARTE 1.-. Prácticas informáticas. Realización de ejercicios y un trabajo de programación de un proyecto realizado con MsProject. Calificación: 15% de la calificación final de la asignatura.
PARTE 2.- Dos exámenes parciales que evaluarán los objetivos teóricos y prácticos de la asignatura. Cada uno de estos exámenes parciales pesa lo mismo a efectos del cálculo de la calificación final del examen. Los exámenes constarán de una prueba objetiva tipo test y preguntas cortas de respuesta abierta. La calificación final de los exámenes parciales supondrá el 45% de la calificación final de la asignatura. Los alumnos que no superen la nota media de 5 puntos sobre 10 en alguno de los parciales, deberán realizar un examen de recuperación del parcial que no hayan superado, aunque la nota media entre los dos parciales salga aprobada. A efectos del cálculo de la nota final sólo se considerará, en su caso, las notas obtenidas en el examen final. Si un alumno no se presenta al examen final para recuperar la parte suspendida, se le calificará el correspondiente parcial con 0 puntos. La nota obtenida en esta recuperación supondrá el 45% de la nota de la asignatura.
PARTE 3.- Desarrollo de un Plan de Dirección de un Proyecto realizado los alumnos en grupos de trabajo de entre 5 y 7 alumnos seleccionados de modo aleatorio. El Trabajo se defenderá públicamente al final de curso ante un tribunal formado por, al menos, dos profesores de la asignatura. En la evaluación se tendrá en cuenta el trabajo presentado y las competencias de comportamiento en Dirección de Proyectos, según están definidas por la International Project Management Association (IPMA). También se evaluará la calidad de la presentación, en la que deberán participar todos los integrantes del grupo. La nota obtenida en el trabajo supondrá el 30% de la nota de la asignatura. Si algún trabajo no alcanza la calificación de 5 puntos sobre 10, se podrá recuperar, volviendo a presentar un nuevo trabajo que incorpore las recomendaciones que haya indicado el tribunal.
PARTE 4.- Actividades desarrolladas en las Prácticas de Aula. Supondrán el 10% de la calificación final. Estas calificaciones se repartirán del siguiente modo: 3.1 Lectura, resumen y exposición pública de un artículo de investigación en que se desarrolle algún aspecto relacionado con las unidades temáticas del curso (5% de la calificación final).
3.2 Asistencia y entrega de la actividad asociada al seminario sobre “Seguridad y medio Ambiente” que se impartirá durante el curso en horario diferente al lectivo y que se anunciará con antelación (3% de la calificación final).
3.3 Ejercicios y actividades desarrolladas durante las prácticas en aula que se entregarán como Tareas en PoliformaT (2% dela nota final)
CALIFICACIÓN FINAL. La nota final de la asignatura será la suma ponderada de las calificaciones obtenidas por el alumno en cada una de las cuatro partes de que consta la evaluación. Sin embargo, para que se realice esta nota media final ponderada,el alumno deberá haber obtenido una calificación final mínima en la parte de examen (Parte 2) de 4,5 puntos sobre 10. En caso de que el alumno no alcance la nota mínima en el examen (parte 2), la calificación final de la asignatura será la obtenida en el examen, sin tener en cuenta las notas de las partes 1, 3 y 4. No se guardarán notas de partes de la asignatura de un curso a otro.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: ECODISEÑO. INTEGRACION DEL FACTOR AMBIENTAL EN EL DISEÑO DE PRODUCTOS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **R. VINOLES CEBOLLA**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	60		6
	Autonomous work: 70				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☒ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☒ **SC5** ☐ **SC6**				

Educational objectives of the course:

Antes de la Revolución Industrial, quienes producían muchos o todos los objetos cotidianos eran los herreros, los carpinteros, los tejedores, los encuadernadores. Estos hábiles artesanos empleaban recursos de su zona, que podían conseguirse fácilmente, con la intención de elaborar productos destinados a durar toda la vida. Por desgracia, desde entonces, la producción en masa de artículos manufacturados, los productos de desecho, así como la expansión urbanística, la superpoblación y la contaminación han causado estragos en el entorno. A pesar de estas malas noticias, debemos combinar todo lo bueno de la tecnología moderna con la artesanía tradicional. Estos conocimientos y tecnología pueden aplicarse para ahorrar energía, emplear con eficiencia los materiales, generar energías limpias y desarrollar practicas sostenibles de trabajo, mediante la selección de productos que desafíen las tendencias del diseño contemporáneo. En el Master Universitario en Ingeniería Industrial que se imparte en la ETSII se ha promovido el desarrollo de una gran cantidad de asignaturas optativas que permite a los alumnos poder encaminar su formación ya sea perfeccionando la especialidad escogida o escogiendo una optatividad en otra línea. Para cualquiera de los dos casos, la asignatura Ecodiseño. Integración del factor ambiental en el diseño de productos les permite profundizar en una línea de formación más orientada a la concepción o rediseño de productos o servicios teniendo presente el factor ambiental con el fin de reducir su impacto negativo en el entorno. La asignatura se centra en la consideración sistemática de la función del diseño con respecto a objetivos medioambientales, desalud y seguridad a lo largo del ciclo de vida completo del producto y del proceso. Partiendo de un análisis inicial de los conceptos ambientales más conocidos como desarrollo sostenible, ecoeficiencia, ecología industrial, se llegará a aplicar una de las metodologías de ecodiseño más extendidas en el ámbito Europeo. También se aplicarán técnicas y herramientas específicas como el análisis del ciclo de vida y el diseño para el reciclaje y para el desmontaje, y se verá la importancia de la aplicación del ecodiseño en los productos para las empresas fabricantes.

Syllabus:

1. CONTEXTO DEL ECODISEÑO (1. Desarrollo sostenible - 2. Ecología Industrial - 3. Ecoeficiencia - 4. Introducción al ecodiseño - 5. Legislación ambiental y ecodiseño)
2. METODOLOGÍA DE ECODISEÑO (1. Propuestas metodológicas para un diseño respetuoso con el medio ambiente - 2. Estrategias de diseño respetuoso con el medio ambiente - 3. Ejemplos de productos y servicios más respetuosos con el medio ambiente)
3. TÉCNICAS Y HERRAMIENTAS DE AYUDA PARA EL ECODISEÑO (1. Análisis de Ciclo de Vida (ACV) - 2. Técnicas de Design for X (DfD, DfRe, DfRc) - 3. Selección de materiales para el ecodiseño)
4. EL ECODISEÑO Y LA EMPRESA (1. Consumo sostenible y compra responsable - 2. Información ambiental – ecoetiquetado - 3. Norma UNE-EN ISO 14006 y la empresa)

Pedagogical procedures (organization, assessment, pedagogical resources):

La evaluación de la asignatura comprenderá 4 sistemas de evaluación:
1. OBSERVACIÓN: Se llevará un registro de la asistencia de los alumnos a las diferentes sesiones presenciales, así como un registro de si muestran una actitud activa hacia el aprendizaje. Se llevarán a cabo 28 actos de evaluación, suponiendo en total un 10% del peso de la nota final de la asignatura.
2. PRUEBA OBJETIVA TIPO TEST: Se llevarán a cabo dos exámenes parciales, en las fechas fijadas por la ETSII. En cada uno de esos exámenes se realizará un acto de evaluación consistente en una prueba objetiva tipo test. Cada acto supondrá un 10% de la nota de la asignatura. Por lo tanto las pruebas objetivas tipo test suponen un total del 20% de la nota de la asignatura.
3. PRUEBA ESCRITA DE RESPUESTA ABIERTA: Se llevarán a cabo dos exámenes parciales, en las fechas fijadas por la ETSII. En cada uno de esos exámenes se realizará un acto de evaluación consistente en una prueba escrita de respuesta abierta. Cada acto supondrá un 10% de la nota de la asignatura. Por lo tanto las pruebas escritas de respuesta abierta suponen un total del 20% de la nota de la asignatura.
4. TRABAJOS ACADÉMICOS: Durante el desarrollo de la asignatura los alumnos, en grupos de 3 personas, llevarán a cabo dos trabajos académicos aplicando los conocimientos impartidos en la asignatura a un producto o servicio específico. Cada acto supondrá un 25% de la nota de la asignatura, es decir, el conjunto de trabajos académicos supondrá un 50% de la nota de la asignatura.
Aquel alumno que mediante los 4 sistemas de evaluación anteriormente mencionados no alcance como mínimo la nota de 5 tendrá la posibilidad de realizar una recuperación en la fecha acordada por la ETSII. Dicha recuperación consistirá en una prueba escrita de respuesta abierta que supondrá el 90% de la asignatura. La parte de nota (10%) correspondiente al sistema de evaluación por Observación se guardará y se sumará a la nota obtenida en la recuperación.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
EMPRENDIMIENTO Y GESTION DE LA INNOVACION Y LA TECNOLOGIA</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: J. D. BARBERA TOMAS</td></tr>
<tr><td>EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>24</td><td>12</td><td>74.5</td><td></td><td>4.5</td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 115</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☐ C6 ☒ C7 ☒ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

The course has two objectives. First, to study the fundamental concepts related with Innovation and Technology Management and Entrepreneurship. Second, to analyze the technological trajectories of a technology innovation and develop a business plan to market a product related to these technologies.

Syllabus:

1. Basic Concepts (1. Basic concepts about Innovation - 2. The culture of innovation)
2. Innovation and Technology Management (1. The management of innovative organizations over time - 2. Innovation and business strategy.)
3. Entrepreneurship (1. Entrepreneurship and Innovation - 2. Entrepreneurial mindset, motivations, and behaviors - 3. Industry understanding - 4. Business Plan)

Pedagogical procedures (organization, assessment, pedagogical resources):

Caso 70% - Pruebas objetivas (tipo test) 30%

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: NEGOCIACION Y TOMA DE DECISIONES	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. V. CHAPARRO GONZALEZ**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	58		4
	Autonomous work: 75				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☐ **C6** ☒ **C7** ☒ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☒ **SC6**				

Educational objectives of the course:

La asignatura tiene como finalidad que el alumno conozca los conceptos básicos de la negociación y de la decisión en el entorno de la dirección de las empresas. Con ello se pretende desarrollar en el alumno unas competencias necesarias para el correcto desempeño de su profesión y prepararlo para poder acceder a cargos de dirección. Una parte importante del curso de dedicará a el análisis de casos de estudio de procesos de negociación y toma de decisiones en grupo.

Syllabus:

1. TOMA DE DECISIONES (1. Planteamiento general del Análisis Multicriterio de Decisiones - 2. Decisiones participativas - 3. Identificación de los grupos de interés. Análisis de stakeholders - 4. Identificación de los objetivos - 5. El proceso analítico jerárquico (AHP) y el Proceso Analítico en Red (ANP) - 6. Otros métodos: TOPSIS y PRES - 7. Aplicación a diversos casos de estudio)
2. CONCEPTO Y ELEMENTOS DE LA NEGOCIACIÓN (1. Introducción - 2. ¿Que es negociar? - 3. Condiciones necesarias para la negocición - 4. Requisitor del negociador - 5. Fundamentos de la negociación)
3. ELEMENTOS CLAVE EN LA NEGOCIACIÓN (1. La estrategia negociadora - 2. Las claves de la negociación - 3. Estilos negociadores - 4. La pscología del negociador - 5. El proceso comunicador en la negociación)
4. PREPARACIÓN DE LA NEGOCIACIÓN (1. Fases de la negociación - 2. Reglas para la concesión - 3. Reglas para el cierre - 4. Errores en la negociaciones - 5. La negociación de ventas)

Pedagogical procedures (organization, assessment, pedagogical resources):

La parte fundamental de la evaluación son dos parciales con preguntas de respuesta abierta, test, casos o problemas.
Se recuperan en el examen final de la asignatura donde también se podría examinar de prácticas a los alumnos que no las hubieran superado.
El trabajo académico supondrá un 40% de la nota y se realizará en grupo.
Al final de cada clase de teoría el alumno realizará un test de comprensión de la materia explicada. Se realizarán un total de diez test, que supondran el 10% de la nota final. Para aprobar la asignatura será necesario completar un mínimo de siete.
El caso práctico, que supondrá el 20% de la nota final, se desarrollará mediante dos sesiones de prácticas en el aula. Para aprobar la asignatura será necesario asistir al menos a una.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: TECNOLOGIA DE FABRICACION	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **M. D. MESEGUER CALAS**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	54		
	Autonomous work: 78				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☒ **C6** ☒ **C7** ☒ **C8**	☐ **SC1** ☒ **SC2** ☒ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

La asignatura de tecnología de fabricación proporciona al alumno conocimientos tecnológicos avanzados sobre fabricación. En ella se trata la planificación de procesos de fabricación. En la planificación de procesos se debe tener en cuenta la forma que pueden conseguir los distintos procesos de fabricación. Pero también hay que considerar las capacidades tecnológicas: tolerancias alcanzables con los distintos procesos, sus costes, herramientas, utillajes, máquinas, etc. También se estudia el lenguaje de programación de control numérico (CNC). Este es esencial para automatizar las distintas operaciones de fabricación. El tercer aspecto considerado en la asignatura es la automatización y la integración de los sistemas productivos de una fábrica. Esto es fundamental hoy en día en la ingeniería industrial.

Syllabus:

1. Máquina Herramienta de Control Numérico (1. Introducción al control numérico - 2. Elementos de las máquinas herramientas de control numérico - 3. Conceptos para programación de máquina herramienta de control numérico - 4. Lengueje ISO de programación MHCN. Ejemplos prácticos)
2. Planificación de procesos (1. Descripción de recursos: máquinas, utillajes, procesos y operaciones - 2. Métodología para planificación de procesos - 3. Desarrollo de planes de proceso. Aplicaciones prácticas)
3. Sistemas de producción industrial (1. Organización y estrategias de sistemas de fabricación flexible - 2. Automatización de células de fabricación flexible)

Pedagogical procedures (organization, assessment, pedagogical resources):

Se realizarán las siguientes pruebas:
Teoría, prueba objetiva tipo test (20%).
Ejercicio de programación CNC, prueba de respuesta abierta (25%).
Planificación de procesos, cuatro pruebas objetivas tipo test (11.25% cada una).
En las clases y las prácticas se realizarán varios trabajos académicos con un peso del 10%. Se trata de pequeños ejercicios que se realizarán en grupos de 2 ó 3 alumnos. Los trabajos serán presenciales y no se podrán entregar una vez finalizada la sesión donde se propongan. El alumno deberá asistir al grupo de prácticas asignado por la Escuela en la matrícula.
No hay mínimos en ninguna de las pruebas. Se obtendrá el aprobado si la suma ponderada de las notas alcanza el 5.
Se realizará un examen final de recuperación para los alumnos que no logren el aprobado durante el curso. En este examen se pueden recuperar las pruebas que no hayan sido superadas con un 5. Los trabajos académicos no son recuperables

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: TOMA DE DECISIONES Y ETICA	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **M. GARCIA MELON**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	22.5	18.5	67		18
	Autonomous work: 54				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☐ **C4** ☒ **C5** ☒ **C6** ☒ **C7** ☒ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☒ **SC5** ☒ **SC6**				

Educational objectives of the course:

En esta asignatura, el alumno de Master en Ingeniería Química se enfrenta por primera vez a conceptos relacionados con la ética y la toma de decisiones. Se trata de conocer los procesos complejos de toma de decisión en los cuales la ética toma un papel predominante: dilemas morales, conflictos de intereses.
Para conseguirlo la asignatura consta de una primera mitad donde el alumno estudia ética y una segunda mitad donde el alumno estudia técnicas de decisión y aplica la ética en ellas.

Syllabus:

1. Análisis de los procesos de toma de decisiones (1. Introducción al concepto de decisión - 2. Ejemplos decisiones difíciles)
2. Elementos del análisis de decisiones (1. Los actores - 2. Los criterios - 3. Las alternativas)
3. El Proceso Analítico Jerárquico, AHP (1. Axiomas - 2. La jerarquía - 3. Cálculo de prioridades)
4. Toma de decisión en grupo con AHP (1. Consenso - 2. Agregación de prioridades - 3. Metodo Delphi)
5. La dimensión ética en el ejercicio profesional (1. Ética en la emrpesa - 2. Responsabilidad Social Corporativa)
6. Valores éticos y toma de decisiones (1. Criterios éticos)

Pedagogical procedures (organization, assessment, pedagogical resources):

La nota de la asignatura vendrá determinada por:
1.- 1ª parte de la asignatura, Ética, 35% de la nota. Un examen y varios casos de estudio en el aula
2.- 2ª parte de la asignatura, Toma de decisiones, 65% de la nota. Un examen tipo test y tres entregas de casos de estudio resueltos en el aula
NOTA TOTAL= 0,35*Nota Ética+0,65*Nota Decisión

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

4th year

[SEMESTER 8- SARREBRUCKEN]

Name des Modulelementes	ECTS
Wahlpflichtmodule (Teil 1)	
Anwendungen von Polymeren	
Polymerwerkstoffe	3
Metalltechnologie	
Stahlkunde	3
Werkstoffe - Funktion une Prüfung	
Funktionswerkstoffe Vertiefung	4
Methodik Mikrostrukturmechanik und Schädigungsmechanismen	3
Materialphysik 2	5
Methodische und Technische Wahlpflichtmodule (Teil 2)	
Theoretische une Rechenmethoden	
Empirische und statistische Modellbildung	4
Anwendungen von Glas und Keramik	
Glasanwendungen	3
Hochleistungskeramik	3
Anwendungen von Metallen	
Amorphe Metalle	3
Pulvermetallurgie	3
Leichtbausysteme	3
Wahlfächer des Werkstofftechnik (frei wählbar) (Weitere Veranstaltungen)	
Feinbearbeitungstechnologien	3
Physikalische Akustik 1	3
Laseranwendung	3
Hybridmaterialien und Nanokomposite	3
Smart Polymers	2
Aspekte des chemischen Materialdesigns	2
Analytische Mechanik	3
Materialmodellierung	4
Finite Elemente in der Mechanik	4
Strömungsmechanik	3
3D-Analyse von Mikro- und Nanostrukturen II-fortgeschrittene Methoden	3
Methodik 3 Hochauflösende Mikroskopieverfahren I	4
Methodik 7 Nano- und mikromechanische Messmethoden	3
Methodik 9 Anwendungen der Rasterkraftmikroskopie	3
Theoretische Materialphysik	5
NanoBiomaterialien 2	3
Seminar Werkstofftechniker Sommer	2

<table>
<tr><td colspan="3">Teaching Unit:
POLYMERWERKSTOFFE</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="3"></td><td colspan="5">Course manager: K. LIENKAMP</td></tr>
<tr><td colspan="3">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="3" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>30</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3"></td><td colspan="5">Autonomous work: 60</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Die Studierenden erwerben umfangreiche Kenntnisse und Fertigkeiten in Polymerwerkstoffe

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: STAHLKUNDE	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. AUBERTIN**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☒ **C4** ☒ **C5** ☒ **C6** ☒ **C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Die Studierenden erwerben vertiefte Kenntnisse in Stahlkunde II
• Herstellung und Bearbeitung der Eisenwerkstoffe
• Einfluss der Legierungspartner auf das thermodynamische und kinetische Verhalten
• Gefüge- und Eigenschaftsentwicklung am Beispiel gängiger Stahlsorten

Syllabus:

• Rekapitulation der Herstellungs- und Bearbeitungsverfahren, der Einteilung sowie der thermodynamischen und kinetischen Gegebenheiten von Eisenwerkstoffen
• Mikrostruktur, Kinetik und Mechanismen der Phasenumwandlungen während der thermomechanischen Behandlung von Stählen
• Konstitution, Umwandlungsverhalten, Eigenschaften und Anwendungen gebräuchlicher Stähle

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: FUNKTIONSWERKSTOFFE VERTIEFUNG	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. MUKLICH**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	45				
	Autonomous work: 75				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☒ **C1** ☒ **C2** ☒ **C3** ☒ **C4** ☒ **C5** ☒ **C6** ☒ **C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Die Studierenden erwerben Kenntnisse in:
• Kontaktwerkstoffe und deren Anwendungsfelder
• mehrkomponentige Funktionswerkstoffe im Volumen- und Dünnschichtmaterial
• Werkstoffe für Energiekonversion und -transport
• Nanoskalige Funktionswerkstoffe

Syllabus:

• Aufbau, Eigenschaften und Schädigungsmechanismen gebräuchlicher Kontaktwerkstoffe
• Theoretische Grundlagen der Tribologie und Möglichkeiten der werkstoffseitigen Optimierung
• Physikalische Eigenschaften und Herstellung von Halbleitern und Supraleitern
• Einsatzgebiete von Halbleiterwerkstoffen und Thermoelektrika bei Energiekonversion
• Physikalische Eigenschaften nanoskaliger Funktionswerkstoffe am Beispiel von u.a. Carbon-Nanotubes

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: Skript zur Vorlesung;
"Physical Metallurgy Principles" von Reed-Hill, Wadsworth Verlag, 3. Auflage
"Phase Transformations in Metals and Alloys" von Porter, CRC Press Inc., 2. Auflage
"Einführung in die Festkörperphysik" von Kittel, Oldenbourg Verlag, 14. Auflage
"Physikalische Grundlagen der Materialkunde" von Gottstein, Springer Verlag, 2. Auflage
„Keramik" von Schaumburg und Lippe, Teubner Verlag

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
METHODIK MIKROSTRUKTURMECHANIK UND SCHÄDIGUNGSMECHANISMEN</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: M. MARX – C. MOTZ</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>30</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work: 60</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Die Studierenden erlernen:
• Den Einfluss mikroskopisch inhomogener Gefüge auf die makroskopischen mechanischen Eigenschaften kennen.
• Aus komplexen Daten mikroskopisch inhomogener Gefügemittels Homogenisierungsverfahren einfache, makroskopisch homogene Materialeigenschaften zu errechnen.
• Unterschiedliche Schädigungsmechanismen und deren Ursachen kennen.
• Anhand physikalischer Experimente die Grundlagen der Schädigungsmechanismen zu erforschen mit dem Ziel der Materialverbesserung

Syllabus:

• Mechanische Eigenschaften inhomogener Gefüge
• Ausgewählte Defekte, Defektstrukturen und Grundlösungen (Eigendehnungen, Inhomogenitäten)
• Effektive elastische Eigenschaften inhomogener Gefüge (Repräsentative Volumenelemente, analytische Näherungsmethoden)
• Schädigungsmechanismen (Ermüdungsrisse, Size Effects, Wasserstoffversprödung)

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: MATERIALPHYSIK 2	Year/Semester of EEIGM studies: 4A – 2nd semester
	Course manager: C. MOTZ
EEIGM Department: Materials specialisation	Hours/student:
Teaching method: Academic	In-person classes: 60
Assessment: Classic	Lecture: 60 / Tutorial: / Lab work: / Project: / Test:
	Autonomous work: 90

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☒ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Die Studierenden erwerben Kenntnisse:
• in den Grundlagen der Festkörperphysik für Werkstoffwissenschaftler und in der Materialphysik. In den Übungen werden Übungsaufgaben gestellt, besprochen und bewertet.
• Die Vorlesungen und Übungen legen die theoretischen und experimentellen Grundlagen für die Materialentwicklung und dem Verständnis der Funktionsweise intelligenter Bauteile bis hin zur Mikro/Nanotechnologie
• Im Fokus liegen das Verständnis der mechanischen und physikalischen Eigenschaften von Materialien und deren Anwendung in modernen Werkstoffen.

Syllabus:

• Materialfestigkeit, Basierend auf MP1 werden der Einfluss der Kristallstruktur auf Versetzungen (Beispiel intermetallische Phasen), der Einfluss von Korngrenzen auf die Festigkeit (Beispiel ultrafeinkörnige und nanokristalline Materialien), der Einfluss der Phasengrenzen auf das Materialverhalten (Beispiel Verbundwerkstoffe), die Rolle der Diffusion bei Keimbildung, Wachstum, Rekristallisation und beim Kriechen mehrphasiger Legierungen besprochen.
• Versagensmechanismen und Lebensdauervorhersage Einführung in die Mikrostrukturbruchmechanik, Ermüdung und Lebensdauervorhersage, Porenwachstum und Kriechbruchmechanik, Korrosion und Wasserstoffversprödung
• Elektronische und magnetische Eigenschaften von Werkstoffen (z.B. Halbleiterwerkstoffe)

Pedagogical procedures (organization, assessment, pedagogical resources):

Benotete Klausur

Student's expected work in autonomy:

Bibliographic references:

Kittel Festkörperphysik, Haasen Metallphysik, Manuskript
Reed-Hill Physical Metallurgie, Manuskript

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
EMPIRISCHE UND STATISTISCHE MODELLBILDUNG</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: D. BÄHRE</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>45</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 75</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Ziel ist die Vermittlung von Wissen zu Prinzipien und Anwendung empirischer und statistischer Modelle bei ingenieurwissenschaftlichen Fragestellungen. Neben einem Überblick über grundlegende Begriffe und Vorgehensweisen werden Methoden der Datenermittlung und Modellerstellung sowie beispielhafte Anwendungen vermittelt. Die Lehrveranstaltung befähigt die Studenten, verschiedene Methoden zur Erstellung empirischer und statistischer Modelle mit ihren Möglichkeiten und Grenzen zu kennen und auf einzelne ingenieurwissenschaftliche Aufgaben anzuwenden.

Syllabus:

• Begriffsklärung Empirie, Statistik, Modellierung
• Statistische Modellbildung
• Lineare und nichtlineare Regression
• Interpolation und Extrapolation
• Statistische Versuchsplanung
• Mustererkennung
• Künstliche neuronale Netze
• Anwendungen in der Fertigungstechnik: Modelle in der Zerspanungstechnik, Prozessüberwachung, Qualitätssicherung, Modellierung und Simulation von Schleifprozessen

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: GLASANWENDUNGEN	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **G. FALK**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☒ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☒ SC5 ☐ SC6

Educational objectives of the course:

Die Studierenden erwerben umfangreiche Kenntnisse und Fertigkeiten in Glasanwendungen:
• Glasrohstoffe, Glasschmelze und Schmelzreaktionen
• Technische Schmelzaggregate, neue Entwicklungen bei Glaswannen
• Heißformung von Hohl- und Flachglas
• Neue Anwendungen durch Beschichtung von Glas
• Herstellung von Spezialglas
• Nachbearbeitung und Qualitätskontrolle von Glas

Syllabus:

• Literaturangaben, Wirtschaftsfaktor Glas, Rohstoffe, Lagerstätten und Aufbereitung
• Netzwerkbildner und -wandler, Schmelzreaktionen, Läutern
• Techn. Schmelzaggregate: Hafenofen, Hohlglaswanne, Flachglaswanne, „Low-Nox-Melter“
• Feuerfestmaterial, Brenner, Wärmeübertrag, Wärmebilanz, Elektroschmelze
• Hohlglasherstellung: Handbetrieb, Speiser, Blas-Blas- und Press-Blasverfahren, Leichtgewichtflasche, Veredlung von Hohlglas, Vergleich mit Kunststoff
• Rohrherstellung, Pressglas, Herstellung und Anwendung von Glasfasern
• Herstellung von Flachglas: Mondglas, Lubber-Verfahren, Ziehverfahren, Floatprozess, Displayglas
• Glastechn. Produktionsfehler: Schlieren, Steinchen, Blasen, Entglasungen, Formfehler, Risse
• Veredlung von Flachglas, Wärme-, Sonnen- und Schallschutzgläser, U- und g-Wert von Verglasungen, Verbund- und Sicherheitsglas im Auto
• Brandschutzglas, mech. und chem. Funktionsschichten, selbstschaltende und schaltbare Gläser, Emaillierung von Glas und Metall
• Kieselglasherstellung: natürliche und synthetische Rohstoffe, Schmelzprozess, Vycorglas, Sinterverfahren
• Sondergläser: Filter, Membranen, opt. Gläser, Isolierglas, Bearbeitung von Glas: Trennen, Schleifen, Polieren, Verbinden, Linsenherstellung

Pedagogical procedures (organization, assessment, pedagogical resources):

Student’s expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: HOCHLEISTUNGSKERAMIK	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **G. FALK**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

• Herstellung und Eigenschaften oxidkeramischer und nichtoxidkeramischer Hochleistungswerkstoffe
• Gefüge-Eigenschaftskorrelationen Hochleistungskeramischer Funktionswerkstoffe für Anwendungen in der Elektronik, Energietechnik, Sensorik, Umwelttechnik, Verfahrenstechnik, Optik, Medizintechnik und Mikroelektronik

Syllabus:

• Einführung: Übersicht Zusammensetzungen, wirtschaftliche Bedeutung, Prozesstechnik
• Herstellung und Eigenschaften von Aluminiumoxid, Zirkonoxid, Titanoxid und weiteren Oxidkeramiken
• Kohlenstoff, Modifikationen, Herstellung und Eigenschaften, Carbide
• Herstellung und Eigenschaften von Siliziumnitrid, Aluminiumnitrid, Bornitrid
• Herstellung und Eigenschaften von Precursorkeramiken, Formkörper und Fasern
• Herstellung und Eigenschaften von Elektrokeramik: Kondensatoren, Piezokeramik, LTCC, NTC, PTC
• Herstellung und Eigenschaften von Ionenleitern: SOFC, Gastrennung, Sensoren, HT-Supraleiter
• Herstellung und Eigenschaften von Magnetwerkstoffen: Ferrite, Ferrofluide
• Herstellung und Eigenschaften Keramikmembranen, verfahrenstechnische Anwendungen
• Herstellung und Eigenschaften von Optokeramik, Lampenkolben, Linsen. Laser, Panzerungen
• Anwendungen Herstellung und Eigenschaften von Biokeramik: Dental- und Implantatwerkstoffe
• Herstellung und Eigenschaften von Substratwerkstoffen für die Mikroelektronik

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: AMORPHE METALLE	Year/Semester of EEIGM studies: 4A FPA - 2nd semester				
	Course manager: **BUSCH**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Die Studierenden erwerben Kenntnisse in:
• Grundlegende Eigenschaften metallischer Legierungen ohne Fernordnung
• Herstellungsverfahren für amorphe Metalle
• Thermodynamische und kinetische Aspekte metallischer Gläser
• Bearbeitungsverfahren und Anwendungen

Syllabus:

• Nahordnung und Fernordnung in Schmelzen und Festkörpern
• Kinetik der Ordnungseinstellung und des Wärmetransports
• Herstellungsverfahren mit flüssig - fest Übergang, über Festkörperreaktionen und über Gasphasenabscheidungen
• Untersuchungsmethoden zum Studium des Glasübergangs
• Kinetik des Glasübergangs
• Kristallisationsvorgänge, Keimbildung und Stofftransport
• Viskosität metallischer Schmelzen und Nahordnung
• Eigenschaften metallischer Gläser
• Anwendungen und Verarbeitungsverfahren für amorphe Metalle

Pedagogical procedures (organization, assessment, pedagogical resources):

Lectures in english

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: PULVERMETALLURGIE	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. AUBERTIN**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

• Herstellung, Charakterisierung und Konditionierung von Metallpulvern
• Formgebung, Konsolidierung und Eigenschaftsprüfung der pulvermetallurgischen Produkte
• Anwendungen pulvermetallurgisch erzeugter Bauteile

Syllabus:

• Verfahren zur Pulverherstellung, Pulvercharakterisierung und Aufbereitung der Pulver
• Formgebung durch Pressen, ohne Druckanwendungen und der Einfluss der Temperatur
• Grundlagen des Sinterns homogener und heterogener Systeme, auch mit flüssiger Phase
• Metal Injection Moulding und Prüfung der Sinterwerkstoffe
• Anwendungsbeispiele: gesinterte Massenformteile, poröse Teile (Filter), Gleitlager, Reibwerkstoffe, Hartstoffe und Verbundwerkstoffe

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
LEICHTBAUSYSTEME</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: H-G. HERRMANN</td></tr>
<tr><td>EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>30</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work: 60</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Die Teilnehmer lernen die grundlegenden Methoden des Leichtbaus kennen. Sie erwerben darüber hinaus Erfahrungen darin, wie diese auf praktische Probleme anzuwenden sind.

Syllabus:

- Grundlagen Leichtbau
- Gestalt- / Werkstoff- / Fertigung- Leichtbau
- Bionischer Leichtbau
- Lebensdauer / ZfP
- Bewertung Kosten/Qualität
- Neue Trends (z.B. für alternative Antriebe)

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben
Johannes Wiedemann, "Leichtbau: Elemente und Konstruktion", Springer, 2006

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
FEINBEARBEITUNGSTECHNOLOGIEN</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: D. BÄHRE</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>30</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work: 60</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Im Mittelpunkt der vertiefenden Betrachtungen stehen spanende Verfahren mit geometrisch bestimmter Schneide sowie mit geometrisch unbestimmter Schneide. Die Lehrveranstaltung befähigt die Studenten, verschiedene spanende und abtragende Fertigungsverfahren, auch zur Feinbearbeitung, mit ihren Haupteinflussgrößen zu kennen, sowie entsprechend verschiedenen Anforderungen auszuwählen und durch geeignete Parameterwahl anpassen zu können.

Syllabus:

• Eigenschaften und Anforderungen technischer Oberflächen
• Randzonenbeeinflussung durch Fertigungsprozesse
• Verfahrensübersicht und Einsatzbereiche
• Spanen mit geometrisch unbestimmter Schneide: Abtragsprinzipien, Prozesskenngrößen, Schleifmittel und Werkzeuge, Konditionieren, Schleifen, Honen, Läppen, Finishen
• Mikroabtragsverfahren
• Entgrat- und Verrundungsverfahren
• Verfahren zur Oberflächenbeeinflussung: Rollieren, Glattwalzen, Strahlen, Autofrettage

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: PHYSIKALISCHE AKUSTIK 1	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **U. RABE**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 30				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				

Generic EEIGM competencies	Specific EEIGM competencies
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**

Educational objectives of the course:

Die Studierenden erwerben umfangreiche Kenntnisse und Fertigkeiten in:
- Grundkonzepte der physikalischen Akustik
- Einführung in die Materialprüfung mit Ultraschall
- Gerätetechnische Aspekte
- Grundlegende Konzepte der Bildgebung und Rekonstruktion

Syllabus:

- Schwingungen, Schallwellen, Ultraschall
- Anregung und Empfang von Ultraschallwellen, Methoden der Bildgebung (A-B-C-Scan)
- Beugung und Fehlergrößenbestimmung
- Ultraschall-Mikroskopie
- Anwendungsbeispiele

Pedagogical procedures (organization, assessment, pedagogical resources):

Benotete Klausur

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

A.Ehrhard, Verfahren der zerstörungsfreien Materialprüfung, DVS Media Gmbh, Berlin, 2014
James P. Wolfe, Imaging Phonons, Acoustic Wave Propagation in Solids, Cambridge University Press, 1998
B.A. Auld, Acoustic Fields and Waves in Solids, Vol I, II, Robert E. Krieger Publishing, 1990

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: LASER ANWENDUNG	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. MÜCKLICH**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Die Studierenden erwerben umfangreiche Kenntnisse und Fertigkeiten in:
- Wechselwirkung Laserstrahlung mit Materie
- Laserstrahlung in Prozess- und Fertigungstechnik
- Ultrakurzgepulste Laserstrahlung
- Laserinterferenz-Strukturierung

Syllabus:

- Laserstrahlung in Prozess- und Fertigungstechnik
- Ultrakurzgepulste Laserstrahlung
- Laserinterferenz-Strukturierung

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

"Laser Material Processing" von Steen, Springer Verlag, 2. Auflage
„Lasers" von Siegman, University Science Books
"Laser Fundamentals" von Silfvast, Cambridge University Press,2. Auflage
"Principles of Lasers" von Svelto, Springer Verlag, 4. Auflage
„Laser Beam Interactions with Materials" von Allmen und Blatter, Springer Verlag, 2. Auflage

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: HYBRIDMATERIALIEN UND NANOKOMPOSITE	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **G. KICKELBICK**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:** 30				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☒ **SC1** ☒ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Die Studierenden erwerben Kenntnisse im Bereich der Chemie moderner Materialien:
• Kenntnisse zur chemischen Synthese und Struktur von Hybridmaterialien und Nanokompositen
• Überblick zu Charakterisierungsmöglichkeiten der Materialien
• Verständnis von technologischen Anwendungen

Syllabus:

• Historie, Begriffe, Definitionen
• Abgrenzung Hybridmaterialien-Nanokomposite
• Chemie der Vorstufen
• Herstellung amorpher Hybridmaterialien, Sol-Gel Prozess
• Eigenschaften von Nanobausteinen
• Herstellung von anorganisch-organischen Nanokompositen
• Rolle der Grenzfläche
• Eigenschaftsprofile
• Anwendungen

Pedagogical procedures (organization, assessment, pedagogical resources):

Benotete Klausur

Student's expected work in autonomy:

Bibliographic references:

Vorlesung auf Powerpoint-Folien (zum Download im Internet zugänglich).
G. Kickelbick, Hybrid Materials: Synthesis, Characterization, and Applications, Wiley-VCH, 2006

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
SMART POLYMERS</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: G. KICKELBICK</td></tr>
<tr><td>EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes: 15</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>15</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work: 45</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Überblick zu wechselnden Themenbereiche aus dem Gebiet der modernen chemisch-orientierten Herstellung, Charakterisierung und Anwendung von Funktions- und Biomaterialien

Syllabus:

- Schaltbare Polymere: thermisch, pH, optisch, magnetisch, elektrisch
- leitfähige Polymere für oLEDs und Photovoltaic
- flüssigkristalline Polymere
- Polymere für den gerichteten Transport von Wirkstoffen

Pedagogical procedures (organization, assessment, pedagogical resources):

Benotete Klausur

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: ASPEKTE DES CHEMISCHEN MATERIALDESIGNS	Year/Semester of EEIGM studies: 4A - 2nd semester
	Course manager: **G. KICKELBICK**
EEIGM Department: Materials specialisation	**Hours/student:**
Teaching method: Academic	**In-person classes:** 15
	Lecture: 15 / Tutorial: / Lab work: / Project: / Test:
Assessment: Classic	**Autonomous work:** 45
Generic EEIGM competencies	**Specific EEIGM competencies**
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☒ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Die Studierenden erwerben Kenntnisse im Bereich der Chemie moderner Materialien:
• Einführung in die Methoden des modernen Materialdesigns
• Selbständiges Erarbeiten eines Themas aus dem Bereich chemisches Design moderner Materialien anhand der Analyse von Primärliteratur
• Präsentation des Wissensstandes im Rahmen eines Vortrages

Syllabus:

Methoden des Aufbaus von chemischen Funktionsmaterialien aus kleinen Bausteinen (z.B. Nanopartikel, Materialien mit besonderen elektronischen optischen oder elektrischen Eigenschaften, Poröse Materialien, usw.)
• Moderne chemische Funktionsmaterialien
• Vom Molekül zum Material
• Bottom-Up Synthese
• Nanopartikel

Pedagogical procedures (organization, assessment, pedagogical resources):

Seminarvortrag

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: ANALYTISCHE MECHANIK	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **S. DIEBELS**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Die Studierenden erwerben umfangreiche Kenntnisse und Fertigkeiten in:
• Beschreibung der Bewegung einzelner Massenpunkte und diskreter Systeme im Rahmen der klassischen Mechanik
• Aufstellen von Bewegungsgleichungen und Bestimmung von Bahngleichungen freier und geführter Körper

Syllabus:

• Kinematik des Massenpunktes
• Newtonsche Mechanik: Einzelner Massenpunkt, Massenpunktsysteme
• Lagrangesche Mechanik: Zwangsbedingungen, Generalisierte Koordinaten, Prinzip von d'Alembert, Lagrangesche Gleichungen, Lagrangesche Funktion, Erhaltungsgrößen
• Hamiltonsche Mechanik: Hamiltonfunktion, Hamiltonsche Gleichungen, Hamiltonsches Prinzip

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: MATERIALMODELLIERUNG	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **S. DIEBELS**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	45				
	Autonomous work: 75				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Die Studierenden erwerben Kenntnisse in:
• Grundkonzepte der Materialmodellierung bei inelastischem Verhalten anhand von rheologischen Modellen
• Formulierung von Materialmodellen im Rahmen der nichtlinearen Kontinuumsmechanik

Syllabus:

• Eindimensionale rheologische Modelle linearen viskoelastischen und elasto-plastischen Materialverhaltens
• Einbettung des Konzepts interner Variablen in den Rahmen der nichtlinearen Kontinuumsmechanik
• Formulierung thermomechanisch konsistenter, viskoelastischer und elasto-plastischer Materialmodelle
• Aspekte der numerischen Umsetzung der nichtlinearen Modelle

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben
Skripten zu den Vorlesungen
P. Haupt: Continuum Mechanics and Theory of Materials, Springer
R. Greve: Kontinuumsmechanik, Springer

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: **FINITE ELEMENTE IN DER MECHANIK**	**Year/Semester of EEIGM studies:** 4A - 2nd semester				
	Course manager: S. DIEBELS				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	45				
	Autonomous work: 75				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Die Studierenden erwerben umfangreiche Kenntnisse und Fertigkeiten in Finite Elemente in der Mechanik:
• Verständnis der Funktionsweise nichtlinearer Finite-Elemente-Programme in der Kontinuumsmechanik
• Fähigkeit, geeignete finite Elemente für bestimmte Anwendungen auszuwählen
• Implementierung mathematischer Modelle für Simulationen

Syllabus:

• Nichtlineare Gleichungssysteme
• Linearisierung von Modellgleichungen
• Materiell nichtlineare finite Elemente
• Geometrisch nichtlineare finite Elemente
• Numerische Behandlung von Elastizität und Plastizität

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: **STRÖMUNGSMECHANIK**	**Year/Semester of EEIGM studies:** 4A - 2nd semester				
	Course manager: **S. DIEBELS**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Die Studierenden erwerben umfangreiche Kenntnisse und Fertigkeiten in:
• Abgrenzung von Fluiden und Festkörpern
• Entwicklung der Modellgleichungen für ideale und linearviskose Fluide
• Lösungskonzepte für technische Anwendungen
• Grundzüge der Turbulenztheorie

Syllabus:

• Eigenschaften von Fluiden
• Herleitung der Euler-, der Bernoulli- und der Navier-Stokes-Gleichung
• Analytische Lösungskonzepte für einfache Strömungsprobleme, technische Anwendungen
• Grundkonzepte der Turbulenztheorie

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: **3D-ANALYSE II - FORTGESCHRITTENE METHODEN**	**Year/Semester of EEIGM studies:** 4A - 2nd semester				
	Course manager: F. MÜCKLICH				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☒ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Die Studierenden erwerben grundlegende und Kenntnisse und weiterführende Fertigkeiten über:
• Focused Ion Beam Technik für Zielpräparation und Tomografie
• moderne tomografische Verfahren in der Materialwissenschaft
• 3D Bildbearbeitung
• Quantitative Gefügeanalyse in 3D
• Verfahren der FIB-Gefügetomografie
• Rekonstruktion der Tomografiedaten

Syllabus:

Vorlesung 3D-Analyse II - fortgeschrittene Methoden (3 CP):
• Übersicht über moderne tomografische Verfahren in der Materialwissenschaft (Röntgen- und Synchrotron CT, Atomsonde, FIB-Tomografie, TEM-Tomografie)
• Grundlagen der quantitativen Gefügeanalyse in 2D und 3D
• 3D Bildbearbeitung und Rendering, Morphologische Operationen
• Verfahren der FIB-Gefügetomografie: Probenvorbereitung, Datenaufnahme, Rekonstruktion und Visualisierung
• Bedienung einer 3D-Bildanalysesoftware, praktische Arbeiten im CIP-Pool
• Simulation effektiver Eigenschaften, praktische Arbeiten im CIP-Pool
• Bearbeitung eines kleinen Projektes

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
METHODIK 3 HOCHAUFLÖSENDE MIKROSKOPIEVERFAHREN I</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester
Course manager: M. MARX</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>45</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

• Die Studierenden erlernen die physikalischen und technologischen Grundlagen der Rasterelektronenmikroskopie und Mikrosondentechnik
• Die Studierenden lernen die Messmethoden, Einsatzgebiete, Möglichkeiten und Grenzen der Rasterelektronenmikroskopie und Mikrosondentechnik kennen.
• Die Studierenden lernen, die Bilder und Daten der unterschiedlichen Abbildungs- und Messverfahren zu verstehen und zu beurteilen.
• Die Studierenden lernen in praktischen Übungen die Probenpräparation und den Umgang mit dem Rasterelektronenmikroskop und der Mikrosonde

Syllabus:

• Wechselwirkung zwischen Elektronen und Festkörper
• Aufbau eines Rasterelektronenmikroskops
• Funktionsweise der Bauteile
• Kontrastmechanismen
• Probenpräparation
• Energie- und wellenlängendispersive Mikroanalyse
• Orientierungsmessungen mittels Electron Channelling Pattern und Electron Back Scatter Diffraction
• 3D-Analyse mittels Stereoskopie

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: METHODIK 7 NANO- UND MIKROMECHANISCHE MESSMETHODEN	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **M. MARX – C. MOTZ**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Die Studierenden erlernen:
• Die theoretischen und technologischen Grundlagen zur Ermittlung mechanischer Größen auf der Mikro- und Nanoskala
• Präparationsmethoden zur Herstellung von Mikroproben
• Einsatzgebiete, Möglichkeiten und Grenzen der unterschiedlichen Messverfahren
• Messdaten der unterschiedlichen Verfahren zu verstehen und zu beurteilen.

Syllabus:

• Mikro- und Nanoindentierungsmethoden
• Mikro- und Nano-Scratchtests
• Präparation von Mikroproben mittels unterschiedlicher Verfahren (Lithografie, FIB)
• In-Situ Methoden der Mikro- und Nanoindentierung

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
METHODIK 9 ANWENDUNGEN DER RASTERKRAFTMIKROSKOPIE</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: C. MOTZ</td></tr>
<tr><td>EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>30</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work: 60</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Die Studierenden erlernen:
• die physikalischen und technologischen Grundlagen der Mikrosondentechnik
• die Messmethoden, Einsatzgebiete, Möglichkeiten und Grenzen der Mikrosondentechnik kennen.
• die Bilder und Daten der unterschiedlichen Abbildungs- und Messverfahren zu verstehen und zu beurteilen.
• in praktischen Übungen die Probenpräparation und den Umgang mit der Mikrosonde.
• vertiefend die physikalischen und technologischen Grundlagen unterschiedlicher Mikroskopieverfahren, deren Auflösungen bis in den atomaren Bereich reichen.
• die Einsatzgebiete, Möglichkeiten und Grenzen der unterschiedlichen Messverfahren kennen.
• die Messdaten der unterschiedlichen Verfahren zu verstehen und zu beurteilen.

Syllabus:

• Rastersondenmikroskopie (AFM, MFM, RTM, SPSTM, SNOM, Theorie und Praxis)
• Ausgewählte Beispiele der Anwendung der Rasterkraftmikroskopie

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: **THEORETISCHE MATERIALPHYSIK**	**Year/Semester of EEIGM studies:** 4A - 2nd semester				
	Course manager: M. MÜSER				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	60				
	Autonomous work: 90				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☒ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Die Studierenden erwerben umfangreiche Kenntnisse und Fertigkeiten in:
• Materialverhalten unter dem Blickwinkel der Festkörperphysik
• Aspekte der statistischen Mechanik

Syllabus:

Vorlesung und Übung Theoretische Materialphysik :
• (Klassischer) Elektromagnetismus der kondensierten Materie (Debye Hückel Theorie, Clausius Mossotti, Drude-Lorentz Modell, Kramers-Kronig Relation)
• Mechanische Eigenschaften von Festkörpern (Dynamische Matrix, optische und akustische Phononen, Kontinuumslimit, elastische Konstanten aus atomaren Wechselwirkungen, Cauchy Relationen, Symmetriebetrachtungen)
• Statistische Mechanik von Materialien (Lineare Antwort Theorie, Fluktuations-Dissipations-Theorem, Ginzburg-Landau Theorie der Phasenübergänge, kritische Exponenten)
• Elektronen in Festkörpern (Brillouinzone, Bloch'sches Theorem, Hybridisierung, semiklassische Beschreibung von Elektronen, Boltzmann-Gleichung, Elektronen und Lochleitung, Punktdefekte)
• Fermifläche und Zustandsdichte
• Elementare Anregungen (Phononen, Magnonen, Exzitonen)

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: NANOBIO-MATERIALIEN	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **E. ARZT**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	30				
	Autonomous work: 60				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☒ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Die Studierenden erwerben Kenntnisse in:
• Skaleneffekte in der Materialwissenschaft – Grundlagen und Anwendung
• Präparatives Arbeiten in der Materialwissenschaft
• Analytisches Arbeiten in der Materialwissenschaft

Syllabus:

• Komposit-Materialien für die Optik
• Schutzschichten
• PVD/CVD Processes and Biomedical Coatings
• Biomineralisation
• Material-Bio-Wechselwirkungen und ihre biologischen Grundlagen
• Materialien in der Biomedizin
• Biologische Materialien und Biomineralisation
• Nano-Bio-Analytik

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Literaturhinweise: werden zu Beginn der Veranstaltung bekannt gegeben

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

4th year [SEMESTER 8- BRUSSELS]

Modules	ECTS
Common Core - Compulsory courses - Block 1	
Organic chemistry : reactions and mechanisms	4
Polymer materials	6
Common Core - Compulsory project - Block 1	
Un cours à choisir parmi	
Project : Process technology	5
Project : Multifunctional materials	5
Option Process technology	
Compulsory courses - Block 1	
Modeling and design of multiphase systems and reactors	6
Instrumentation for process technology	4
Heterogeneous catalysis	4
Compulsory courses - Block 2	
(Bio)chemical process design and control	4
Design of chemical plant	5
Un cours à choisir parmi	
Molecular and biomolecular engineering	3
Micro and nanobiotechnology	3
Elective courses	
Ceramics	4
Engineering aspects of circular economy	5
Non destructive testing of material	3
Recycling of inorganic materials	5
Biocompatible and nanostructured materials	5
Nanochemistry and nanotechnology	4
Advanced thermal analysis	3
Manufacturing Technology 2	3
Logistics Engineering and Management |	5
Entrepreneurial ecosystems	5
IP Management and Technology Transfer (Chaire Solvay)	5
Management and sustainable development : constraints and opportunities	5
Innovation strategy	5

Seminar of emerging technologies	5
Free elective courses	
Logistics Engineering and Management	5
Supply Chain Performance Analytics	5
Ethique de l'ingénieur	3
Comptabilité financière	5
Introduction to theoretical finance	5
Marketing management	5
How To Make (almost) Any Experiment Using Digital Fabrication	5
Option Materials science	
Compulsory courses - Block 1	
Ceramics	4
Mechanics of materials	3
Production of metals	3
Advanced materials (incl. company visits in even years)	4
Compulsory courses - Block 2	
Polymers : rheology and processing	4
Forming of metals (incl. company visits in even years)	4
Non destructive testing of materials	3
Elective courses - Block 2	
Engineering aspects of circular economy	5
Non destructive testing of materials	3
Molecular and biomolecular engineering	3
Recycling of inorganic materials	5
Biocompatible and nanostructured materials	5
Nanochemistry and nanotechnology	4
Micro and nanobiotechnology	3
Heterogeneous catalysis	4
Advanced thermal analysis	3
Manufacturing Technology 2	3
Logistics Engineering and Management	5
Entrepreneurial ecosystems	5
IP Management and Technology Transfer (Chaire Solvay)	5
Management and sustainable development : constraints and opportunities	5
Innovation strategy	5
Seminar of emerging technologies	5
Free elective courses	
Interfaculty and interdisciplinary program in Healthcare Innovation	5

Logistics Engineering and Management	5
Supply Chain Performance Analytics	5
Ethique de l'ingénieur	3
Comptabilité financière	5
Introduction to theoretical finance	5
Marketing management	5
How To Make (almost) Any Experiment Using Digital Fabrication	5

<table>
<tr><td colspan="2">Teaching Unit:
ORGANIC CHEMISTRY : REACTIONS AND MECHANISMS</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: K. BARTIK</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>24</td><td></td><td>24</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should

- Acquire a general overview of the broad range of organic reactions which can be used to prepare molecules and molecular materials
- Understand the central role played by the chemical industry in our society.

Syllabus:

Chapter titles:

Reactions and Mechanisms in Organic Chemistry
Radical Halogenation
Reactions of Haloalkanes: Nucleophilic Substitutions
Reactions of Haloalkanes: Eliminations
Alcohols
Alkenes
Aldehydes and Ketones
Carboxylic Acids
Delocalized pi Systems
Aromatic Systems: Electrophilic Substitution
Concluding comments

Pedagogical procedures (organization, assessment, pedagogical resources):

Interactive lectures with powerpoint presentations
Exercices and laboratory sessions

Contribution au profil d'enseignement

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
- Collaborate in a (multidisciplinary) team
- The flexibility and adaptability to work in an international and/or intercultural context
- An integrated insight in chemical process and materials' technology

Student's expected work in autonomy:

Bibliographic references:

Organic Chemistry: Structure and Function. Vollhardt and Schore, Freeman and Co. (any of the editions !)
Organic Chemistry. Clayden, Greeves, Warren and Wothers, Oxford University Press (1st or 2nd Ed.)
Organic Chemistry. McMurry, Thomson (any edition)

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: POLYMER MATERIALS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **N. P. VAN DEN BRANDE**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24		48		
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Knowledge and understanding of polymeric materials' properties by means of a systematic study of 'structure-property relations' (theory). Application of this knowledge and understanding to solve practical material problems by means of appropriate experimental characterization, and to communicate motivated interpretations and conclusions in written and oral reports (practicals).

Syllabus:

Basic course in polymer science. The properties of polymeric materials are studied, with the molecular properties of the polymer chains as a starting point. The relations between microstructure and macroscopic properties are focused. The most important analytical techniques for the characterization of 'structure-property relations' are treated. The course contains three major parts: macromolecular structure, supramolecular structure, and macroscopic polymer properties. (i) Chain constitution and architecture, molar mass and molar mass distribution, chain conformations and chain statistics, influence of polymerisation on the macromolecular structure. (ii) Link between microstructure and material properties: amorphous and crystalline phases, phase separation, crystallinity, morphology, networks, chain mobility, temperature-time superposition principle. (iii) Material properties of important polymer classes (thermoplastics, thermosets, elastomers, thermoplastic elastomers, polymer blends and (nano)composites): thermal behaviour, energy-elasticity and entropy-elasticity, mechanical, electrical and optical properties. The most important characterization methods are: molar mass determination, thermal analysis, infrared and Raman spectroscopy, optical and electron microscopy, NMR spectroscopy, X-ray analysis, and mechanical testing.

In the practicals, the theoretical content of the course is illustrated by means of the experimental characterization of both pre-defined as well as unknown polymer materials.

Pedagogical procedures (organization, assessment, pedagogical resources):

Theory: oral examination
Practicals: written report of laboratory work, and an oral presentation (during theoretical exam) on the characterization of unknown polymer of practicals (including a motivated interpretation; ca 10 min).

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

<table>
<tr><td colspan="2">Teaching Unit:
PROJECT : PROCESS TECHNOLOGY</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: M. VERBANCK</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td></td><td>150</td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

Etablir de manière active (travail personnel sur une question donnée) un lien entre les diverses matières enseignées. Sensibilisation à la problématique de la protection de l'environnement et du développement durable.

Syllabus:

Avec l'aide du coordinateur, les étudiants réalisent en cours d'année un travail personnel dont la thématique touche à la protection de l'environnement (contrôle de la pollution à la source, techniques de dépollution) et faisant appel à diverses disciplines de la filière Chimie et Science des Matériaux.

Pedagogical procedures (organization, assessment, pedagogical resources):

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
- Conceive, plan and execute a research project, based on an analysis of its objectives, existing knowledge and the relevant literature, with attention to innovation and valorization in industry and society
- Correctly report on research or design results in the form of a technical report or in the form of a scientific paper
- Present and defend results in a scientifically sound way, using contemporary communication tools, for a national as well as for an international professional or lay audience
- Collaborate in a (multidisciplinary) team
- Develop, plan, execute and manage engineering projects at the level of a starting professional
- Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information
- A creative, problem-solving, result-driven and evidence-based attitude, aiming at innovation and applicability in industry and society
- A critical attitude towards one’s own results and those of others
- Consciousness of the ethical, social, environmental and economic context of his/her work and strives for sustainable solutions to engineering problems including safety and quality assurance aspects
- The flexibility and adaptability to work in an international and/or intercultural context
- An attitude of life-long learning as needed for the future development of his/her career
- An integrated insight in chemical process and materials' technology
- Insight in chemistry as a link between process and materials technology

Student’s expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
PROJECT : MULTIFUNCTIONAL MATERIALS</td><td colspan="5">Year/Semester of EEIGM studies: 4A FPA - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: M-P. DELPLANCKE</td></tr>
<tr><td>EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td></td><td>150</td><td></td></tr>
<tr><td>Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☒ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to apply the acquired knowledge of the previous years to solve or contribute to solving a specific and original material science problem.

Syllabus:

Subjects (modified each year) involving theoretical and practical facets are attributed to groups of 2 or 3 students. They have to investigate (literature survey, propose and carry out experiments...) the problem under the supervision of a senior researcher. The results are presented in a written scientific report and an 15 minutes oral presentation.

Pedagogical procedures (organization, assessment, pedagogical resources):

This teaching unit contributes to the following competences:
- In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
- Conceive, plan and execute a research project, based on an analysis of its objectives, existing knowledge and the relevant literature, with attention to innovation and valorization in industry and society
- Correctly report on research or design results in the form of a technical report or in the form of a scientific paper
- Present and defend results in a scientifically sound way, using contemporary communication tools, for a national as well as for an international professional or lay audience
- Collaborate in a (multidisciplinary) team
- Develop, plan, execute and manage engineering projects at the level of a starting professional
- Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information
- A creative, problem-solving, result-driven and evidence-based attitude, aiming at innovation and applicability in industry and society
- A critical attitude towards one's own results and those of others
- Consciousness of the ethical, social, environmental and economic context of his/her work and strives for sustainable solutions to engineering problems including safety and quality assurance aspects
- The flexibility and adaptability to work in an international and/or intercultural context
- An attitude of life-long learning as needed for the future development of his/her career
- An integrated insight in chemical process and materials' technology
- Insight in chemistry as a link between process and materials technology

The written report and an oral presentation of the results (15 min presentation + 15 min questions) are evaluated as well as the work performed in the laboratories during the realization of the project.
Construction de la note (en ce compris, la pondération des notes partielles)
1/3 individual lab work + 1/3 written report + 1/3 oral presentation (including answers to the questions)

Student's expected work in autonomy:

Bibliographic references:

The references are specific to each subject.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: MODELING AND DESIGN OF MULTIPHASE SYSTEMS AND REACTORS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **P. COLINET**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	24	24		
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

The objectives of the first part of the course (P. Colinet) are: i) to get acquainted with the rich phenomenology of multiphase systems, with a view to major fundamental questions and applications; ii) to learn/review basic equations and boundary conditions describing transport phenomena in multiphase systems with interfaces; iii) to solve these systems of equations in practical cases : droplets, bubbles and thin films with heat transfer, evaporation, solidification, ...

Syllabus:

Phenomenology of multiphase systems; Basic hydrodynamic instabilities in systems with interfaces; Basic equations and boundary conditions for describing transport phenomena in systems involving deformable interfaces between different (liquid, gas or solid) phases; Description of phase change processes (evaporation/condensation, solidification/melting); Basic bifurcation theory; Linear stability analysis

Pedagogical procedures (organization, assessment, pedagogical resources):

Cours théoriques, exercices, et "laboratoires numériques" (utilisation de codes numériques, p.ex. COMSOL multiphysics).
This teaching unit contributes to the following competences:
- In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
- In-depth knowledge and understanding of integrated structural design methods in the framework of a global design strategy
- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
- A creative, problem-solving, result-driven and evidence-based attitude, aiming at innovation and applicability in industry and society
- The flexibility and adaptability to work in an international and/or intercultural context

Student's expected work in autonomy:

Bibliographic references:

R.B. Bird, W.E. Stewart and E.N. Lightfoot, Transport Phenomena, Wiley, Singapore, 1960.
G. Nicolis, Introduction to Nonlinear Science, Cambridge University Press, Cambridge, 1995.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: INSTRUMENTATION FOR PROCESS TECHNOLOGY	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. DUBOIS**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	12		
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6				

Educational objectives of the course:

Bases des différentes techniques de visualisation et d'analyse optique, pouvoir choisir, implémenter et interpréter dans une configuration expérimentale
Instrument and regulate a production unit, understanding the underlying measurements physical principles of the instruments and the theory of regulation and apply it to a physico-chemical unit

Syllabus:

Optique géométrique et ondulatoire
Principe de l'interférométrie et techniques d'analyse des réultats
Holographie digitale
Physical principles of non optical instrumentaion, and characterisation of it
Elements of industrial instrumentation
Elements of regulation and control
Séances d'exercices
Montage d'un interféromère et mesures avec celui-ci de phénomènes de convection
Laboratories
Measurements , regulation, control of a physico-chemical process including optical diagnosis

Pedagogical procedures (organization, assessment, pedagogical resources):

Oral lecture followed by labs and exercices, illustration of cpabilities of the methods (physico-chmeical processing and optical)

Contribution au profil d'enseignement
Amener les étudiants à suivre les problèmes modernes d'instrumentation en physique des fluides de la théorie à la pratique.
Amener les étudiants à comprendre et avoir une analyse critique sur les performances respectives des méthodes modernes de métrologie optique en fluide la physique.
La note est essentiellement établie lors de l'examen oral. Les exercices et TP ne sont pas notés pour permettre aux étudiants d'interroger sans contrainte.

Student's expected work in autonomy:

Bibliographic references:

Eugene Hecht, Alfred Zajac, "Optics", Addison-Wesley Publishing Company, (1982)
Joseph W. Goodman, "introduction to Fourier Optics", McGraw-Hill, (1988)
Joseph Shamir, "Optical Systems and processes", SPIE Optical Engineering Press, (1999)
Joseph W. Goodman, "Statistical Optics", Wiley, (1984)
Max Born, Emil Wolf, "Principles of Optics", Pergamon Press (1959)
M. Nazarathy, J. Shamir "Fourier Optics described by operator algebra", J. Opt. Soc. Am. 70, 150-159 (1980)
Fundamentals of intrumentation (2nd edition) ISBN-13: 978-1418073510

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: HETEROGENEOUS CATALYSIS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **J. DENAYER**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24		24		
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

<table>
<tr><td colspan="2">Teaching Unit:
(BIO)CHEMICAL PROCESS DESIGN AND CONTROL</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester
Course manager: P. BOGAERTS</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="2">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td colspan="2"></td><td>24</td><td>24</td><td></td><td></td><td></td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

Développer la capacité d'utilisation de notions pluridisciplinaires déjà acquises dans le cadre de différents cours (génie des réacteurs, opérations unitaires, technologies de l'environnement, microbiologie, phénomènes de transport, ...) pour la résolution d'un problème concret de dimensionnement d'un bioréacteur.

Aborder des structures de régulation adaptées à des procédés chimiques et biotechnologiques et les illustrer sur des cas concrets.

Syllabus:

Partie 1 (B. Haut) : 4 problèmes relatifs au design de bioprocédés, à résoudre individuellement.

Partie 2 (Ph. Bogaerts) : Réglage d'un réacteur chimique parfaitement mélangé : rappels de principes généraux. Réglage d'un réacteur discontinu parfaitement mélangé non isotherme. Régulation de systèmes à temps mort et de systèmes à déphasage non minimum. Compensation anticipative des perturbations. Régulation de procédés à plusieurs grandeurs d'entrée et plusieurs grandeurs de sortie.

Pedagogical procedures (organization, assessment, pedagogical resources):

Partie 1 (B. Haut) : problèmes à résoudre individuellement. Chaque problème doit faire l'objet d'un rapport, à transmettre avant le 1er juin. Ensuite, lors d'un examen oral, les rapports sont discutés.

Partie 2 (Ph. Bogaerts) : cours magistraux avec diaporamas PowerPoint, séances d'exercices en simulation sur PC.

Contribution au profil d'enseignement

This course helps to train students to :

reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity) ;
collaborate in a (multidisciplinary) team ;
conceive, plan and execute a research project, based on an analysis of its objectives, existing knowledge and the relevant literature, with attention to innovation and valorization in industry and society.

Student's expected work in autonomy:

Bibliographic references:

Coulson et Richardson's Chemical Engineering (Volume 3 : Chemical and Biochemical Reactors & Process Control), D. G. Peacock and J. F. Richardson, 3rd edition, 1994, Butterworth-Heinemann.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: DESIGN OF CHEMICAL PLANTS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. DEBASTE**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	12	12	12	
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☒ SC6

Educational objectives of the course:

This teaching unit contributes to the following competences:

In-depth knowledge and understanding of integrated structural design methods in the framework of a global design strategy

In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes

Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)

Work in an industrial environment with attention to safety, quality assurance, communication and reporting

Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information

A critical attitude towards one's own results and those of others

Consciousness of the ethical, social, environmental and economic context of his/her work and strives for sustainable solutions to engineering problems including safety and quality assurance aspects

The flexibility and adaptability to work in an international and/or intercultural context

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: MOLECULAR AND BIOMOLECULAR ENGINEERING	Year/Semester of EEIGM studies: 4A - 2nd semester
	Course manager: G. BRUYLANTS
EEIGM Department: Materials specialisation	Hours/student:
Teaching method: Academic	In-person classes:
Assessment: Classic	Lecture: 24 / Tutorial: 12 / Lab work: / Project: / Test:
	Autonomous work:

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☒ SC6

Educational objectives of the course:

At the end of the course, the student should be able to apply all acquired knowledge in chemistry to critically analyse the complex issues related to the production and use of a molecular sensor. In groups, and under the supervision of the teacher, students will have to find in the literature protocols to set up the test and apply them in the laboratory. The obtained results will have to report to the other students as an oral presentation and as a written scientific report.

Syllabus:

Through the development of a Lateral Flow Assay (LFA) - a test similar to the pregnancy test, different aspects of the development of a molecular sensor are discussed: the synthesis, characterization and functionalization of nanomaterials, the use of biomolecules to provide selectivity, the validation of the test.

Pedagogical procedures (organization, assessment, pedagogical resources):

Students will have to work in groups on one of the three following topics:
- synthesis and characterization of the nanoparticles
- functionalization of the particles using a selected biomolecule
- functionalization of the cellulose membrane and validation of the test.

Students will have to prepare a oral presentation for their colleagues presenting the requested theoretical concepts and the results that have been obtained experimentally.
The experimental results will also have to be reported as an scientific report to the teacher.

This teaching unit contributes to the following competences:

In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
The flexibility and adaptability to work in an international and/or intercultural context
An integrated insight in chemical process and materials' technology
Ability to reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
Ability to conceive, plan and execute a research project, based on an analysis of its objectives, existing knowledge and the relevant literature, with attention to innovation and valorization in industry and society
Report correctly on research or design results in the form of a technical report or in the form of a scientific paper
Present and defend results in a scientifically sound way, using contemporary communication tools, for a national as well as for an international professional or lay audience
Collaborate in a (multidisciplinary) team
Develop, plan, execute and manage engineering projects at the level of a starting professional
Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information
Adopt a critical attitude towards one's own results and those of others
Be conscious of the ethical, social, environmental and economic context of his/her work and strives for sustainable solutions to engineering problems including safety and quality assurance aspects

Student's expected work in autonomy:

Bibliographic references:

Chemical and Engineering News (American Chemical Society) - https://cen.acs.org

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
MICRO AND NANOBIOTECHNOLOGY</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: G. DESMET</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>13</td><td></td><td></td><td>26</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: CERAMICS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **M-P. DELPLANCKE**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24		24		
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

Introduce the ceramics, their synthesis methods and their properties, linking the properties to the microstructure.

Syllabus:

This is a class in common between ULB anf VUB. The theoretical class is given by prof. H. Rahier at VUB and the practicals are taking place at ULB with Prof. M.P. Delplancke.

The most important goal of the course is to make the link between the microstructure of ceramics and their properties (structural and functional).
This course aims at linking chemistry to material science.
Further more characterization methods wil be used in practice.
The course starts with the synthesis routes for ceramics.
The most common crystallographic structures are discussed.
Some properties of inorganic materials are discussed in combination with their microstructure.

The different subjects that are illustrated are:
- synthesis : methods, use of phase diagrammes
- general properties:melting point, density, solubility, hardness
- electronic, magnetic and optical properties
- thermal properties
- glass:order, glassy ceramics, controlled cristallization.

Pedagogical procedures (organization, assessment, pedagogical resources):

Ex-cathedra class and in laboratory practicals

The practicals are illustrating the different chapters of the theoretical class: synthesis, processing and characterization of ceramic materials. They are realized by group of students.

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
- The flexibility and adaptability to work in an international and/or intercultural context
- An integrated insight in chemical process and materials' technology
- Insight in chemistry as a link between process and materials technology

Oral presentation of a subject chosen by the students and discussion on this presentation. Evaluation of the practicals reports
oral presentation = 2/3 of the final note
practicals reports = 1/3 of the final note

Student's expected work in autonomy:

Bibliographic references:

Ceramic Materials: Science and Engineering, C.Barry Carter and M. Grant Norton, Springer 2007

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: ENGINEERING ASPECTS OF CIRCULAR ECONOMY	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **P. VENKATESAN**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24		36		
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☒ **SC5** ☐ **SC6**				

Educational objectives of the course:

The objective of the course is that the students gain insights into a holistic life cycle thinking/approach in the context of designing products/materials. By the end of this course, students should be able to critically and quantitatively evaluate processes that are integral to circular economy - recycling, reuse, repair and remanufacture. Finally, students should be able to incorporate environmental aspects while designing/conceiving/creating processes in their own domains of interest with the aid of quantitative/measurable life cycle tools, indicators and guidelines.

Syllabus:

Introduction : Broad overview of circular economy (problems of linear economy, schools of thoughts of CE - Industrial ecology, industrial symbiosis, the butterfly diagram, performance economy, functional and social economy). The course consists of separate modules for the key concepts of CE - Recycling, repair and remanufacturing with specific case studies (business models, product examples) for each of them with an integrated life cycle approach. Specific modules will be dedicated to a broad overview of ecodesign and its implementation. Subject areas: LCA methods - Material selection techniques - Design for environment/recycling - Eco indicator. The last few modules will provide information about life cycle costing and policies and legislation relevant to circular economy/eco-design.

Pedagogical procedures (organization, assessment, pedagogical resources):

Lectures - Guest lectures from experts in Industry/ Academia.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: NON DESTRUCTIVE TESTING OF MATERIALS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **F. DUBOIS**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	12	12		12	
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☒ SC1 ☐ SC2 ☒ SC3 ☒ SC4 ☒ SC5 ☒ SC6

Educational objectives of the course:

Sensibiliser les étudiants à l'importance des tests non destructifs dans l'industrie au travers d'une série d'exemples représentatifs.

Syllabus:

Le cours comporte une introduction insistant sur l'importance des NDT dans l'industrie. Ensuite, l'objectif est de décrire aux étudiants une série de techniques couramment utilisée. En particulier : Rappel des éléments en optique nécessaire Méthodes de visualisation – Théorie Méthodes de mesure de forme – Théorie et pratique Interférométrie holographique – Holographie digitale - Méthode en temps moyénné - Thermographie. Eléments sur les Méthodes ultrasoniques, Resuage. et radiographie.

Pedagogical procedures (organization, assessment, pedagogical resources):

Cours magistral + séances de démonstration.

Cette unité d'enseignement contribue aux compétences suivantes:

- La flexibilité et l'adaptabilité de travailler dans un contexte international et / ou interculturelle

- Un aperçu intégré dans le processus des tests de conformité des matériaux

Student's expected work in autonomy:

Bibliographic references:

Paul E. Mix, "Introduction to Nondestructive testing, A training Guide", Second Edition, Wiley-Interscience, 2005. R. Jones and C. Wykes, "Holographic and Speckle Interferometry", Cambridge Studies in Modern Optics, 1989. Joseph W. Goodman, "Introduction to Fourier Optics", McGraw-Hill, (1988).

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: RECYCLING OF INORGANIC MATERIALS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **P.VENKATESAN**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	36	12	12		
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☐ **SC4** ☒ **SC5** ☐ **SC6**				

Educational objectives of the course:

The objective of the course is to give comprehensive insights into the world of recycling with equal emphasis on the theoretical metallurgical fundamentals and on the applied processes. The course provides a broad overview on the recycling of key metals/alloys such as steel, copper, zinc and lead. Course modules will contain information about the conventional recycling processes as well as information about novel/cutting-edge recycling processes that are currently in development. Necessary theoretical background (Ellingham diagrams, hydrometallurgical and electrometallurgical unit operations) will be introduced with examples and exercises. At the end of the course, students should be able to critically evaluate and design recycling flowsheets to recover metals from complex waste feeds based on principles of green chemistry.

Syllabus:

Module 1 Part I- The Larger picture : The concept of planetary boundaries; footprints (material, carbon and water footprints); emissions from primary production and benefits of recycling; concept of embodied energy and exercises
Module 1 Part II - Introduction into recycling of metals ; Terminologies in recycling, types of scrap ; Recycling rates definitions ; Material centric vs product centric recycling ; Concept of Metal wheel ; Definition of criticality - examples of Lithium criticality and the 2010 crisis of Rare earth crisis
Module 2 - Recycling of steel - Broad introduction into facts about steel (production, emissions, consumption etc) ; Sorting methods; Basics of electric arc furnace steel making chemistry (EAF); Ellingham diagrams - examples and exercises ; Slag basicity ; Issue of tramp elements and scrap purification
Module 2 Advanced : Alternatives to conventional steel recycling - ULCOS ; MIT's Boston metal electrochemical process
Module 3: Lead recycling - - Broad introduction into facts about lead (production, consumption, emissions, main uses and applications) ; The "Lead wheel" ; Recycling of Lead Acid Batteries - Desulfurization, Primary smelting, direct smelting (QSL furnace, Kivcet process) , Secondary smelting (shaft and rotary furnace), Electrorefining of lead
Module 3 Advanced : 2 different hydrometallurgical processes from Cambridge
Module 4: Fundamentals of hydrometallurgy and electrometallurgy - Pourbaix diagram - step by step construction, exercises and examples ; electron ladder ; Solubility product and precipitation ; Cementation ; Hydrogen reduction of metals ; Electrowinning and electrorefining ; Exercises and examples
Module 5: How to construct a recycling flowsheet - Comparative examples in recycling rare earth metals from rare earth permanent magnet waste (NdFeB)
Module 6: Zinc recycling - Introduction – Primary production • Zinc recycling brief introduction • ZnO from dross – Muffle and Larvik furnaces • EAF dust - Waelz process • Fuming slags from Pb
Module 6 Advanced:Solvometallurgical and hydrometallurgical processes - Indutec/Ezinex process ; Jarosite leaching with methanesulfonic acid
Module 7: Three different guest lectures - A day of seminar will be organized where experts in the field of recycling/metallurgy will give a detailed overview on the project(s) they have worked on - Examples: Photovoltaic recycling, Platinum group metals recycling ; Bauxite residue recycling etc
Module 8: Copper recycling - Introduction ; Chemical metallurgy of copper recycling - blast furnace ; Top blown rotary converter ; Electrorefining/Fire refining; Copper recycling in primary smelter ; Mistubushi process smelting
Module 8 Advanced: Magnetic nanohydrometallurgy ; Copper recover from WEEE - Hydrometallurgical (Ammoniacal) processes; Copper recovery within a fuel cell
Module 9: Lithium batteries recycling - Broad introduction ; Conventional pyrometallurgical process; Examples of industrial processes ; Advanced hydrometallurgical and electrometallurgical processes ; Battery recycling in a fuel cell; Supercritical CO2 extraction
Module 10: Policies and legislation - Historical evolution of recycling policies and legislation ; Extended producer responsibility ; Waste Hierarchy Index ; EU Sustainable battery regulations

Pedagogical procedures (organization, assessment, pedagogical resources):

Students will be required to design a recycling flowsheet to recover metal(s) of interest from a waste feed of their choice. The evaluation for the course will be based on a written report and oral presentation/defense of their flowsheet. You will be required to give a mid-point presentation of your flowsheet and will receive detailed feedback from the course instructor and also your peers which can aid in improving your flowsheet further for the final presentation.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: BIOCOMPATIBLE AND NANOSTRUCTURED MATERIALS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **S. GODET**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	36	12	12		
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

This course is an introduction to functional materials and in particular to biocompatible and nanostructured materials. In the case of biocompatible materials, the difficulty of replacing a living tissue is underlined. Indeed, they are most often nano- and hierarchically structured. Some examples and case studies are given for the different material families. In a second part, nanomaterials are envisaged. First, bulk nanomaterials (organic and inorganic) are introduced. A particular attention is paid to their mechanical properties. Second, nanostructured thin films and their related properties are described. Their specific properties (mechanical, magnetic,…) are compared to their bulk counterparts .

Syllabus:

Part 1: Biocompatible Materials
I. Introduction to biocompatible materials
II. Materials : reminder
III. The bone as a nanostructured and hierarchical material: the concept of bioinspired materials and examples.
IV. Materials in medicine
Part 2 Nanostructured materials
I. Bulk Inorganic nanomaterials
II. Bulk Organic nanomaterials
III. Functional nanolayers

Pedagogical procedures (organization, assessment, pedagogical resources):

Ex-cathedra lectures with invited guest speakers in the field, when appropriate. The nanomaterials part also involves lab sessions (production of nanpowders, nanoindentation)
The present course is a course that should open the mind of the students to the very vast world of nanostructured and biocompatible materials and contribute to extend their culture on materials.
This teaching unit contributes to the following competences:
In-depth knowledge and understanding of integrated structural design methods in the framework of a global design strategy
Correctly report on research or design results in the form of a technical report or in the form of a scientific paper
Present and defend results in a scientifically sound way, using contemporary communication tools, for a national as well as for an international professional or lay audience
Collaborate in a (multidisciplinary) team
Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information
Consciousness of the ethical, social, environmental and economic context of his/her work and strives for sustainable solutions to engineering problems including safety and quality assurance aspects
The flexibility and adaptability to work in an international and/or intercultural context
An attitude of life-long learning as needed for the future development of his/her career
An integrated insight in chemical process and materials' technology

Student's expected work in autonomy:

Bibliographic references:

Understanding the nanotechnology revolution, E.L. Wolf, M. Medikonda, Wiley-VCH, 2012, ISBN 9783527411092
Nanostructures & nanomaterials: synthesis, properties and applications, Guozhong Cao, Imperial College Press, 2004, ISBN 9781860944802

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: NANOCHEMISTRY AND -TECHNOLOGY	Year/Semester of EEIGM studies: 4A FPA - 2nd semester				
	Course manager: **G. VAN ASSCHE**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	24			
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6

Educational objectives of the course:

The students should be able to:
- gain insight in the speed of new developments in nanoscience and –technology and the importance to closely follow up these trends
- critically evaluate the prospects and threats of nanotechnology
- evaluate the valorization potential of the actual research in nanotechnology
- do a literature search on any kind of nanotechnological topic
- develop a research strategy for a subject of choice in nanotechnology and a feasible path for its elaboration.

By means of its intrinsic 'nanometer-scale approach', this course contributes to the integrated philosophy of chemical technology and material science of the Master program. Moreover, this course is the technological link to the optional package 'Entrepreneurship', elaborated together with the Faculty ES.

Syllabus:

Nanochemistry and -technology: aims at providing knowledge and understanding on the history, development and applications of nanochemistry and nanotechnology. This goal is accomplished by means of the study of (i) general developments on an international level, and (ii) specific activities on nanotechnology in the research groups of the department of chemistry and materials.

The course series of introductory lectures on the background and diverse disciplines of nanotechnology, in combination with a lectures by speakers from industry and colleagues of the department on their specific research in nanotechnology and a nanotechnology related project.

- History of nanochemistry and -technology and most important milestones
- Bottom-up approach ('real' nanotechnology)
- Top-down approach (microtechnology and lab-on-a-chip)
- Nanostructured materials and polymer nanocomposites
- Physical methods for studying nanostructured materials
- Commercial applications of nanotechnology
- Topics from the research groups of the department of chemistry and materials

- Practical sessions: under guidance, the students develop a research plan and have the opportunity to design and perform experiments using the research infrastructure of the different research groups of the department of chemistry and materials.

Pedagogical procedures (organization, assessment, pedagogical resources):

Digital course material (Required) : Handouts of powerpoint presentations
Practical course material (Recommended) : Open literature

Student's expected work in autonomy:

Bibliographic references:

Handouts of powerpoint presentations are available on Pointcarré.
Open literature: to get you started a few introductionary papers will be handed-out per topic

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: ADVANCED THERMAL ANALYSIS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **B. VAN MELE**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	12		24		
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6				

Educational objectives of the course:

Knowledge and understanding of thermal analysis as a characterization tool is aimed at, with emphasis on the most recent developments and primarily applied on polymers.
The student should be able to perform an optimized characterization of a wide variety of products and materials by means of well chosen complementary thermal analysis techniques.
The student should be able to interprete thermal analysis data, combining information of different analyses, and should be able to suggest other experiments to confirm or disprove the interpretation made. he end of the course, the student could.

Syllabus:

Differential Scanning Calorimetry (DSC) is fully worked out as the most important thermal analysis technique: instrumentation, measuring principle, calibration, choice of experimental parameters.
Modulated Temperature DSC (MTDSC), a recent extension of the conventional DSC technique, is treated in detail.
Additional techniques are discussed: thermogravimetric analysis (TGA),thermomechanical and dynamic mechanical analysis (TMA and DMA), dielectric analysis (DEA), micro(nano)-calorimetry, micro-and nano thermal analysis.
Theory and practice are combined.

Pedagogical procedures (organization, assessment, pedagogical resources):

The final grade is composed based on the following categories:
Oral Exam determines 50% of the final mark.
PRAC Presentation determines 50% of the final mark.

Within the Oral Exam category, the following assignments need to be completed:
- Oral exam with a relative weight of 1 which comprises 50% of the final mark.

Within the PRAC Presentation category, the following assignments need to be completed:
- Presentation with a relative weight of 1 which comprises 50% of the final mark.

Student's expected work in autonomy:

Bibliographic references:

P.J. Haines (Ed.), Thermal Methods of Analysis; Principles, Applications and Problems, Blackie Academic and Professional (Chapman and Hall), London, 1995.
Additional literature:
V.B.F. Mathot (Ed.), Calorimetry and Thermal Analysis of Polymers, Carl Hanser Verlag, Munich, Vienna, New York, 1994.
G. Höhne, W. Hemminger, H.-J. Flammersheim, Differential Scanning Calorimetry. An Introduction for Practitioners, Springer Verlag, Berlin, Heidelberg, New York, 1996.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: MANUFACTURING TECHNOLOGY II	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **H. TERRYN**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	12	24			
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☒ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☐ SC6				

Educational objectives of the course:

In this course forming and processing of materials are discussed for the students of the master in applied sciences and engineering: mechanics. Getting familiar with applied mechanical technology and current ISO 9000 procedures. The student has to understand how a product is formed from a specific bulk material. The relations are worked out between material microstructure, the forming process and the obtained properties of the realised product. The student has to identicate and define the most important parameters of a forming process. He or she should be able to understand the influence of the selected material (for example the relation between the nature of the metal, selected alloy within relation to the obtained mechanical properties)in relation with the selected forming process. He or she should be able to understand some tribological factors and estimate different surface defects that can occur during the forming operations. Relevant industrial processing operation as rolling, extrusion, deep drawing, hydroforming are discussed. Some visits to industrial plants are organised. This course can also be selected as an option for the program of Master of Applied Sciences and Engineering: Chemistry and Materials: Option Packet Materials For Construction.

Syllabus:

The course gives an overview of most important forming and processing applied on materials. The transformation from raw metal to a metal product is considered. The start is for example a metal alloy and the different steps to form a metal product , such as can, automotive sheets, bicycle frame, exhaust are discussed. The concept of the limit forming diagram is introduced. Definition, formation and importance of the texture of metals are discussed. The metal forming processes with a strong link to relevant industrial processes such as rolling, extrusion, drawing, hydroforming, used in important industries such as Arcelor-Mittal, Corus, Bekaert, Aleris, Alcan, Hydro. In this context also aspects of tribology during formation processes of metals is discussed. Forming processes of polymers and ceramics is also considered. Another part deals with surface technology. With specific focus on the formation of wear and corrosion resistance layers. An introduction about PVD/CVD technology is given. The student has to work out a case study on a product, with argumentation of the selection of the material, forming process, price, joining technology, end of life of the product. The last part focuses on rapid processing and rapid prototyping of materials. Within the course a visit to companies abroad is organised.

Pedagogical procedures (organization, assessment, pedagogical resources):

Digital course material (Required) : slides
Handbook (Required) : Manufacturing Engineering and Technology, Serope Kalpakjian and Steven R. Smith, Vth Edition, Prentice Hall Singapore, 9789810694067, 2013
Course text (Required) : Manufactoring Technology, Broeckhoven Maes, VUB, 2220170002415, 2016
The final grade is composed based on the following categories:
Other Exam determines 100% of the final mark.

Within the Other Exam category, the following assignments need to be completed:
Oral exam with a relative weight of 2 which comprises 66.7% of the final mark.
Note: An oral examination covering the whole content of the course is organized. For the oral examination the student has first to do a written preparation. Three main questions are given and the level of the questions is such that the student is able to show his or her competence and problem solving skills. Participation to the visits is compulsory. For this work, a report is requested which is discussed during the oral examination. No separate quotation is given for this report.
Case study with a relative weight of 1 which comprises 33.3% of the final mark.
Note: For the case study the students have to make a small report and prepare a presentation. The case study is 1/3 of the total score the oral examen 2/3 of the total score.For second term the student has to redo the examination if the score is less than 10/20. Separate scores are not transferred to the next year in case of failure of the student for the course.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td rowspan="2">Teaching Unit:
LOGISTICS ENGINEERING AND MANAGEMENT</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="5">Course manager: A. B. NDIAYE</td></tr>
<tr><td>EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td rowspan="2">Assessment: Classic</td><td>24</td><td>24</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

Introduce to the future engineer, the key concepts of logistics operations, logistics optimization, quality engineering and quality management of industrial systems and products while insisting on the underlying principles and assumptions as well as the resulting limitations and practical issues of their application.

Syllabus:

This logistics course deals with the engineering and management of the multiple flows in every segment (node or link) of the network consisting of suppliers, manufacturers, distributors, vendors, and customers. The coordination and integration of these flows within and across these network elements are critical and acknowledged as a key to any successful industrial strategy.
As such, this course is dedicated to the fundamental concepts and techniques of logistic processes' optimization, logistics management, quality engineering and quality management systems.
The course focuses particularly on demand and supply forecasting models, logistics network planning and modelling, warehousing and inventory management models, production and manufacturing logistics, logistics distribution & transport systems, reverse logistics, quality engineering and quality management systems. The course closes with a discussion about (1) the challenges of greening logistics operations, and (2) the integration of all of the above towards supply chain management.

Pedagogical procedures (organization, assessment, pedagogical resources):

Theoretical part: 1 ECTS (3 sessions of 4 hours each).

Exercises/Practicals part: 3 ECTS (9 sessions of 4 hours each) comprising exercises, illustrations, workshops with experts.

Eventual take-home exercises to be solved or a case to be elaborated (1 ECTS personal work).

Student's expected work in autonomy:

Bibliographic references:

Essentials of Logistics and Management, EPFL-Press

Introduction to Logistics Systems Planning and Control. G. Ghiani, G. Laporte, R. Musmanno. Editions WILEY.

Fundamentals of Production Planning and Control. S. Chapman, Edition Pearson Prentice Hall.

Management Industriel et Logistique: Conception et pilotage de la Supply Chain. G. Baglin, O. Bruel, A Garreau, M. Greif, et al. Editions Economica.

Other books, brochures, papers and case studies will be regularly provided to the students.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
ENTREPRENEURIAL ECOSYSTEMS</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: J. BEHRENS</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>24</td><td>24</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
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</table>

Educational objectives of the course:

The successful completion of this seminar will enable you to:
1. Familiarize you with key concepts, opportunities, and challenges of entrepreneurial ecosytsems
2. Understand the role of entrepreneurial ecosytems in looking at all its dimensions
3. Gain practical experience in entrepreneurship
4. Learn to give constructive feedback, and learn from receiving others' feedback
5. Learn to collaborate with others & function effectively in a team
6. Apply critical thinking and come up with novel solutions to complex problems
7. Help prepare you personally and professionally for meaningful employment by reflecting on the issues of entrepreneurship.
8. Improve your presentations skills and teamwork activities.
9. Improve academic writing styles.

Syllabus:

Fostering entrepreneurship has become a core component of economic development. To realize growth and innovation, the ecosystem must function well for entrepreneurs. Such an "entrepreneurial ecosystem" is an interactive network. This class looks on different actors, institutions, regulations, trends, and financing opportunities that impact an entrepreneurial ecosystem. Starting by looking into the start-up ecosystem, this class will also deal with topics such as social entrepreneurship, digital entrepreneurship, among others. This class will not only provide the student with real cases, however, will also enrich the knowledge in management theory and practice. Finally, students can connect themselves to the great entrepreneurial ecosystem in Brussel.

Pedagogical procedures (organization, assessment, pedagogical resources):

Participating in Case Discussions
1. Keep in mind that there is usually more than one right answer. A case is a problem-solving situation, and managerial effectiveness often depends upon seeing different solutions.
2. Offer your ideas, substantiating them with facts from the case and course material.
3. Adopt an open-minded stance, entertain new ideas from others and consider how your recommendations might change in light of these new insights.
4. Listen to your classmates and build on what they have to say. Resist the impulse to focus so strongly on what you want to say next that you lose track of where the discussion has moved.
5. Be fearless, but professional and most important, respectful in questioning or disagreeing with a colleague. Case discussions are also an opportunity to refine interpersonal skills. "I see some drawbacks to your proposal" or "I'm wondering if you considered the effects of x on y" creates a much different climate than "You're wrong" or "That's not a good idea."
6. Write down new ideas that occur to you and make note of any theories or course concepts brought to bear that you did not apply in your analysis.
7. Evaluate the discussion and your participation in it. What could you do to improve in the next case discussion?

Adapted from: http://www.stern.nyu.edu/mgt/mo/wrzesniewski/

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
IP MANAGEMENT AND TECHNOLOGY TRANSFER (CHAIRE SOLVAY)</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: B. VAN POTTELSBERGHE</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>24</td><td>12</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to:

Understand the complexity of effective knowledge transfer from universities inventions to the market place
Understand the main Intellectual property assets and how they are valued and managed by companies, individuals, public institutions
Develop strategies to enhance budgets

Syllabus:

The students must perform a group work and present it in front of a committee. The group work consists in developping a valorisation strategy for patents invented at ULB and recently filed in a patent office. The students must first assess the market potentials and then put forward a strategy for value creation, either through a licensing scheme or a spin-off creation. The student work on a real case and are coached by the TTO (tech transfer office of the ULB) officers. The students must also interact with the inventors.
Changing each year.

The course develops the following skills (Business Engineering) :

- Adopt a professional and pragmatic stance to work effectively under pressure.
- Critically analyse situations based on a scientific managerial approach to develop innovative ideas.
- Devise strategies by developing innovative approaches and practical solutions to drive progress.
-

Pedagogical procedures (organization, assessment, pedagogical resources):

Seminar, group work, max 40 students allowed
subject to small changes or variations each year: group work 40%; Class participation 30%; Final test 30%

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: MANAGEMENT AND SUSTAINABLE DEVELOPMENT : CONSTRAINTS AND OPPORTUNITIES	Year/Semester of EEIGM studies: 4A - 2nd semester
	Course manager: **E. MONAMI**
EEIGM Department: Materials specialisation	Hours/student:
Teaching method: Academic	In-person classes:
Assessment: Classic	Lecture: 20 / Tutorial / Lab work / Project / Test
	Autonomous work:

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☒ SC6

Educational objectives of the course:

This course aims at offering a comprehensive overview of the issues of sustainability as they relate to business and influence corporate strategy. It features a wide range of cases and an extensive discussion of tools to incorporate sustainability issues into strategic decision making. Students will build and then be able to apply a solid understanding of sustainability in business. It is vitally important for future business leaders to have a holistic understanding of the many issues surrounding and shaping sustainability. The objective of this course is to make students aware of the big challenges of the world we are currently living in and teach them, through a variety of new tools, how to transform these constraints into new business opportunities.

Syllabus:

The course covers the following topics:

Part 1: Foundations
- A brief historical overview of economic development and the environment;
- Measuring Wealth and Well-being;
- An Overview of Environmental Economics;
- An Outline of Ecological Economics;
- Cost-Benefit Analysis and Measuring Environmental Benefits;
- Placing a Value on Human Life;
- Risk Analysis and the Precautionary Principle;
- Some Relevant Ecological Principles.

Part 2: The Private Sector
- A Brief History of Corporate Response to Sustainability Issues;
- Eco-efficiency and other paradigms;
- Mimicking Nature: Biomimicry and Industrial Ecology;
- Thinking Systemically: Mass Balances and Industrial Metabolism; Life-Cycle Analysis; Carbon Accounting; Input-Output Analysis;
- The Search for Innovative Business Models;
- Defining Sustainability and its Components;
- Internalizing Sustainability into Corporate Strategy;
- Social Enterprise and the Social Return on Investment;
- Sustainability and Corporate Culture.

Pedagogical procedures (organization, assessment, pedagogical resources):

Continuous evaluation (no final exam).

Student's expected work in autonomy:

Bibliographic references:

The theoretical contents of this course are mainly based on Nemetz, Peter N. 2014. Business and the Sustainability Challenge: An Integrated Perspective. London: Routledge.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: INNOVATION STRATEGY	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **M. HENSMANS**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	36				
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

Gain innovation strategy insights and learn to apply them to advanced and emerging contexts in business.
Meeting today's business and world challenges requires going beyond the thinking that created the challenges in the first place. This is where a good innovation strategy helps. On this course you will develop your knowledge of the challenges of open innovation, management innovation, platform innovation and emerging market innovation and learn how to meet them with a long-term approach. Using quizzes, the newest theoretical insights, cases on pioneering businesses, and thought-provoking debates with leading experts, you will solidify your knowledge of innovation.

Syllabus:

Students will learn to apply and hone competences of individual and group learning, interaction and presentation.

We shall use the following methods to obtain those objective:
- A combination of individual distance learning (preparatory online modules on the uv.ulb.ac.be site) and active class execution in group
  Evaluation of individual distance learning at beginning of class
  Group case discussions and class interaction
  Group learning using different group roles

Pedagogical procedures (organization, assessment, pedagogical resources):

This course to a very large extent relies on online modules.
Students should be willing to engage in flipped classroom learning : individual learning of modules and group preparation will alternate with question and answer session with the instructor.
Group case report (60%, maximum 14 points)
Pecha Kucha group presentation (40%, maximum 6 points)
The individual grade for the group case report is weighted according to each student's performance as an animator, secretary or participant in the team work of sessions average group peer evaluation of each individual's performance (weighted individual score) x result of group report (group score)
An "individual sum" variable (Si) will be obtained by summing the numerical values for all the criteria. An "average sum" variable (Sn) will be obtained by calculating the average of the individual sums within the group. Let n be the number members of the group: Sn = (Σ (i = 1)
The individual weighting factor of the group case result = Si / Sn

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: SEMINAR OF EMERGING TECHNOLOGIES	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **M. BECQUET**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24				
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☐ **SC6**

Educational objectives of the course:

Seminar of emerging technologies

– How emerging technologies could change our life in the next years?

– What is the potential impact on our industrial landscape?

– Recent MIT study has point out some of the breakthrough technologies incl. ultra-efficient solar panel, 3D printing and additive manufacturing, Supergrid…

Syllabus:

Pedagogical procedures (organization, assessment, pedagogical resources):

The seminar will be a combination of presentations and an individual essay to be prepared by each student.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

<table>
<tr><td colspan="2">Teaching Unit:
LOGISTICS ENGINEERING AND MANAGEMENT</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: A. B. NDIAYE</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="2">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td>24</td><td>24</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

Introduce to the future engineer, the key concepts of logistics operations, logistics optimization, quality engineering and quality management of industrial systems and products while insisting on the underlying principles and assumptions as well as the resulting limitations and practical issues of their application.

Syllabus:

This logistics course deals with the engineering and management of the multiple flows in every segment (node or link) of the network consisting of suppliers, manufacturers, distributors, vendors, and customers. The coordination and integration of these flows within and across these network elements are critical and acknowledged as a key to any successful industrial strategy.

As such, this course is dedicated to the fundamental concepts and techniques of logistic processes' optimization, logistics management, quality engineering and quality management systems.

The course focuses particularly on demand and supply forecasting models, logistics network planning and modelling, warehousing and inventory management models, production and manufacturing logistics, logistics distribution & transport systems, reverse logistics, quality engineering and quality management systems. The course closes with a discussion about (1) the challenges of greening logistics operations, and (2) the integration of all of the above towards supply chain management.

Pedagogical procedures (organization, assessment, pedagogical resources):

Theoretical part: 1 ECTS (3 sessions of 4 hours each).

Exercises/Practicals part: 3 ECTS (9 sessions of 4 hours each) comprising exercises, illustrations, workshops with experts.

Eventual take-home exercises to be solved or a case to be elaborated (1 ECTS personal work).

Student's expected work in autonomy:

Bibliographic references:

Essentials of Logistics and Management, EPFL-Press

Introduction to Logistics Systems Planning and Control. G. Ghiani, G. Laporte, R. Musmanno. Editions WILEY.

Fundamentals of Production Planning and Control. S. Chapman, Edition Pearson Prentice Hall.

Management Industriel et Logistique: Conception et pilotage de la Supply Chain. G. Baglin, O. Bruel, A Garreau, M. Greif, et al. Editions Economica.

Other books, brochures, papers and case studies will be regularly provided to the students.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: **SUPPLY CHAIN PERFORMANCE ANALYTICS**	**Year/Semester of EEIGM studies:** 4A - 2nd semester				
	Course manager: A. B. NDIAYE				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	12	36			
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☐ **SC2** ☐ **SC3** ☐ **SC4** ☐ **SC5** ☒ **SC6**				

Educational objectives of the course:

Introduce to the future engineer the advanced concepts of supply chain management while insisting on the underlying principles and assumptions as well as the resulting limitations and practical issues of their application. Familiarize the future engineer with the most advanced methodologies/tools and the best practices for the design, implementation and follow up of value creative and sustainable solutions capable of driving supply chain performance to the next level of excellence.

Syllabus:

This course is the continuation of the course GEST-H-501 "Logistics Engineering & Management". It is dedicated to supply chain management. As such, it is built around the SCOR pillars: PLAN (demand and supply), SOURCE (sourcing, procurement), MAKE (production/manufacturing, design of services), STOCK (inventory management), WAREHOUSING (warehouse management), DELIVER (transport & distribution system/network) RETURN (reverse logistics).

The course focuses on INTEGRATION & COORDINATION, e.g., on the advanced strategies for an optimal integration of the different functions of the above SCOR pillars. A great deal is dedicated to supply chain management strategies and to supply chain performance modelling and management.

Pedagogical procedures (organization, assessment, pedagogical resources):

Theoretical part: 1 ECTS (3 sessions ex cathedra lectures of 4 hours each).

Practicals: 3 ECTS (9 sessions of 4 hours each) comprising exercises, illustrations, workshops with industrial experts, coaching and eventual field visits.

Case study: real-life business case to be elaborated (1 ECTS personal work).

Student's expected work in autonomy:

Bibliographic references:

Designing and Managing the Supply Chain: Concepts, Strategies & Case Studies. D. Simchi-Levi, P. Kaminsky, E. Simchi-Levi. Edition McGraw Hill.

Supply Chain Management: Strategy, Planning and Operation. S. Chopra & P. Meindl. Edition Prentice Hall.

Management Industriel et Logistique: Conception et pilotage de la Supply Chain. G. Baglin, O. Bruel, A Garreau, M. Greif, et al. Editions Economica.

Other books, brochures, papers and case studies will be regularly provided to the students.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: **ETHIQUE DE L'INGENIEUR**	**Year/Semester of EEIGM studies:** 4A - 2nd semester
	Course manager: C. KERMISCH
EEIGM Department: Materials specialisation	**Hours/student:**
Teaching method: Academic	**In-person classes:**
Assessment: Classic	**Autonomous work:**

Lecture	Tutorial	Lab work	Project	Test
12	12	12		

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☐ SC6

Educational objectives of the course:

Ce cours constitue une initiation à l'éthique de l'ingénieur. Il a pour objectif de familiariser l'étudiant aux concepts de l'éthique, à la pluralité des valeurs par rapport auxquelles il est amené à se positionner, et aux types de problèmes qu'il est susceptible de rencontrer dans le cadre de sa future pratique professionnelle. Il lui fournit les outils conceptuels qui lui permettent de dégager les enjeux éthiques associés à une prise de décision, enjeux qui restent bien souvent sous-jacents et implicites. En développant sa capacité à mettre ces enjeux en évidence, ce cours arme l'étudiant pour affronter les dilemmes éthiques auxquels sa profession le confrontera et pour argumenter en faveur de décisions en accord avec les valeurs qu'une société démocratique souhaite promouvoir. Le cours contribue ainsi à sa formation d'ingénieur responsable, conscient des enjeux sociétaux, et au développement de son esprit critique.

A l'issue du cours, l'étudiant sera capable :

- d'expliciter les enjeux éthiques liés à une situation professionnelle ;
- de faire face à un dilemme éthique en mettant au jour les tensions entre les parties prenantes et en construisant un argumentaire d'ordre éthique, afin de défendre une position personnelle susceptible d'aboutir à une décision
- d'identifier dans quelles conditions sa responsabilité est engagée.

Syllabus:

- Ethique et entreprise
- Les codes de conduite
- L'éthique normative
- Le risque technologique - enjeux éthiques
- La responsabilité

Pedagogical procedures (organization, assessment, pedagogical resources):

Le cours est structuré en deux parties :

- une partie magistrale interactive, étayée par l'exploitation de cas concrets empruntés à l'activité professionnelle de l'ingénieur (Ford Pinto, Challenger, Herald of Free Enterprise, etc.) ;
- un travail personnel et écrit portant sur l'éthique de l'ingénieur, qui permet à l'étudiant d'exercer ses compétences en matière de réflexivité.

Dans un premier temps, le cours magistral fournit un cadre théorique, de manière à initier l'étudiant aux principaux concepts de l'éthique et aux types de problématiques rencontrées par l'ingénieur. A cette fin, des cas concrets sont présentés et analysés. Ils ont pour principal objectif de familiariser les étudiants avec la mise en évidence de problèmes et d'enjeux éthiques qui restent en général implicites.

Ensuite, un travail personnel est réalisé. Il a pour but d'inciter l'étudiant à mener une réflexion éthique personnelle sur une thématique qui l'intéresse et de mettre en évidence sa capacité à mener à bien une telle analyse.

Examen oral : 50% de la note finale

Travail personnel écrit: 50% de la note finale

Student's expected work in autonomy:

Bibliographic references:

van de Poel I. et Royakkers L., Ethics, Technology, and Engineering: An Introduction, Wiley-Blackwell, 2011.
Dion M., L'éthique de l'entreprise, Montréal, Fides, 2007.
Mitcham, C. (éd.), Encyclopedia of science, technology, and ethics, Farmington Hills, Thompson Gale, 2005.
Whitbeck C., Ethics in engineering practice and research, Cambridge, Cambridge University Press, 1998.

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
COMPTABILITE FINANCIERE</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: F. KHROUZ</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>36</td><td>8</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

Ce cours a pour objet de développer la compréhension et surtout la lecture et l'élaboration des états financiers des entreprises commerciales et industrielles.

Syllabus:

Il s'articule autour de l'étude et de l'enregistrement des opérations dans les livres, de l'inventaire et des travaux comptables de fin d'exercice, de l'analyse des comptes de l'actif, du passif, des charges et des produits.

Pedagogical procedures (organization, assessment, pedagogical resources):

Student's expected work in autonomy:

Bibliographic references:

Texte coordonné de la loi du 17 juillet 1975 relative à la comptabilité des entreprises, dernièrement modifié par la loi-programme du 22 décembre 2008,

AR du 12 septembre 1987, dernièrement modifié par l'AR du 25 janvier 2005,

AR coordonné du 30 janvier 2001

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: INTRODUCTION TO THEORETICAL FINANCE	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **L. GHEERAERT**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24	24			
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

L'objectif du cours est de donner aux étudiants une solide connaissance des concepts de base de la théorie financière, en particulier, la valeur actuelle, les outils d'évaluation de projets, et le principe de diversification du portefeuille.

A l'issue du cours, les étudiants seront capables d'utiliser et d'appliquer les concepts étudiés à la prise de décisions financières, dans les contextes à la fois de la finance personnelle et d'entreprise.

Syllabus:

1.Introduction – What is finance? – Basics of accounting
2.From Accounting to Finance – Free Cash Flows and financial planning
3.Present Value – Interest rates and time value of money
4.Bond valuation
5.Equity and corporate valuation
6.Decision Criteria – Investment project analysis and capital budgeting
7.Expected return & risk – Efficient Market Hypothesis and Portfolio theory
8.Expected return & risk – Capital Asset Pricing Model (CAPM)
9.Introduction to Financial Structure and Company Valuation (time allowing)

Pedagogical procedures (organization, assessment, pedagogical resources):

Le cours théorique comporte des exposés magistraux (présentation des outils théoriques de la théorie financière) alternant avec des exercices théoriques visant la participation active des étudiants (présentation et résolution de problèmes théoriques, rappels théoriques).
Les travaux pratiques proposent une batterie d'exercices concrets et de mini-cas ("short business cases").
Finalement, un travail, basé sur une problématique concrète de finance d'entreprise ou de marché, sera réalisé par les étudiants.

Student's expected work in autonomy:

Bibliographic references:

Berk & DeMarzo ("BDM"), Corporate Finance, Pearson Education (Addison Wesley), 3rd edition, 2013 (version complète)
Farber, M. Laurent, K. Oosterlinck, H. Pirotte, ("FLOP") Finance, 3ème édition, Collection Synthex, Pearson Education, 2012

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: MARKETING MANAGEMENT	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: C. JANSSEN				
EEIGM Department: Materials specialisation	Hours/student:				
Teaching method: Academic	In-person classes:				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24				
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☐ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

A la fin du cours, les étudiants seront capables de :

Comprendre les enjeux du marketing contemporain et le rôle du marketing pour l'organisation

Comprendre et utiliser les concepts et outils-clés du marketing

Comprendre la démarche et la culture du marketing

Syllabus:

Le marketing est une fonction clé de toute organisation, en lien direct avec sa stratégie globale ; c'est un processus social et managérial visant à créer de la valeur pour les consommateurs, les clients, les partenaires et la société au sens large. Ce cours de Marketing Management vise à fournir aux étudiants une vision claire et une compréhension complète de la démarche marketing.

Plus spécifiquement, ce cours couvrira le sujets suivants : (1) les principaux concepts théoriques du marketing, (2) les principes du marketing stratégique ; (3) le marketing opérationnel, c'est-à-dire le développement du marketing mix (les 4Ps) en lien avec la stratégie marketing.

L'unité d'enseignement vise à fournir aux étudiant.e.s les concepts fondamentaux du marketing tels que la segmentation, le ciblage et le positionnement ainsi que de donner les bases concernant les décisions liées aux produits, au prix, à la distribution et à la communication, qui sont essentiels à acquérir pour être capable de suivre des cours de marketing plus avancés en Master.

Pedagogical procedures (organization, assessment, pedagogical resources):

Cours théoriques

Etudes de cas

Student's expected work in autonomy:

Bibliographic references:

Kotler, Keller, Manceau, et Hemonnet (2019), Marketing Management, 16e édition, Pearson France

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

Teaching Unit: HOW TO MAKE (ALMOST) ANY EXPERIMENT USING DIGITAL FABRICATION	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **D. TERWAGNE**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24		30		
	Autonomous work:				

Generic EEIGM competencies	Specific EEIGM competencies
☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8	☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☐ SC5 ☒ SC6

Educational objectives of the course:

This course, intended for a scientific audience, aims to open the student to new technologies, digital fabrication and the great potential of the Fablabs network to increase his or her experimental skills and respond to societal challenges. It will allow students to develop their technological, communication, collaboration and project management skills. These four skills are essential in today's modern world.

Syllabus:

The course "How To Make (Almost) Any Experiment Using Digital Fabrication" is inspired by the famous "How To Make (Almost) Anything" course taught at MIT (USA) by Neil Gershenfeld as well as the worldwide intensive "Fab Academy" training. Its particularity is that it is here oriented towards experimental scientific research and therefore intended for a scientific and technical audience.

Immersed in the interdisciplinary environment of the ULB FabLab, the student will identify a societal challenge that is important to him/her. Supported by mentors, they will design, build and document a scientifically-based and frugal project to solve the challenge they have identified. They will be introduced to rapid prototyping techniques and digital design and fabrication tools. In particular, the student will learn to:

- design 2D and 3D images using CAD (Computer Aided Design) software,
- print objects using a 3D printer,
- cut various materials using laser cutters, vinyl cutters or digital milling machines,
- assemble and integrate the above techniques to develop an experimental device,
- use electronic sensors and micro-controllers, such as Arduino or Raspberry Pi, for experimental data acquisition,
- learn how to post-process and interpret the acquired data,
- use graphical user interfaces and software for data presentation,
- use the GIT system for real-time, open and shared documentation.

Pedagogical procedures (organization, assessment, pedagogical resources):

The weekly exercises carried out by the students and the final project (documented and presented in front of a jury) will be evaluated. Attendance is mandatory; evaluation is continuous and culminates in a final presentation. No exams. No second session. It is essential to be present at the first class. In case of absence due to force majeure, please contact Mr. Terwagne as soon as possible.

This course will be taught at the FabLab ULB. Students will learn rapid prototyping techniques by preparing and executing a new exercise (involving the discovery of a new technique) each week. Students will finally put into practice the knowledge and skills learned by developing a final experimental research project in the FabLab environment.

Week after week, students will document their work in order to build a portfolio of their technical accomplishments and share their experiences with their peers.

Student's expected work in autonomy:

Bibliographic references:

- Fab Academy - https://fabacademy.org/
- N. Gershenfeld, A. Gershenfeld and J. Cutcher-Gershenfeld, Designing Reality (Basic Books, New- York, 2017).
- J. M. Pearce Open-Source Lab: How to Build Your Own Hardware and Reduce Scientific Research Costs (Elsevier, 2014).

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

<table>
<tr><td colspan="2">Teaching Unit:
MECHANICS OF MATERIALS</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: S. GODET</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>24</td><td>12</td><td></td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">Generic EEIGM competencies</td><td colspan="4">Specific EEIGM competencies</td></tr>
<tr><td colspan="3">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="4">☐ SC1 ☐ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

This course aims at illustrating how plasticity/viso-elasticity mechanisms at the microstrctural scale translate into the macroscopic behaviour. It also helps the student apprehend how numerical methods can be used to solve problems in mechanics of materials.

At the end of this course, the students should be able to:

Understand and explain how elementary mechansims lead to various visco-elastic behaviours

Understand and explain in a quantitative way how the microtructural features are translated into a macroscopic mechanical behaviour

Understand, master and explain the notions of stress, strain and yield surface

Understand and explain how discritization methods can be used to solve linear and non linear problems on the basis of the virtual work principle

Explain the principle of a newton raphson scheme in such a context

Syllabus:

The part related on the links between microtructure and mechanical porperties focuses on

Elasticity, viscoelasticity and anelasticity

Dislocation dynamics

Yield surface and yielding criterion

Hardening by grainsize, work hardening and precipitation

Creep

The part related to the use of numerical methods to solve problems in mechanics of materials focuses on:

Continuum Mechanics

Linear FEM

Non linear problems

Numerical implementation of plasticity

Homogeneization

Pedagogical procedures (organization, assessment, pedagogical resources):

2 ECTS cours - 1 ECTS lab session where a commercial code is used to solve some practical cases

Student's expected work in autonomy:

Bibliographic references:

G.E. Dieter, Mechanical Metallurgy,ISBN-13: 978-0070168930

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
PRODUCTION OF METALS</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: M-P. DELPLANCKE</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="2">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td>24</td><td></td><td>12</td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☐ SC3 ☐ SC4 ☒ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

The aim of the course is that students gain insight into extractive metallurgy and recycling. It is a continuation and extension of the bachelor courses. The scope in broadened towards all extractive / recycling processes an their technological characteristics, with special attention for the comparison of different processes. Based on the knowledge of (1) transport phenomena and (2) the relevant unit operations, the student is expected to understand (1) the set up of the global process and (2) the selection of the reactors. Also the process determining parameters need to be known. Finally the student should demonstrate the ability to select a processing route, based on incomplete data on the metal in question.

Syllabus:

The course combines all unit operations of extractive metallurgy and recycling. In order to gain comprehensive insight in extractive metallurgy and recycling, the basic principles of pyro-, hydro- and electrometallurgy are applied to the production/recycling of the main metals. In order to acquire the ability to select an adequate processing cheme, a number of metals is studied that can, depending on the conditions, be produced/recycled following different routes. The students will do this in small teams, in the format of guided self study. The students are also familiarized with the industrial aspects (compulsory company visits with guided tours along the industrial installations).

Pedagogical procedures (organization, assessment, pedagogical resources):

Self guided study.
Visits of industrial sites.
1st session
The evaluation is based on permanent evaluation during the sessions. At the en d of the course, the student teams present their work through a presentation containing two parts (1) report of one of the compny visits, completed with additional information regarding the processes used, (2) discussion of 3 aspects of the processing of a metal (choice subject to approval) : primary production from ores, recycling and new processes under development. The presentation is followed by a Q&A session and discussion. By preference, the final mark is a mark for the team. Only if during the quadrimester the team members contrinutions are very unequal will individual marks will be given. 20% of the mark is on permanent evaluation, 80% on the presentation and Q&A
2d session
the candidate will receive an individual assignment : discussion of two aspects of the processing of a metal (one not treated by one of the teams in first session). 100% of the mark is based on the presentation and Q&A.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

<table>
<tr><td colspan="2">Teaching Unit:
ADVANCED MATERIALS</td><td colspan="5">Year/Semester of EEIGM studies: 4A FPA - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: G. VAN ASSCHE</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="3">Teaching method: Academic

Assessment: Classic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td>24</td><td>24</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☒ SC3 ☐ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

The students are expected to be able to:
- gain insight in new developments in advanced materials and materials technology
- discuss these developments for the material classes encountered in the course
- critically evaluate the prospects and threats of modern material developments
- do a literature search on a subject of choice in materials' research and development
- develop a research strategy for the development of innovative materials and their applications and a feasible path for its elaboration
- interact with specialists in industrial or academic material's research
- communicate knowledge and insight acquired in this field to their peers
- report in writing on practical sessions and/or industry visits

Syllabus:

This course focuses on the development and application of modern materials and innovative material concepts, such as, but not limited to, nanocomposites, materials for organic photovoltacis and plastic electronics, advanced thin films,… Topics will be covered in introductionary classes and in seminars given by colleagues from industry and academia, as well as in practical sessions (uneven years) or in the framework of company visits (even years). The course also aims at giving the student a better understanding of advanced materials' research in academia and industry and insight in recent developments in this field. In the practical sessions, basic skills regarding the use of modern instrumentation involved in materials' research are acquired.

Pedagogical procedures (organization, assessment, pedagogical resources):

The final grade is composed based on the following categories:
Oral Exam determines 50% of the final mark.
LEC Presentation determines 25% of the final mark.
PRAC Report determines 25% of the final mark.

Students are obliged to participate the seminars, the practical sessions, and the industry visits (100% attendance is obliged). In case of an absence for valid reasons and pending approval by the primary instructor, the sessions missed can be either attended at a later time, or replaced by a task, both completed before the end of the semester the course is taught in. In case of absence, the student needs to contact the primary instructor and his assistant personally to make the necessary arrangements for catching up his absence.

If the student does not pass overall, but passes the practical part, it is possible to move these points on the practical part from the first to the second exam session, within the same academic year.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

<table>
<tr><td colspan="2">Teaching Unit:
POLYMERS : RHEOLOGY AND PROCESSING</td><td colspan="5">Year/Semester of EEIGM studies: 4A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: G. VAN ASSCHE</td></tr>
<tr><td colspan="2">EEIGM Department: Materials specialisation</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="2">Teaching method: Academic</td><td colspan="5">In-person classes:</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Classic</td><td>36</td><td></td><td>12</td><td></td><td></td></tr>
<tr><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td colspan="2">☐ C1 ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ C6 ☐ C7 ☐ C8</td><td colspan="5">☐ SC1 ☒ SC2 ☐ SC3 ☒ SC4 ☐ SC5 ☐ SC6</td></tr>
</table>

Educational objectives of the course:

The main objective is to give to the students some insight on the complexity of an industrial widely used manufacturing method, called Injection Moulding.
During presentations the issues, difficulties in processing or part defects and weakness are constantly related to polymer physics fundamentals.
The importance of pressure effects and compressible flow aspects are particularly important and quite unique to this process when compared to extrusion, taught in Bruno Van Mele course section.

Syllabus:

The course is devoted to Injection Moulding, one of the most usd processing methods, aside extrusion, for thermoplastics.
The course highlights rheolgical and thermodynamics aspects of the industrial problems encountered in designing parts and manufacturing them by this molding process.

Pedagogical procedures (organization, assessment, pedagogical resources):

The part of the course taught by Vito LEO is based on Lectures. A visit to Solvay is also part of the course, and gives the students the opportunity to see an actual injection molding machine running. The possibilities of Numerical Simulation of the molding process are also demonstrated by skilled professionals during this visit.

In the frame of this shared course with Prof. Van Mele (VUB), the students also have a separate lecture based course, as well as Lab practical activities.

Student's expected work in autonomy:

Bibliographic references:

Other EEIGM courses directly linked to this course:

Upstream**:** Downstream**:**

Teaching Unit: FORMING OF METALS	Year/Semester of EEIGM studies: 4A - 2nd semester				
	Course manager: **S. GODET**				
EEIGM Department: Materials specialisation	**Hours/student:**				
Teaching method: Academic	**In-person classes:**				
	Lecture	Tutorial	Lab work	Project	Test
Assessment: Classic	24		24		
	Autonomous work:				
Generic EEIGM competencies	**Specific EEIGM competencies**				
☐ **C1** ☐ **C2** ☐ **C3** ☐ **C4** ☐ **C5** ☐ **C6** ☐ **C7** ☐ **C8**	☐ **SC1** ☒ **SC2** ☐ **SC3** ☒ **SC4** ☐ **SC5** ☐ **SC6**				

Educational objectives of the course:

The objective of this course is to help the students mobilize their skills at the microstrural scale (bulk and surface) in order to understand the modern forming technologies. At the end of this course the students should be able to

Explain the different forming operations with their strong points and drawbacks
Unsderstand and explain how both surface and bulk properties are affecting the final product
Explain how the technological and processing parameters canbe tuned to optimize the properties and related microtructure of the final part
Discuss the importance of material's anisotropy during forming operations

Syllabus:

The content of the course is as follows:
Reminder of continuum mechanics and plasticity under mutiaxial loading
Forming limit diagrams
Texture and anisotropy
Annealing phenomena: static and dynamic recrystallization
Rolling and controlled rolling
Extrusion
Deep drawing

The industrial visits consists in 6 visits in 3 days illustrating varioy-us aspects of materials technology; Exemples are: ASCO,Materialize, AGC Glass Europe production site, Safran,...

Pedagogical procedures (organization, assessment, pedagogical resources):

Lectures are given using PPT slides - Examen oral

Student's expected work in autonomy:

Bibliographic references:

Kalpakjian, Serope ; Schmid, Steven R ; Vijai Sekar, K S, Manufacturing engineering and technology, 2014, ISBN 9789810694067

Other EEIGM courses directly linked to this course:

Upstream: Downstream:

5th year

[SEMESTER 9]

TEACHING UNITS	ECTS	In-Person classes	Coordinator
EEIGM Department: Development and Research	**30**		
Research Internship	30	1 semester	D. HORWAT

<table>
<tr><td rowspan="2">Teaching Unit:
RESEARCH INTERNSHIP</td><td colspan="5">Year/Semester of EEIGM studies: 5A - 1st semester</td></tr>
<tr><td colspan="5">Course manager: D. HORWAT</td></tr>
<tr><td>EEIGM Department: Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td rowspan="3">Teaching method: Active Learning</td><td colspan="5">In-person classes: 1 semester</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td></td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>Assessment: Competencies approach</td><td colspan="5">Autonomous work: 1 semester</td></tr>
<tr><td>Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
<tr><td>☒ C1 ☒ C2 ☒ C3 ☒ C4 ☒ C5 ☒ C6 ☒ C7 ☒ C8</td><td colspan="5">☒ SC1 ☒ SC2 ☒ SC3 ☒ SC4 ☒ SC5 ☒ SC6</td></tr>
</table>

Educational objectives of the course:

At the end of the course, the student should be able to carry out research work in the laboratory under the responsibility of a researcher or a professor, to write a scientific report, to present orally the results obtained. The project takes place in a university laboratory or in one of the universities developing collaborations with the EEIGM. Students have access to the field of research on a European or international scale.

Syllabus:

Research topics are proposed by the coordinators of the partner universities and are related to materials science and engineering

Pedagogical procedures (organization, assessment, pedagogical resources):

Students carry out their research full time in the host laboratory and according to the supervisor's requirements within the host research team. All the resources are either provided by the host laboratory and the host group, or the result of bibliographic research specific to the student on the databases available at the host laboratory / institution. At the end of the internship, the student writes a report and makes an oral presentation to a jury. The jury fills out a form indicating the level reached by the students concerning the different skills defined by the EEIGM. This form serves as the basis for the school's evaluation. At the end of their internship, students also produce a poster summarizing the results of their work accompanied by an audio description of 120 seconds maximum.

Student's expected work in autonomy:

Yes. Following suitable training: use of equipments and softwares useful to carry out research. Bibliographic research, data formatting, comprehensive thinking, writing and presentation.

Bibliographic references:

Instructions available on the Arche platform. Bibliography provided by the host team, own bibliographic research.

Other EEIGM courses directly linked to this course:

Upstream: All lectures from previous years

Downstream: Industrial internship

5th year

[SEMESTER 10]

TEACHING UNITS	ECTS	In-Person classes	Coordinator
EEIGM Department: Development and Research	**30**		
Industrial Internship	30	1 semester	Z. ACEM

<table>
<tr><td colspan="2">Teaching Unit:
INDUSTRIAL INTERNSHIP</td><td colspan="5">Year/Semester of EEIGM studies: 5A - 2nd semester</td></tr>
<tr><td colspan="2"></td><td colspan="5">Course manager: Z.ACEM</td></tr>
<tr><td colspan="2">EEIGM Department: Development and research</td><td colspan="5">Hours/student:</td></tr>
<tr><td colspan="2" rowspan="2">Teaching method: Active Learning</td><td colspan="5">In-person classes: 1 semester</td></tr>
<tr><td>Lecture</td><td>Tutorial</td><td>Lab work</td><td>Project</td><td>Test</td></tr>
<tr><td colspan="2" rowspan="2">Assessment: Competencies approach</td><td></td><td></td><td></td><td>X</td><td></td></tr>
<tr><td colspan="5">Autonomous work:</td></tr>
<tr><td colspan="2">Generic EEIGM competencies</td><td colspan="5">Specific EEIGM competencies</td></tr>
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</table>

Educational objectives of the course:

The training course of an EEIGM student is completed with a six months industrial internship.
The objectives of the training, its management and its duration make it an excellent educational tool, which ensures to the students the best transition from student life to working life

Syllabus:

Discover engineer work in a company.
- Promoting greater awareness of the technical aspects of the engineering function, which also include human, economic and social factors.
-Integrate in the industrial world and apply their knowledge by conducting concrete studies for the host company.
During the internship, the engineering student must demonstrate the following qualities:
• Ability to fit into the company and to adapt to the world of work.
• Ability to deliver tangible results to the company in connection with the objectives of the training.
• Ability to stand back on its work in relation with the received Teachings.

Pedagogical procedures (organization, assessment, pedagogical resources):

Organization: information meetings and monitoring by the Partnerships Supervisor

The theme of the course is subject to mandatory validation of the Industrial internship supervisor.
The monitoring of the training is carried out by internship supervisors, the EEIGM tutor and the industrial tutor

Duration: 6 months; location: Company all over the world; Convention: mandatory prior starting the internship
.
Validation: four deliverables: written report, oral presentation (30 minutes of presentation and 30 minutes for questions / deliberation) before a jury, poster presentation, "my internship in 120s".
Defense: A single session in the second half of September

Student's expected work in autonomy:

Upstream : CVs and cover letter writting ; active research of the course (by itself and via the Partnerships direction).
During the internship : Mission defined by the company and validated by EEIGM
Downstream : preparation of the validation of the course and actively seek employment.

Bibliographic references:

Arche platform : section "Direction des Partenariats".

Other EEIGM courses directly linked to this course:

Upstream: All modules of the training and especially the personal and professional project

Downstream: Recruitment