INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES RENNES

Academic year 2020/2021

Courses offered by the programme

Génie Mécanique et Automatique (GMA)
Mechanical and Control Systems Engineering

Semester(s) : 7-8-9-10

Curricula are organized in groups of courses (Unités d'Enseignement (UE)), consisting of several courses (Eléments Constitutifs (EC)). An EC is a teaching module including lectures (cours magistraux (CM)), tutorials (travaux dirigés (TD)), laboratory work (travaux pratiques (TP)), projects (PR), conferences (CONF), personal work (TA) and possibly other pedagocial activities (DIV). Some internships (stages (ST)) are compulsory

Commonly used abbreviations
CM : Lectures
TD : Tutorials
TP : Laboratory Work
CONF : Conferences
TA : Personal Work
PR : Project
ST : Internship
DIV : Miscellaneous

Code	Libelle
GMA08-MOROB	Robot Modelling
GMA08-PRCONS	Manufacturing & Design Project
GMA08-STAGE	4GMA Work Placement
GMA09-PI	Industrial project
GMA09-SYSME	Mechanical Systems
GMA09-VATR	Accuracy of Robots and Machine-tools
GMA10-PFE	Final Year Project

List of courses with handout in English or that can be taught in English

Numerical Methods and Finite Elements	GMA07-MNEF
Number of hours : 42.00 h	3.00 ECTS credit
CM : 20.00 h, TD : 22.00 h	
Reference Teacher(s) : RAGNEAU ERIC	

Objectives :
Understanding the methods and algorithms involved in finite element calculation code. Basics of F.E.M. in order to fully
understand calculation software. Application of the methods to solve various field problems in deformable Solid Mechanics
and Heat Transfer. Application of the various formulas to practical problems using CAST3M software.

Content :
Introduction: Main points. Understanding the basic tools of numerical analysis: Interpolation, Approximation. Numerical
resolution of systems of linear equations. Numerical integration techniques. Partial differential equations. Boundary problems:
Finite Elements Methods. Variational formulation of a boundary (Reminder). Matrix formulation of the method in plane
elasticity. Interpolation function of plane elements. Generalisation to 3D. Curved isoparametric elements. Problems associated
with numerical integration. Specific elements: beams, thin plates, thick plates, shells. Extension of the method to heat transfer
problems.

Bibliography :
Zienkiewicz : La méthode des Eléments finis. Edisciences Gallagher : Introduction au calcul par Eléments Finis. Editions
Pluralis Batoz, Dhatt : Modélisation des structures par éléments finis. Editions Hermès
K. J. Bathe : Finite Element Procedures in Engineering Analysis. Prentice et Hall

Requirements :
Basics of Continuum Mechanics.

Organisation :
2 hours per week.

Evaluation :
Three-hour written examination at the end of the semester.
Continuous assessment mark.

Target :

Resistance of Materials 2	GMA07-RDM2
Number of hours : 56.00 h	4.00 ECTS credit
CM : 22.00 h, TD : 22.00 h, TP : 12.00 h	
Reference Teacher(s) : RAGNEAU ERIC	

Objectives :
A continuation of the RDM I module of the third year of studies. This module deals with the dimensioning of beams under
torsion, the study of systems of beams and the modelling of plates.

Content :
Torsion: Theory of Saint Venant Torsion. General theory. Bredt's theory (thin-walled closed sections). Analogy of a membrane. Non-uniform torsion. Vlassov's theory (small distortion). General theorem for the calculation of displacement and
rotation of beams in a common plane. Application of the energy theorems from the "mechanics of continuous media" module.
NAVIER-BRESSE equations. General equations for solving hyperstatic beams and beam systems. Treillis. Porticos. Arcs and
systems of beams. Plate theory. Thin plates. Kirchhoff's theory. Thick plates. Mindlin's theory.

Bibliography :
M. KERGUIGNAS, G. CAIGNAERT : Résistance des Matériaux. DUNOD (1997).
M. ALBIGES : Résistance des Matériaux Appliquée.
DUNOD.
J. COURBON : Résistance des Matériaux. DUNOD (1971).

Requirements :
Basics of mechanics of continuous media.

Organisation :
Two hours per week.

Evaluation :
Three-hour written examination at the end of the semester.
Mark for practical work reports.

Target :

Computer - aided Mechanical Design (Level 2)	GMA07-CMAO2
Number of hours : 42.00 h	3.00 ECTS credit
CM : 10.00 h, TD : 20.00 h, TP : 12.00 h	
Reference Teacher(s) : LEOTOING LIONEL	

Objectives :
- Methods for functional specifications and technical solutions for product functionality
- Advanced Design methods using CATIA
- Virtual evaluation of the adequacy of the product with respect to its specifications
- The principles of PLM.

Content :
1 - Methods of design (AFB, AFT)
2 - Advanced design with CATIA V5 (Design with context, power copies, publications, ...)
3 - Virtual conformity with the product specifications (simulation tools, exchange formats, ...)
4 - Creating geometrically optimal systems
5 - Introduction to PLM

Bibliography :

Requirements :
GMA06-CMAO1

Organisation :
1 hour per week.

Evaluation :
- 1 four-hour written examination on the Catia computer programme
- 1 mark for practical work

Target :

Mechanical Behaviour of Materials	GMA07-PUIS
Number of hours : 56.00 h	4.00 ECTS credit
CM : 16.00 h, TD : 24.00 h, TP : 16.00 h	
Reference Teacher(s) : GUINES DOMINIQUE	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :
45h

Evaluation :
Three-hour written examination at the end of the semester
Evaluation of the practical work reports

Target :

Control System Engineering 2	GMA07-AUTO2
Number of hours : 56.00 h	4.00 ECTS credit
CM : 22.00 h, TD : 18.00 h, TP : 16.00 h	
Reference Teacher(s) : LE BRETON RONAN	

Objectives :
-The concept of State for the modelling of dynamic systems.
-Solutions to state equations.
-Study of controllability, stability and operability of systems.
-Digital or analog command of multivariable dynamic systems.
-Synthesis of means of control by returning to a reconstructed state.

Content :
Analysis of dynamic systems in State-space. Models of State: the concept of State, conversion State - transfer, conversion
Transfer.
- State, Equivalence of models of State.
- Resolution of State equations - own functions of free systems, symbolic or numerical calculation of the transition matrix,
numerical integration of State equations, discrete state equations of pulsed systems (zero order blockers and ideal pulsed
systems). Stability of systems: Stability with respect to initial conditions..
- Stability for limited input.
- Limited output, stability of linear invariant systems.
- Control and observation: Canonical decomposition into controllable and observable subsystems.

Bibliography :
JAUME D., 1989, « Applications du formalisme d'état à la commande des systèmes continus », Eyrolles.
JAUME D., THELLIEZ S., VERGE M., 1991, « Commande des systèmes dynamiques par calculateur », Eyrolles.
KUO Benjamin C., 1995, « Automatic control systems », Prentice Hall International Editions.
DE LARMINAT Ph., 1993, « Automatique, commande des systèmes linéaires », Hermès.
GILLE J.-C., CLIQUE M., 1990, « Systèmes linéaires - Equations d'état », Eyrolles.

Requirements :
GMA05 SISYS -GMA05 AUT1

Organisation :
Revision of lecture notes. Preparation of exercises, problems and practical work (Three hours per week).

Evaluation :
Three-hour written examination at the end of the semester.
Mark for practical work report.

Target :

Electrical and Electronics Engineering	GMA07-EEP
Number of hours : 36.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 14.00 h, TP : 8.00 h	
Reference Teacher(s) : GUEGAN SYLVAIN	

Objectives :
Fundamentals of electrotechnics in order to understand the functionality, energy supply, modelling and controls of electric
machines.

Content :
-Single-phase and three-phase circuits: Analysis methods. Real power and reactive power. Measurement of power.
-Magnetic circuits and inductance: Electromagnetism (Reminder). Magnetic circuit. Inductance and coupled circuits.
-Transformers: Single-phase and three-phase power transformers.
-Conversion of electric energy: Principles of the conversion of electric energy. Power components: diode, thyristor, bipolar
transistor, MOSFET, IGBT. Basic converter circuits: AC-DC, DC-DC, DC-AC, AC-AC. Applications.
-Electric machines: Principles (Reminder). Introduction of various types of machines (applications and trends). Main points on
the making and dimensioning of machines and materials used. Equilibrium and stability of a force. Characteristics of
couple-velocity of common driven loads. Characteristics and limits.

Bibliography :
R. MERAT et al., ""Génie électrotechnique"", Etapes références, Nathan, 1997.
G. GRELLET, G. CLERC, ""Actionneurs électriques : principes - modéles - commandes"", Eyrolles, 2000.
M. MARTY, D. DIXNEUF, D. GARCIA GILABERT,
""Principes d'électrotechnique"", Sciences Sup, Dunod, 2005.

Requirements :
Basics in electrotechnics and electromagnetism.

Organisation :
30 hours.

Evaluation :
2-hour written examination.
Continuous evaluation.

Target :
4GMA

Project: Industrialisation	GMA07-PRIND
Number of hours : 42.00 h	4.00 ECTS credit
CM : 2.00 h, TD : 20.00 h, TP : 20.00 h	
Reference Teacher(s) : SOHIER CHRISTOPHE	

Objectives :
This is a proactive project in which the student plays a fundamental role calling upon previously acquired knowledge while
developing new technical and organisational skills. The aim of this module is to present the student with the following
objectives: Find solutions to technical procedural issues. Establish a clear overview of the process. Make necessary
adjustments to production tools.

Content :
From product specifications, set out the various manufacturing phases including design. Establishment of the manufacturing
process and the production phase. Subdividing the process into three steps allows the clear identification of the relationships
and constraints between the various phases and resources. The financial constraints are established through a cost estimate and
form an important part of the approach to the project.

Bibliography :

Requirements :
GMA05-PMI and GMA06-MOPI

Organisation :
20 hours.

Evaluation :
Manufacturing report.
Oral presentation.

Target :

English	HUM07-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : RANNOU ISABELLE	

Objectives :
Acquiring the required skills for working in a firm as an engineer. Reaching the required level (B2) is compulsory in order to graduate.

Content :
-Learning by doing:
The student will have to be able to talk and listen, write documents while showing he/she can solve problems, reason, convince and demonstrate in an articulate manner.
-Expressing oneself accurately and fluently.
The student will engage in activities requiring creative and reactive skills (such as debates, role-plays, individual oral presentations using PowerPoint, projects), which will be based on scientific topics and current events.
-Writing CVs and cover letters
-Scientific English
-Discovering the professional world in an international context
-Preparing for the TOEIC (during the second semester, a specific ¿Toeic Booster¿ course will be available)

Bibliography :
- Oxford Advanced learners¿ Dictionary
- English Grammar in Use (Cambridge University Press)

Requirements :
1st, 2nd and 3rd year English courses (or equivalent)

Organisation :
Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia language lab and computer rooms are also available and make it possible for the students to work in a stimulating environment. Our teaching resources include press articles, audio and video documents (TV reports, extracts from films and series). We also use the Internet.
Regular personal work is obviously required. The student must be curious and practise English outside the classroom as well.

Evaluation :
One two-hour written exam.

Target :

Entrepreneurship and Innovation	HUM07-EI
Number of hours : 48.00 h	3.00 ECTS credit
CM : 24.00 h, TD : 24.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Sport and physical education	HUM07-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h	
Reference Teacher(s) : LE LAGADEC PIERRE	

Objectives :
Team work, discovery of one's capabilities, communication, invention and management responsibilities.

Content :
Choice of two activities from a menu. Adapting to destabilising situations and taking responsibility when risk is involved.
Speaking to groups. Leading group stretching exercises. Indoors: Rock climbing or badminton in teams. Outdoors: C.O or
Kayak or golf

Bibliography :
Several specialized books are available to the students at the library. Links to internet sites are given on the EPS website.

Requirements :

Organisation :

Evaluation :
Evaluation is based upon student participation, progress and acquisition. The student is asked to criticise his own progress with respect to the objectives of the course. The ability to be self-critical leads to self-discovery. Sharing this knowledge with a group reinforces one's confidence.

Target :

Semestre 8

Parcours Formation Initiale GMA

1	**GMA08-1**		**Mechanical Engineering and Materials S8**	**6.00**
	GMA08-CMAT	O	Mechanical Behaviour of Materials	4.00
	GMA08-COMP	O	Mechanics of Composite Materials	2.00
2	**GMA08-2**		**Design and Processes S8**	**7.00**
	GMA08-PRCONS	O	Manufacturing & Design Project	4.00
	GMA08-PROD	O	Production and Quality Control Management	3.00
3	**GMA08-3**		**Automation and Model-Building S8**	**3.00**
	GMA08-MOROB	O	Robot Modelling	3.00
4	**GMA08-STAGE**		**Work placement S8**	**8.00**
	GMA08-STAGE	O	4GMA Work Placement	8.00
5	**HUM08**		**Non-scientific syllabus S8**	**6.00**
	HUM08-ANGL	O	English	2.00
	HUM08-ECO	O	Economy and Management	1.00
	HUM08-SHES1	O	Engineer & Society - M1	1.00
	HUM08-SHES2	O	Engineer & Society - M2	1.00
	HUM08-EPS	O	Sport and Physical Education	1.00

O = compulsary, C= in choice , F= optional

Mechanical Behaviour of Materials	GMA08-CMAT
Number of hours : 56.00 h	4.00 ECTS credit
CM : 26.00 h, TD : 22.00 h, TP : 8.00 h	
Reference Teacher(s) : GUINES DOMINIQUE	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Mechanics of Composite Materials	GMA08-COMP
Number of hours : 28.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 8.00 h, TP : 8.00 h	
Reference Teacher(s) : RAGNEAU ERIC	

Objectives :
The design of structural elements made of composite materials.
Part One: Mathematical formulas for the thermo-mechanical behaviour of composite materials (anisotropy, homogenisation, rupture criteria) leading to the dimensioning of composite cross-sections (beams or plates).
Part Two: Implementation and manufacturing technologies.

Content :
Part One: Introduction. Formulas for the behaviour of an anisotropic elastic media (Reminders). Full anisotropy. Orthotropy.
Transversal isotropy. Mechanical formulation of the rupture criteria in anisotropic materials. Hill-Tsaï's criterion. Wu's
criterion. Homogenisation techniques. thermoelastic constants of a unidirectional composite. Thermoelastic behaviour of a
layer in any direction. Matrix formulas for the behaviour of a laminate. Predimensioning and checking of the laminate in
comparison with the rupture criterion.
Part Two: General introduction. General definition of a composite material, reinforcements, matrices. semi-finished products.
Manufacturing procedures. Casting without press. Casting under pressure. Continuous transformation. Manufacturing of
revolution's form. Case study comparison. Scopes of application. Functional analysis. Design of composite parts. The market
for composites. Sandwich materials. The sandwich effect. Components. Mechanical analysis. Applications.

Bibliography :
Daniel Gay - Matériaux Composites 3ème édition. Hermès Editeur.
Jean-Marie Berthelot - Matériaux Composites :
comportement mécanique et analyse des structures. Editions Masson, Paris 1996.

Requirements :

Organisation :
2 hours per week.

Evaluation :
Two-hour written examination at the end of the semester.
Mark for reports on practical work (laboratory).

Target :

Manufacturing & Design Project	GMA08-PRCONS
Number of hours : 56.00 h	4.00 ECTS credit
CM : 12.00 h, TP : 44.00 h	hand-out in English and course taught in English
Reference Teacher(s) : LEOTOING LIONEL	

Objectives :
This project deals with the study of a mechanical system and the implementation of research techniques for solutions,
geometrical modelling, digital simulation and component dimensioning.

Content :
1) Obtaining solutions from functional specifications.
2) Technical definition of solution (choosing bonds and components).
3) Dimensioning of the components.
4) Geometric optimisation of the system.
5) Integration of manufacturing and assembly constraints.

Bibliography :

Requirements :
GMA07-CMAO2 GMA05-TCONS.

Organisation :
3 hours per week.

Evaluation :
Mark for project.

Target :

Production and Quality Control Management	GMA08-PROD
Number of hours : 28.00 h	3.00 ECTS credit
CM : 14.00 h, TD : 14.00 h	
Reference Teacher(s) : SORRE FREDERIC	

Objectives :
To manufacture, in accordance with requirements, low-cost, high-quality products, which respect consumers' requirements and
can be supplied in reasonable time. Organisational techniques, production management, quality control, communication.

Content :
I- Experimental methodology: Introduction. Vocabulary and study approach. Calculation tools. Screening. Common
experiment matrices. Analysis of results. Validation of the model. Taguchi's method.
II- Production control. Concept of capability. Quality checking cards: particular cases. Forecasting techniques. Advanced
planning techniques. Organisation in specialised workshops. Manufacturing lines. ERP

Bibliography :
P. Souvay La statistique : outil de la qualité Recueil des normes ISO 9000 G. et M.C. Sado, De l'expérimentation à l'assurance qualité - Afnor Technique Jacques Goupy, Introduction aux plans d'expériences - Dunod

Requirements :
TCM06-ISIP

Organisation :
1 hour per week.

Evaluation :
Two-hour written examination at the end of the semester.

Target :

Robot Modelling	GMA08-MOROB
Number of hours : 42.00 h	3.00 ECTS credit
CM : 16.00 h, TD : 10.00 h, TP : 16.00 h	handout in English
Reference Teacher(s) : MAURINE PATRICK	

Objectives :
Methods and basic tools necessary for the modelling of simple, open-chain manipulating robots.

Content :
-Modelling of simple open-chain manipulating robots. Terminology and main definitions.
-Transformation matrixes between vectors, frames and torque.
-Direct and inverse geometrical models.
-Study of singularities.
-Analysis of the workspace.
-Analysis of manipulability. Transfer of velocities and stresses.
-Static equilibrium.

Bibliography :
KHALIL W., DOMBRE E., 1999, « Modélisation, identification et commande des robots », Hermès.

Requirements :
Matrix calculus

Organisation :
2 hours per week

Evaluation :
A two-hour written examination at the end of the semester.
Mark for reports on practical work in the laboratory.

Target :

4GMA Work Placement	GMA08-STAGE
Number of hours : 240.00 h	8.00 ECTS credit
TP : 1.00 h	hand-out in English and course taught in English
Reference Teacher(s) : GAVRUS ADINEL	

Objectives :
Students put into practice the industrial context of the scientific and technical skills they have acquired.

Content :
First-hand work experience is an essential step in the education of GMA engineers. The work experience internship at the end
of the eighth semester can last from 8 to 16 weeks and is compulsory. The objective is to solve a real technical issue in an
industrial context. The student has four months, from the end of May to the end of September, to carry out the training course,
by the end of which he will have gained a better insight into the professional world which lies ahead of him.
Each student has the responsibility of finding a host company and the further task of defining a plan for the internship with his
employer. Students are advised that their internship plan must be relevant to the domains of Mechanical Engineering or
Automatics and cannot commence without an Internship Agreement being signed between the company and INSA-Rennes. In
any case, before the establishment of this agreement, a clear plan for the internship must be defined and submitted to the
department for agreement.

Bibliography :

Requirements :

Organisation :
Each student undertakes to find his own work placement. See "Programme" (above) for further details.

Evaluation :
A twenty-page synthesis-report is compulsory and may be written in French or in English (for students having completed their internship abroad). It can be accompanied by one or more appendices of unrestricted length. Each student must present to a jury comprising his tutor(s) and representatives of the host company a poster (designed by himself) describing the context and the objectives of the internship. Note: Reports must not be a chronological description.

Target :

English	HUM08-ANGL
Number of hours : 24.00 h	2.00 ECTS credit
TD : 24.00 h, TD : 24.00 h	
Reference Teacher(s) :	

Objectives :
Acquiring the required skills for working in a firm as an engineer. Reaching the required level (B2) is compulsory in order to graduate.

Content :
-Learning by doing:
The student will have to be able to talk and listen, write documents while showing he/she can solve problems, reason, convince and demonstrate in an articulate manner.
-Expressing oneself accurately and fluently.
The student will engage in activities requiring creative and reactive skills (such as debates, role-plays, individual oral presentations using PowerPoint, projects), which will be based on scientific topics and current events.
-Writing CVs and cover letters
-Scientific English
-Discovering the professional world in an international context
-Preparing for the TOEIC. Furthermore, during the second semester, a specific ¿Toeic Booster¿ course is available for students wishing to attend.

Bibliography :
- Oxford Advanced learners¿ Dictionary
- English Grammar in Use (Cambridge University Press)

Requirements :
1st, 2nd and 3rd year English courses (or equivalent)

Organisation :
Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia language lab and computer rooms are also available and make it possible for the students to work in a stimulating environment. Our teaching resources include press articles, audio and video documents (TV reports, extracts from films and series). We also use the Internet.
Regular personal work is obviously required. The student must be curious and practise English outside the classroom as well.

Evaluation :
TOEIC
15 minute oral exam

Target :

Economy and Management	HUM08-ECO
Number of hours : 10.00 h	1.00 ECTS credit
TD : 10.00 h, TD : 10.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Engineer & Society - M1	HUM08-SHES1
Number of hours : 14.00 h	1.00 ECTS credit
TD : 14.00 h, TD : 14.00 h	
Reference Teacher(s) : ECHARD PHILIPPE	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Engineer & Society - M2	HUM08-SHES2
Number of hours : 14.00 h	1.00 ECTS credit
CM : 14.00 h, CM : 14.00 h	
Reference Teacher(s) : ECHARD PHILIPPE	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Sport and Physical Education	HUM08-EPS
Number of hours : 20.00 h	1.00 ECTS credit
TD : 20.00 h, TD : 20.00 h	
Reference Teacher(s) :	

Objectives :
Team work, discovery of one's capabilities, communication, invention, autonomy, self-discovery and management responsibilities.

Content :
Whole class: "role of the coach, role of the referee, management" (knowledge of the rules, getting involved, leading, decision
making and communicating). Practice and knowledge of the sociomotive roles involved in the strategies of team attack and
team defence. Finding one's place in a group and awareness of your team-mates and their responsibilities.
Organisation of Physical and Sports Education: two 15-hour and one 30-hour sports or physical activity programmes in groups.

Bibliography :
Specialised publications are available at the library. Internet links are posted and updated on the INSA Physical Education website.

Requirements :

Organisation :

Evaluation :
Evaluation is based upon student participation, progress and acquisition. The student is asked to criticise his own progress with respect to the objectives of the course. The ability to be self-critical leads to self-discovery. Sharing this knowledge with a group reinforces one's confidence.

Target :

Semestre 9

Parcours Formation Initiale GMA

1	**GMA09-1**		**Mechanical Engineering and Materials S9**	**7.50**
	GMA09-MECAFORM	O	Metallic Materials: Shaping	4.50
	GMA09-CMP	O	Non-Metallic Materials: Processing	1.00
	GMA09-MNEF	O	Numerical Methods: Nonlinear Finite Elements	2.00
2	**GMA09-2**		**Automation and model-building S9**	**6.00**
	GMA09-ROBOT	O	Robotics II	2.00
	GMA09-SYSME	O	Mechanical Systems	2.00
	GMA09-COMOP	O	Automation III: Optimal Control	2.00
3	**GMA09-3**		**OUVERTURE**	**11.00**
	GMA09-CORO	C	Robust Design	2.00
	GMA09-CODYM	C	Comportement dynamique des matériaux et des structures	2.00
	GMA09-INGAS	C		2.00
	GMA09-VATR	C	Accuracy of Robots and Machine-tools	2.00
	GMA09-PI	O	Industrial project	7.00
	GMA09-ANNUM	C	Analyse numérique pour ingénieur	2.00
4	**HUM09**		**Non-scientific syllabus S9**	**5.50**
	HUM09-ANGL-CONV	C	English S9 Conversation	1.50
	HUM09-ANGL-TOEIC	C	TOEIC 5th year	1.50
	HUM09-PM-A	C	Economics, Law and Business Studies A (Lean six sigma)	2.00
	HUM09-PM-B	C	Economics, Law and Business Studies B (Human Resource Management)	2.00
	HUM09-PM-C	C	Economics, Law and Business Studies C (Human Resources Management)	2.00
	HUM09-PM-D	C	Economics, Law and Business Studies D (MANAGEMENT - ETHICS - RESPONSIBILITY)	2.00
	HUM09-PM-E	C	Economics, Law and Business Studies E (International Strategy and Development)	2.00
	HUM09-PM-F	C	Economics, Law and Business Studies F (sustainable development)	2.00
	EII09-EVST	C	Evaluation stage	1.00
	HUM09-PM-G	C	Economics, Law and Business Studies G (serious game)	2.00
	EII09-HUMT	C	Societal responsibility of business	1.00
	EII09-EVST	C	Evaluation stage	1.00
	INF09-DROIT	C	Legal Training for Engineers	2.00
	SRC09-SPEC	C	Conferences	1.00
	SRC09-CONF	C	SRC09-CONFERENCES	1.00

O = compulsary, C= in choice , F= optional

Metallic Materials: Shaping	GMA09-MECAFORM
Number of hours : 60.00 h	4.50 ECTS credit
CM : 34.00 h, PR : 2.00 h, TD : 16.00 h, TP : 8.00 h	
Reference Teacher(s) : GAVRUS ADINEL	

Objectives :
Metallurgy of Metallic Materials.Introduction to the plasticity of materials and elasto-(visco)plastic behaviour definition. Study
of the relationship between structure and rheology. Formulation of the rheological and tribological laws. Examination of
mechanical and tribological tests. Description of the principal processes for metals forming. Optimization and Inverse Analysis
Principle.

Content :
1° Mechanical Metallurgy of Metallic Materials.
2° Elasticity, viscoplasticity, plasticity, criteria of plasticity.
3° Elements of physical and mechanical metallurgy concerning metals forming.
4° Rheology and Tribology of metals forming.
5° Analysis of Industrial Metals Forming Processes.
6° Numerical Simulations, Optimization and Inverse Analysis applied to the rheological and tribological properties identification according to the forming conditions.

Bibliography :
[1] J. PHILIBERT A. VIGNES Y. BRECHET P. COMBRADE « Métallurgie du minerai au matériau » Ed Masson 1998
[2] D. FRANCOIS, A. PINEAU, A. ZAOUI, « Comportement mécanique des matériaux », Tome1, Hermes, 1995
PHILIBERT, VIGNES, BRECHET, COMBRE, " Métallurgie du minerai au matériau ", Masson,
[3] J-M. HAUDIN, F. MONTHEILLET ²Notions Fondamentales sur les Matériaux², Ed. S.N.P.M.D., Paris, 1989.
[4] M. BELLET, J-L. CHENOT, L. FOURMENT, E. MASSONI, P. MONTMITONNET ²Séminaire de Plasticité : Eléments Finis et Mise en Forme des Métaux ², Ed. Ecole Nationale Supérieure des Mines de Paris, Sophia Antipolis, 1994.
[5] M. RAPPAZ, M. BELLET, M. DEVILLE ²Modélisation Numérique en Science et Génie des Matériaux², Ed. Presses
Polytechniques et Universitaires Romandes, 1998.

Requirements :
Physics, materials science, technology modules (4th year)
Mechanics of continuous elements (3thd year)
Fluid mechanics (4th year)

Organisation :
Revision of lecture notes. Problems solving: 10 hours

Evaluation :
Two-hour written examination and practical works evaluation.

Target :

Non-Metallic Materials: Processing	GMA09-CMP
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : GLORIANT THIERRY	

Objectives :
Introduction of Polymers Technology; Physical-Chemical description of Polymers; Structure-Behaviour-Properties Interaction;
Thermo-viscoplasticity and rheological analysis of the melted state; Thermal theory and applications concerning the thermal
analysis; Injection, Extrusion and Calendering Processes Analysis; Rheology of solid polymers; Technology and properties of
ceramics.

Content :
1. Comparison between metals, polymers, ceramics and composites materials and its optimal choice.
2. Introduction to the technology principles of polymers manufacturing.
3. Physical and Chemical description of a polymer.
4. Definition and properties of thermoplastics, thermosettings and elastomers materials.
5. Thermo-viscoplasticity and rheology of polymers in melted state.
6. Thermal Theory and Applications.
7. Manufacturing process for polymers industry.
8. Rheology of solid polymers.
9. Elaboration, properties and technology of ceramics.

Bibliography :
[1] J. F. AGASSANT, P. AVENAS, J.-Ph. SERGENT- "La Mise en Forme des Matériaux Plastiques", Ed. Technique &
Documentation, Ed. Lavoisier, 1996.
[2] J. BOST -"MATIERES PLASTIQUES II : Technologie Plasturgie", Ed. Technique & Documentation, Lavoisier, 1982.
[3] M. REYNE-"LES MATERIAUX NOUVEAUX", Ed. Hermes, Paris, 1990.
[4] M. REYNE "TECHNOLOGIE DES PLASTIQUES", Ed. Hermes, Paris, 1998.
[5] C. GSELL, J.-M. HAUDIN-"INTRODUCTION A LA MECANIQUE DES POLYMERES", Ed. Institut National Polytechnique de Lorraine, 1995.
[6] W.D. KINGERY, H.K. BOWEN, DR UHLMANN -"Introduction to Ceramics", John Wiley & Sons, New-York (1976), ISBN 0.471.47860.1
[7] J.L. CHERMAN -"Caractérisation des poudres et des céramiques", Hermès, Paris (1992), ISBN 2.86601.307.7
[8] L.L. HENCH, R.W. GOULD -"Characterization of Ceramics", M. Dekker Inc, New-York (1971), ISBN 0.8247.1302.8

Requirements :
Physics and Chemistry (1st en 2sd years).
Materials Science (3thd and 4th years).
Continuum Media Mechanics and Fluid Mechanics (3thd and 4th years).

Organisation :
One hour per week.

Evaluation :
Two-hour written examination and project evaluation.

Target :

Numerical Methods: Nonlinear Finite Elements	GMA09-MNEF
Number of hours : 26.00 h	2.00 ECTS credit
CM : 26.00 h	
Reference Teacher(s) : RAGNEAU ERIC	

Objectives :
An extension of the MEFI module (4th year), the consequences of taking material and geometrical nonlinearities into account
in a finite element model are examined. A mini-project on modelling in the nonlinear domain completes the module.

Content :
1. Introduction: Classification of nonlinearities.
2. Matrix formulation of non linearity: understanding tangent and cutting matrix of rigidity.
3. Solution models (Newton-Rahpson).
4. Application to geometrical nonlinearities: Hyperelasticity. Hypoelasticity. Elastoplasticity.
5. Application to geometrical nonlinearity: Lagrangian description "UL" and "TL". Euler's description "ALE". Approximations
for large displacements. Flame and sail effects on thin elements.
6. Application with the Cast 3M program (mini project).

Bibliography :
Zienkiewicz : La méthode des Eléments finis. Edisciences
Gallagher : Introduction au calcul par Eléments Finis. Editions Pluralis Batoz,
Dhatt : Modélisation des structures par éléments
finis. Editions Hermès
K. J. Bathe : Finite Element Procedures in Engineering Analysis. Prentice et Hall

Requirements :
Basics of the mechanics of continuous media and linear finite element modelling.

Organisation :
Two hours per week.

Evaluation :
Two-hour written examination.
Mark for mini-project.

Target :

Robotics II	GMA09-ROBOT
Number of hours : 24.00 h	2.00 ECTS credit
CM : 16.00 h, TD : 8.00 h	
Reference Teacher(s) : ARAKELYAN VIGEN	

Objectives :
Theoretical principles to understand the mechanics of articulated robots. Recent developments in direct polynomial kinematics
and the study of the assembly of parallel robots. Inverse kinematics, Statics, Architecture and Dynamics for parallel robots.
Case studies. Tutorials: Simulation of these applications through models using the ADAMS programme.

Content :
Statics of anthropomorphic and parallel manipulators. Direct and inverse kinematics of parallel manipulators. Generalisation of
movements in articulated and operational space: Polynomial interpolation and calculating minimal time. Newton-Euler and
Newton-Lagrange equations: Application to robotic systems. Balancing of manipulating arms and parallel robots: application
to walking and manual-manipulator robotic systems. Open-loop kinematics for dynamic decoupling and linearization of
movement equations for manipulators. Architecture: calculations and optimisation.

Bibliography :
1. O. Bottema, B. Roth. Theoretical Mechanics. Dover Publications, New York, 1990, 558p.
2. J. Angeles. Fundamentals of robotic mechanical systems. Springer, 2003, 521p.
3. L.W. Tsai. Robot Analysis. John Wiley et Sons, 1999, 505p. Evaluation

Requirements :

Organisation :

Evaluation :
Two-hour written examination at the end of the semester.

Target :

Mechanical Systems	GMA09-SYSME
Number of hours : 24.00 h	2.00 ECTS credit
CM : 16.00 h, TD : 8.00 h	hand-out in English and course taught in English
Reference Teacher(s) : ARAKELYAN VIGEN	

Objectives :
- New analytical methods for the design and fabrication of modern machines.
- Concepts and techniques of the mechanics of complex systems.
- General principles and methods for the study of rigid/articulated multi-body systems.
- Case Studies.

Content :
Use of graphs to describe systems. Position: kinematic (the Gosselin-Angeles method) and dynamic. Kinematic analysis of
closed-loop spatial mechanisms using the Denavit-Hartenberg method. Synthesis of multiple body articulated systems:
Burmester's problem and the problem of the approximate reproduction of a given motion (Roth-Gupta method). Dynamic
synthesis of multiple body systems. Moving moment and optimisation methods. Optimal balance for complex systems based
on the Techichev's approximation. Dynamics of multiple body closed loop systems with multiple degrees of liberty. The
mechanical-electronic approach to the study of mechanical systems.

Bibliography :
1. L.W. Tsai. Mechanism Design. CRC Press, 2001, 311p.
2. H. Dresig., F. Holzweißer. Maschinendynamik. Springer, 2004, 526p.
3. O. Bottema, B. Roth. Theoretical Mechanics. Dover Publications, New York, 1990, 558p.

Requirements :

Organisation :

Evaluation :
Two-hour written examination at the end of the semester.

Target :

Automation III: Optimal Control	GMA09-COMOP
Number of hours : 24.00 h	2.00 ECTS credit
CM : 10.00 h, TD : 6.00 h, TP : 8.00 h	
Reference Teacher(s) : GUEGAN SYLVAIN	

Objectives :
Problems associated with optimal control of dynamic systems, including a number of practical problems: Control with minimal
expenditure of energy, Control in minimal time, etc. Study of linear quadratic commands. Introduction of robustness of the
Gaussian linear quadratic commands; H2 and H¥

Content :
Mathematics in optimal control. Calculation of variations. Principle of the maximum. Dynamic programming. Optimal control
of linear systems. Additions from Lyanpunov's theory. Quadratic optimisation of continuous systems. Continuous stationary
regulator. Quadratic optimisation of discrete systems. Discrete stationary regulator. Linear quadratic command system + stability. Gaussian linear quadratic commands H2 et H¥

Bibliography :
KWAKERNAAK H. SIVAN R., 1972, « Linear optimal control systems», John Wiley 1 Sons, Inc.
THOMAS Y., 1992 « Signaux et systèmes linéaires » 1991, Masson
DE LARMINAT Ph. 1993, « Automatique, commande des systèmes linéaires », Hermès.

Requirements :
Signaux et Systèmes - Automatique 1 - Automatique 2

Organisation :
Revision of lecture notes. Preparation of exercises, problems and practical work (Two hours per week).

Evaluation :
Three-hour written examination at the end of the semester(lecture notes and handouts allowed).
Two practical work reports .

Target :

Robust Design	GMA09-CORO
Number of hours : 24.00 h	2.00 ECTS credit
CM : 10.00 h, TP : 14.00 h	
Reference Teacher(s) : LEOTOING LIONEL	

Objectives :
The choice of an optimal mechanical solution requires the study of its robustness. The evaluation of the reliability of the
product can be an efficient tool for this choice.

Content :
1 - Main optimization algorithms
2 - Introduction to Mechanical reliability
3 - Applications on optimization software ModeFrontier
4 - Project
5 - Lecture on industrial applications

Bibliography :

Requirements :
GMA07-CMAO2

Organisation :
1 hour per week

Evaluation :
- 1 two-hour written examination
- 1 mark for practical work

Target :

Comportement dynamique des matériaux et des structures	GMA09-CODYM
Number of hours : 24.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 12.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

	GMA09-INGAS
Number of hours : 24.00 h	2.00 ECTS credit
CM : 16.00 h, TP : 8.00 h	
Reference Teacher(s) : KOUADRI-DAVID AFIA	

Objectives :
The majority of industries must integrate during their manufacture a stage of assembly and of welding. In this aim, the engineer in mechanics and automatism must have a global vision of the manufacturing processes, machines of assembly or the welding, their operation but also of their limit for better acting and thus guaranteeing the reliability of the end product. Also the objective of this module is to bring to the engineers tools and methods to acquire a competence in the field of the engineering of assembly by the taking into account the process of the welding as well as choice of material in metallurgical, thermal and mechanical terms.

Content :
The module is carried out in the form of course (16 H) and 8 hours of TP. The course part is broken up into several fields which constitute the training of an engineer welder and who requires several level of knowledge:
1. Run
- Process study: Presentation and study of the various processes of welding, control parameters of the process,
- Materials study: Influence of the processes and parameters on the metallurgical and thermal aspects.
- Mechanical study: Impact and effects on the welded structures.
- Coupling: Study of the coupling Process-Material-Mechanics.
- Defects of welding study: Appreciation and recognition of the various types of defects generated by welding.
- Quality controls of the structures: methods of destructive and nondestructive control of the welded structures.
- Qualification: Study of the step of qualification of an engineer welder: QMOS and DMOS.
- Application to various welded systems in automotive, aeronautic¿..

2. Work practice
The TP are realized in the form of welding of plates by the use of various processes. A mechanical qualification is carried out by the students in order to confirm the influence of the process on the final quality of the process. Various tests are carried out to highlight the proceeded coupling material-mechanics.

Bibliography :

Requirements :
- Knowledge of the mechanics of materials
- Knowledge of the manufacturing processes

Organisation :
- 2 H of course per week
- 8 hours of pratics (TP)

Evaluation :
- Exam during 2 Hours
- Practices (TP)

Target :

Accuracy of Robots and Machine-tools	GMA09-VATR
Number of hours : 24.00 h	2.00 ECTS credit
CM : 8.00 h, TD : 8.00 h, TP : 8.00 h	handout in English
Reference Teacher(s) : SOHIER CHRISTOPHE	

Objectives :
The Mechanics Industry is a complex environment with many branches of activity. To be competitive each branch has to
involve automated machines and robots. As a result, the mechanical engineers must have a global overview of these machines
in order to well understand their behaviour and their limits. For machining and assembly applications, the trajectories of the
machines-tools and robots have to be accurately controlled. Therefore the objective of this module is to provide the students
the knowledge and the tools required to enhance the static and dynamic accuracies of robots and machines.

Content :
Courses:
1/ Problem statement:
Problem of Machine and robot accuracy,
Off-line Programming,
CAD/CAM
2/ Objectives and available calibration methods :
Modelling
Identification
Measurement
Compensation
Tutorials:
1/ Practical verification of machines-tool and robot accuracy
2/ Machine and robot modelling
3/ Application to calibration methods to machines and robots
Laboratory :
1/ Application to 3 and 5 axis machine tools
2/ Application to industrial anthropomorphic robots (KUKA, FANUC)

Bibliography :

Requirements :

Organisation :
12 hours

Evaluation :

Target :

Industrial project	GMA09-PI
Number of hours : 110.00 h	7.00 ECTS credit
TD : 110.00 h	hand-out in English and course taught in English
Reference Teacher(s) : COURTEILLE ERIC	

Objectives :
Solving problems in a simulated industrial situation. A look at companies working in the field of Mechanical and Control
Systems Engineering.

Content :
Working alone or in pairs, students must complete a project proposed by a company which is involved in mechanical
engineering, mechanics or automation.

Bibliography :

Requirements :

Organisation :
From 6 to 10 hours per week.

Evaluation :
Two oral presentations:(a) On the planning and organisation of the project (15%) (b) At the end of the project(30%).
Written report (30%).
Mark awarded by teachers and company supervisors (25%).

Target :

Analyse numérique pour ingénieur	GMA09-ANNUM
Number of hours : 24.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 8.00 h, TP : 4.00 h	
Reference Teacher(s) : GAVRUS ADINEL	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

English S9 Conversation	HUM09-ANGL-CONV
Number of hours : 10.00 h	1.50 ECTS credit
TD : 10.00 h, TD : 10.00 h	
Reference Teacher(s) : LE VOT PHILIPPE	

Objectives :
- Improving communication skills in everyday life situations as well as in a professional or social context.
- Obtaining or reinforcing C1 level, strongly advised/recommended by the CTI. t.

Content :
- Learning by doing: students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.
- Expressing oneself accurately and fluently: students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :
1. English Grammar in Use (Cambridge University Press)
2. Dictionnaire Collins Cobuild
3. Polycopié de l' INSA

Requirements :
Having taken and passed the TOEIC test during the previous two years (800 required)
or any other B2 certification recognized by the CTI.

Organisation :
- Each class lasts one hour and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.
- Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet.

Evaluation :
Continuous assessment: The final mark (out of 20) will be based on the attendance rate and the personal implication of the student during the class.

Target :

TOEIC 5th year	HUM09-ANGL-TOEIC
Number of hours : 20.00 h	1.50 ECTS credit
TD : 20.00 h, TD : 20.00 h	
Reference Teacher(s) : LE VOT PHILIPPE	

Objectives :
- Improving communication skills in everyday life situations as well as in company and business context.
- Obtaining or reinforcing the B2 level requested by the CTI.
- Obtaining 800 score at the final TOEIC test.

Content :
Learning by doing : students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.
Expressing oneself accurately and fluently : students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :
- English grammar in Use, Intermediate Edition (CUP)
- Robert and Collins bilingual dictionary or Collins Cobuild

Requirements :
Not having already taken and passed the TOEIC test during the previous two years
B1/B2 level advised

Organisation :
Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.
Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet. B2 level tests are also taken throughout the course.

Evaluation :
Final mark based on :
TOEIC score at final exam + attendance (more than 4 non justified absences result in 0/20 mark).

Target :
5th year students who haven't already passed their TOEIC

Economics, Law and Business Studies A (Lean six sigma)	HUM09-PM-A
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
* Lean Six Sigma (28h / in French)
Lean Six Sigma is a methodology that enables firms to make their processes more effective and efficient. It¿s the current industry standard for process improvement designed to reduce waste and enhance output quality.

* Law (8h / in French)
Main principles of the French legal system

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies B (Human Resource Management)	HUM09-PM-B
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field)
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :
* Human Resource Management (20h / in French)
    - Main current challenges of Human Resource Management
    - Human Resource Management¿s tools and organization
    - Focus on how team managers deal with Human Resource Management

* Law (8h / in French)
    Main principles of the French legal system

* Social legislation (8h / in French)
    Main principles of French social legislation
    Employment contract

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies C (Human Resources Management)	HUM09-PM-C
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field)
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :
* Human Resource Management (20h / in French)
    - Main current challenges of Human Resource Management
    - Human Resource Management¿s tools and organization
    - Focus on how team managers deal with Human Resource Management

* Law (8h / in French)
    Main principles of the French legal system

* Social legislation (8h / in French)
    Main principles of French social legislation
    Employment contract

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies D (MANAGEMENT - ETHICS - RESPONSIBILITY)	HUM09-PM-D
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :
This course aims at enabling students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
The program's main objective is to provide a multidisciplinary approach to the field of innovation, strategy and industrial design. This course will give an overview of the innovative process.
During this program, participants will have the opportunity to explore a business case covering the first stage of a product development project.

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - S7 and S8

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies E (International Strategy and Development)	HUM09-PM-E
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time.

Content :
This course provides students with the tools necessary to understand and work effectively in today's international economic environment. It explores how innovative firms address new markets and compete outside their national frontiers. The course focuses on strategic choices regarding effective actions in international business.

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advice to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies F (sustainable development)	HUM09-PM-F
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
- Project Management (28 h / in French)
    - Efficient Project Management tools and organization according to PMI (Project Management Institute)
    - Agility
    - SCRUM

- Law (8 h / in French)
    Main principles of the French legal system

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advice to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Evaluation stage	EII09-EVST
Number of hours : 5.00 h	1.00 ECTS credit
EP : 1.00 h, EP : 1.00 h, TA : 4.00 h, TA : 4.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Economics, Law and Business Studies G (serious game)	HUM09-PM-G
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	course taught in English
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
-Establishing a strong, specific vocabulary base
-Understanding the main issues that industrial companies deal with (in a specific management field).
-Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
* Business Simulation (serious game) (28h / in English)
The business simulation ¿Global Challenge¿ (a CESIM product) has been designed to improve the understanding and knowledge of the complexity of global business operations in a dynamic, competitive environment. It focuses on strategic management, international management and business policy.
The task for the student teams is to manage a global mobile telecommunications company as its technology and markets evolve. Students will develop and execute strategies for their simulated company operating in the USA, Asia, and Europe.
The simulation is based on an online platform that allows students to play in their own language (many languages available: English, Spanish, Portuguese, Chinese,¿).

* Law (8h / in French)
Main principles of the French legal system

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Societal responsibility of business	EII09-HUMT
Number of hours : 20.00 h	1.00 ECTS credit
CM : 20.00 h, CM : 20.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Evaluation stage	EII09-EVST
Number of hours : 5.00 h	1.00 ECTS credit
EP : 1.00 h, EP : 1.00 h, TA : 4.00 h, TA : 4.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Legal Training for Engineers	INF09-DROIT
Number of hours : 20.00 h	2.00 ECTS credit
CM : 20.00 h, CM : 20.00 h	
Reference Teacher(s) :	

Objectives :
To give to final-year engineers, whether or not in project manager positions, the key legal concepts for understanding the protection of intellectual creations and software, the contractual mechanisms for producing software content, and the terms of software licenses.

Content :
5 independent modules CM1 to CM5

CM1: COMPUTER CREATIONS AND ACTORS

CM 2: GENERIC CONTRACTUAL STRUCTURES AND RESPONSIBILITIES

CM 3: SPECIFIC CONTRACTUAL STRUCTURES

CM 4: SOFTWARE LICENSES (INCLUDING GPL)

CM 5: CREATION AND ADMINISTRATION OF WEB SITES

Bibliography :
On the internet : http://www.legalis.net/

Books : Informatique, T_l_coms, Internet - Ed Francis Lefebvre 2012

Requirements :
passing the introductory module to general law (8H Lectures)

Organisation :
Lectures (7 x 2H)

Evaluation :
final exam

Target :

Conferences	SRC09-SPEC
Number of hours : 16.00 h	1.00 ECTS credit
CM : 16.00 h, CM : 16.00 h	
Reference Teacher(s) :	

Objectives :
Teaching students the fundamentals of Project Management and practice within specific projects.

Content :
Project's Organization
Planning, analysis and formalization of individual and team goals.
Methodological tools for project management
Analysis of deviations from the specifications
Risk Management
All the concepts covered in this course will be applied to a specific case study within dedicated projects (SRC09 TCBE
module).

Bibliography :

Requirements :

Organisation :

Evaluation :
Oral defense of the project (Implementation of the lecture's concepts)

Target :

SRC09-CONFERENCES	SRC09-CONF
Number of hours : 16.00 h	1.00 ECTS credit
CM : 16.00 h, CM : 16.00 h	
Reference Teacher(s) : PREVOTET JEAN-CHRISTOPHE	

Objectives :
Industrial or academic experts in various domains present small talks (typically 2h) about technical and scientific issues in their domain. The main idea is to open students to the world of industry and research and make them sensitive to state of the art issues.

Content :
The talks may vary depending on the availability of experts

Bibliography :

Requirements :

Organisation :

Evaluation :
PASS if every session is attended, FAIL otherwise.

Target :
5SRC and 5M&N

Semestre 10

Parcours Formation Initiale GMA

1	GMA10-1		Final Year Project	30.00
	GMA10-PFE	O	Final Year Project	30.00

O = compulsary, C= in choice , F= optional

Final Year Project	GMA10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ST : 350.00 h	hand-out in English and course taught in English
Reference Teacher(s) : GAVRUS ADINEL	

Objectives :
This work placement must allow the student to acquire practical experience in a professional environment. The student will
aim to develop his teamwork, communication and observation skills, and improve his capacity to integrate a business
environment.

Content :
- Industrial or research laboratory's work placement with agreement (junior engineer level).
- At least 16 weeks duration and maximum 6 months.
- In France or abroad.
- Must be carried out in the second semester of the 5th year of studies.

Bibliography :

Requirements :

Organisation :
Writing a final report
Defence of the internship

Evaluation :
The final mark is obtained considering 3 steps :
* the amount and quality of work according the manager of the student,
* the quality of the writing report,
* the quality of the defence of the internship in front of an examining board.

Target :