INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES RENNES

Academic year 2023/2024

Courses offered by the programme

Mathématiques appliquées (MA)

Semester(s) : 5-6-7-8-9-10

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
DMA07-MSRS	Risk Analysis and Scoring
DMA07-MSSD	Stochastic Models of Dynamical Systems
DMA07-OHA	Hilbertian Tools and Applications
DMA07-RO	Operational research methods
DMA07-ST	Time Series
DMA08-AS	Statistical Learning
DMA08-MERN	Modelling with Partial Differential Equation and Numerical Resolution
DMA08-PE	Design of Experiments

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

INSA RENNES - Mathématiques appliquées (MA) : 2023/2024

Semestre 5

Parcours FISP

1	**DMA05-MATHS**		**MATHEMATICS**	**8.50**
	DMA05-OMB	O	Basic Mathematics Tools	3.00
	DMA05-Proba	O	Probability	3.50
	DMA05-REMED	O	Remediation	2.00
2	**DMA05-MOD**		**MODELLING**	**5.00**
	DMA05-AD	O	Multivariate Data Analysis	2.50
	DMA05-MEDO	O	Modeling with ordinary differential equations	2.50
3	**DMA05-INFOS**		**SCIENTIFIC COMPUTING**	**8.50**
	DMA05-PYTHO	O	Python and Scientific Modules	2.50
	DMA05-ILM	O	Introduction to mathematical software	2.00
	DMA05-MNL	O	Numerical Methods for linear systems	2.50
	ESM05-INFOC	O	C language	1.50
4	**DMA05-SEM**		**SEMINAR**	**1.00**
	DMA05-SE	O	Business Seminar	1.00
5	**HUM05-ISP/PSH**		**Non-scientific syllabus S5**	**7.00**
	HUM05-ANGL	O	English	2.00
	HUM05-EPS	O	Sport and physical Education	1.00
	HUM05-PSH	O	Human sciences project	2.50
	HUMF1-ALL	C	German: Confirmed Level	1.50
	HUMF1-ESP	C	Spanish	1.50
	HUMF1-ITA	C	Italian	1.50
	HUMF1-JAP	C	Japanese	1.50
	HUMF1-POR	C	Portuguese	1.50
	HUMF1-CHI	C	Chinese	1.50

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

Basic Mathematics Tools	DMA05-OMB
Number of hours : 36.00 h	3.00 ECTS credit
CM : 18.00 h, TD : 18.00 h	
Reference Teacher(s) : BRIANE Marc	

Objectives :
This course will provide the basic mathematical tools necessary for the rest of the program.

Content :
LEBESGUE'S INTEGRAL on Rd (9h + 9h)
Definition and properties
Convergence theorems
Integral depending on a parameter
Fubini's theorems
Change of variables theorem

METRIC AND NORMED SPACES (9h + 9h)
Definitions, examples and properties
Complete and compact spaces
Continuityu and uniform continuity
Fixed point theorems

Bibliography :
M. Briane, G. Pagès, Théorie de l'intégration, convolution et transformée de Fourier, ouvrage de cours et d'exercices de Licence et Master de Mathématiques, 7ème édition, De Boeck, 2017.
J.-M. Monier. Analyse MP, Dunod, Paris, 2004.
C. Derschamps, A. Warusfel, J.-F. Ruaud, F. Moulin, J.-C. Sifre, A. Miquel. Mathématiques, tout-en- un, 2ème année MP. Dunod, Paris, 2004.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills.

Organisation :

Evaluation :
One written examination (2h) (1/2) and Continuous assessment (1/2)

Target :

Probability	DMA05-Proba
Number of hours : 44.00 h	3.50 ECTS credit
CM : 18.00 h, TD : 18.00 h, TP : 8.00 h	
Reference Teacher(s) : HERVE Loic	

Objectives :
To understand the various types of convergence of random variables, the basic principles of the conditional expectation, and the Monte Carlo simulation.

Content :
PROBABILITY SPACE ANS RANDOM VARIABLE
- Definition and properties of a probability space
- Real-valued random variables (definition, probability distribution)
- Independent random variables

MATHEMATICAL EXPECTATION OF A RANDOM VARIABLE
- Definition and properties of the expectation value of a real-valued random variable
- Convergence theorems
- Classical inequalities

CONVERGENCE OF A SEQUENCE OF RANDOM VARIABLES
- Convergence in probability and weak law of large numbers
- Almost sure convergence and strong law of large numbers
- Convergence in distribution and central limit theorem

RANDOM VECTORS
- Law of a random vector
- Expectation vector and covariance matrix of a random vector
- Convergence in law for a sequence of random vectors

RANDOM GAUSSIAN VECTORS
- Definition and characteristic function of a Gaussian random vector
- Density function of a Gaussian random vector
- Multi-dimensional central limit theorem
- Properties of Gaussian random vectors

CONDITIONAL EXPECTATION
- Linear regression
- Definition for discrete and absolutely continuous random variables
- Existence and uniqueness theorem (general case)
- Properties of the conditional expectation.

Laboratory work/Project with the software R
- Standard methods for simulation of r.v..
- Illustrations of the convergence of r.v. in probability and statistics

Bibliography :
- N. Bartoli, P. Del Moral. Simulation & Algorithmes stochastiques. Cépaduès, 2001.
- J-P. Delmas. Introduction aux probabilités. Ellipses, 1993.
- D. Foata, J. Franchi, A. Fuchs. Calcul des probabilités. Dunid, 2012. .
- R. Durrett Probability: Theory and Examples, Cambridge Series in Statistical and Probabilistic Mathematics
- C. P Robert, G. casela. Méthodes de Monte-Carlo avec R. Springer, 2011

Requirements :

Organisation :

Evaluation :
- Continuous assessment (Course evaluation) : 50%
- Personal work (solving problems and exercises) : 30%

- Evaluation on practical work/Project : 20%

Target :

Remediation	DMA05-REMED
Number of hours : 24.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 10.00 h	
Reference Teacher(s) : HERVE Loic	

Objectives :
To revise some important results of the mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills (STPI-2A).

Content :
- Linear algebra : matrix reduction, Euclidean space
- Reduction of symmetric matrices and applications to bilinear algebra
- Matrix norm
- Series and generalized integrals,
- Fubini’s theorem for sums and integrals
- Random variables with density
- Differentiation of functions of several Variables.

Bibliography :

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills (STPI-2A).

Organisation :

Evaluation :
Continuous assessment

Target :

Multivariate Data Analysis	DMA05-AD
Number of hours : 26.00 h	2.50 ECTS credit
CM : 10.00 h, TP : 16.00 h	
Reference Teacher(s) : GARES Valerie	

Objectives :
This course will introduce the main methods of multivariate statistical analysis. Students should be able to carry out some multivariate analysis of a dataset using appropriate methods. Students will be able to apply these methods using R software and interpret the results.

Content :
Descriptive statistics
Singular value decomposition Principal component analysis Correspondence analysis Multidimensional scaling R functions dedicated to data analysis

Bibliography :
T.W. Anderson. An introduction to multivariate statistical analysis. Wiley, 2003.
B. Everitt, T. Hothorn. An introduction to applied multivariate analysis with R. Springer, 2011.
F. Husson et al. Analyse des données avec R. PUR, 2009.
J.D. Jobson. Applied multivariate data analysis. Springer, 1992.
L. Lebart, M. Piron, A. Morineau. Statistique exploratoire multidimensionnelle. Dunod, 2006.

Requirements :
Algebra courses from the undergraduate program of INSA (years 1-2) or equivalent skills. Introduction to mathematical software

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Modeling with ordinary differential equations	DMA05-MEDO
Number of hours : 28.00 h	2.50 ECTS credit
CM : 10.00 h, TD : 10.00 h, TP : 8.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The aim of this course is to introduce the tools and classical techniques to study ordinary differential equations which appear in some models in physics, biology, etc.

Content :
Ordinary Differential Equations (ODE)
Cauchy problem for ODEs
Gronwall Lemma. Existence and uniqueness theorems
Global and maximal solutions
Linear systems of ODEs in the plane
Linearization techniques

Bibliography :
V. Arnold. Équations différentielles ordinaires. MIR, Moscou, 1974.
S. Gourmelen, H. Wadi. Équations différentielles, Herman, 2009.
M.W. Hirsch, S. Smale, R.L. Devaney. Differential equations, Dynamical systems and an introduction to chaos. Elsevier, 2004.
J.-P. Demailly. Analyse numérique et équations différentielles. EDP Sciences, 2006.
M. Braun. Differential equations and their applications. Springer Verlag, 1993.
C. Chicone. Ordinary differential equations with applications. Springer Verlag, 1993.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills.

Organisation :

Evaluation :
1 written examination (2/3) and a practical examination and/or a project (1/3).

Target :

Python and Scientific Modules	DMA05-PYTHO
Number of hours : 26.00 h	2.50 ECTS credit
CM : 6.00 h, TP : 20.00 h	
Reference Teacher(s) : LEPLUMEY Ivan	

Objectives :
The goal of this training module is twofold. First, to provide students with the main elements of the Python language in order to get them autonomous with python coding. Provided lectures emphasis on the "pythonic" way of programming. Second this module makes a wide presentation of the large number of python modules related to science (i.e numpy,scipy,pandas,...) and graphics (i.e matplotlib,..) which are relevant for further work in the curriculum and giving readily data analysis skills. This module proposes different practical applications in two different development environment Spyder and the Ipython notebook. The proposed illustrations borrow example in various domains as : statistical analysis, geodata processing, data visualization, genealogical data processing,...

Content :
Basis of python language
Program structure
Classes (OO basic concepts)
Input/output
Handling text and binary file format
Modular decomposition
Regular expressions
Two different development environment
Interactivity : Ipython Notebook for sequential data analysis
IDE : Spyder
Extension module (mostly scientific purpose)
algebra : PyIMSL Studio, NumPy (the broadcasting concept)
modules scientifiques : SciPy (scipy.stats & scipy.interpolation)
Data vizualization : MatPlotLib
Symbolic calculus : SymPy
Data analysis : Pandas (R like module, Series and DataFrame processing)
GIS : gdal/ogr
Data format : csv, xml, beautifulsoup, json, numpy rich format
IHM : PyQt4
DataBase : psycopg2, SQLite

Bibliography :
E. Bressert. SciPy and NumPy: Optimizing & Boosting Your Python Programming. O'Reilly,2012
W. Chun. Au cœur de Python : Tome 1, Notions fondamentales. Campus Press, 2007.
W. Chun. Au Coeur de Python: Notions Avancées. Campus Press, 2007.
H. Langtangen. Python Scripting for Computational Science (3rd ed.). Springer, 2008.
W. McKinney. Python for Data Analysis. O'Reilly Media, 2012.
M. Lutz. Programming Python. O'Reilly Media, 2011.
G. Swinnen. Apprendre à programmer avec Python 3. Eyrolles, 2012.
M. Summerfield. Programming in Python 3. Addison-Wesley, 2009.
M. Summerfield. Rapid GUI Programming with Python and Qt. Prentice Hall, 2008.
A. Camasayou-Boucau, G. Conan, P. Chauvin. Programmation en Python pour les mathématiques. Dunod, 2012.
S. Tosi. Matplotlib for Python Developers. Packt Publishing Limited, 2009.

Requirements :
Basic knowledge in programming
Undergraduate mathematical background for being comfortable with proposed scientific illustrations.

Organisation :

Evaluation :
An evaluation on Practical work

Target :

Introduction to mathematical software	DMA05-ILM
Number of hours : 24.00 h	2.00 ECTS credit
TP : 24.00 h	
Reference Teacher(s) : CHAGNEAU Pierrette, MONIER Laurent	

Objectives :
The aim of this course is to familiarize students with the language and the programming environment of several mathematical software (Matlab, R).

Content :
Overview of mathematical software (Matlab, R)
User interfaces
Data management (importation, export)
Programming languages
Graphics procedures

Bibliography :
A. Biran, M. Breiner. MATLAB 6 for Engineers. Prentice Hall, 2002, 3th ed.
F. Gustafsson, N. Bergman. MATLAB for Engineers Explained. Springer-Verlag, 2003.
D.J. Higham, N. Higham. MATLAB Guide. SIAM, 2005, 2nd Ed.
T. Lyche, J.L. Merrien. Exercises in Computational Mathematics with MATLAB. Springer-Verlag, 2014.
A. Quarteroni, R. Sacco, F. Saleri. Scientific Computing with MATLAB. Springer-Verlag, 2003.
H.B. Wilson, L.H. Turcotte, D. Halpern. Advanced Mathematics and Mechanics Applications using MATLAB. Chapman and Hall, 2003, 3rd ed.
J. Adler. R-L'essentiel. Pearson, 2011.
P. Lafaye de Micheaux, R. Drouilhet, B. Liquet. Le logiciel R : Maîtriser le langage, Effectuer des analyses statistiques. Springer, 2010.
E. Paradis. R pour les débutants. 2005.

Requirements :
Basic understanding of algorithms and skills in programming languages

Organisation :

Evaluation :
Assignment on practical exercises

Target :

Numerical Methods for linear systems	DMA05-MNL
Number of hours : 30.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 10.00 h, TP : 8.00 h	
Reference Teacher(s) : CAMAR-EDDINE Mohamed	

Objectives :
The aim of this course is to provide numerical tools, methods and algorithms that can be used for solving linear systems of equations and for the computation of eigenvalues and eigenvectors of matrices. At the end of this course, students should be able to implement these methods and also interpret the obtained results.

Content :
- Matrix norms
- Review on Gauss method
- Direct methods for linear systems
- Iterative methods for linear systems
- Conditioning of a linear system
- Spectral problems. Power method, inverse power method and deflation method.
- MATLAB and/or SCILAB practical work : solving linear systems

Bibliography :
- G. Allaire, S.M. Kaber. Algèbre linéaire numérique. Ellipses, 2002.
- E. Hairer. consulter la page http ://www.unige.ch/ hairer/polycop.html.
- P. Lascaux, R. Theodor. Analyse numérique matricielle appliquée à l'art de l'ingénieur. Masson, 1987.
- A. Quarteroni, R. Sacco, F. Saleri. Méthodes numériques. Algorithmes, analyse et applications. Springer, 2007.
- M. Schatzmann. Numerical Analysis. A Mathematical Introduction. Oxford University Press, 2002.

Requirements :

Organisation :

Evaluation :
- One written examination (2/3), one practical test and/or a project report (1/3)

Target :

C language	ESM05-INFOC
Number of hours : 22.00 h	1.50 ECTS credit
CM : 6.00 h, TD : 4.00 h, TP : 12.00 h	
Reference Teacher(s) : ARNALDI Bruno	

Objectives :
Basic understanding of the C programming language.
Ability to resolve all common problems.
Find the minimal intersection of needs / C. language.
Writing and comprehension of the code. Syntax and associated semantic.

Content :
1. Introduction to C programming language:
   Introduction.
   Chain of production, from the code source to the executable.

2. Basic C:
   Lexical entities.
   Language syntax.
   Variable declaration.
   Predefined types.
   Operators and expressions.
   General structure of a program.
   Basic input/output.
   Control structures and instructions.
   Fields: 1st form.
   Functions and pass-by-value parameter passing.

3. Advanced C:
   Pointers.
   Functions and pass-by-address parameter passing.
   Standard library functions.
   Memory models for functions and pointers.
   Fields : 2nd form.
   New types and types constructor.
   Explicit type conversion.
   File input/output.
   Allocation class.
   Dynamic Allocation.
   Pointers to functions.

Bibliography :
J.P. BRAQUELAIRE. Méthodologie de la programmation en langage C - Principes et applications. Manuels Informatiques Masson. Masson, 1993.
J.P. BRAQUELAIRE. Méthodologie de la programmation en langage C - Norme C99 - API POSIX. Sciences Sup. Dunod, 2005.
C. DELANOY. Programmer en langage C, avec exercices corrigés. Eyrolles, 1997.
B.W. KERNIGHAN and D.M. RITCHIE. Le langage C. Manuels Informatiques Masson. Masson, 1990.
J.L NEBUT. Le langage C - définition de la norme ANSI. Technical Report Cours C81, IFSIC -Université de Rennes 1, juillet 1989.

Requirements :
Understanding of Algorithms Foundations

Organisation :
Revision of the lecture notes.
6 hours of course, 4 hours of directed work and 12 hours of practical work

Evaluation :
2-hour written examination at the middle of the first semester (documents allowed).

Target :

Business Seminar	DMA05-SE
Number of hours : 26.00 h	1.00 ECTS credit
CM : 26.00 h	
Reference Teacher(s) : GARES Valerie, MONIER Laurent	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
The module will offer (among others) :

- presentations of various career profiles and employment sectors of mathematical engineers ;
- specific mathematical skills (Bayesian networks, sensometry...), computational and software-related skills (specific softwares, computation codes, database management tools for heterogeneous, massive and unstructured data), specific operational skills (clinical trial protocol, banking regulations...) ;
- some awareness to managerial issues (such as business creation, industrial property...) and societal aspects (sustainable development, ethic...) of the profession of engineer.

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery. The obtained mark is independent.

Target :

English	HUM05-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :
Improve expression, comprehension and interaction skills within everyday contexts, with special emphasis on professional and social life.
Language Objectives
Obtain or reinforce B2 level (as required for graduation and defined by CECRL)

Content :
-Action-oriented approach - learning by doing :
students have to listen and speak, write documents while using their problem-solving, reasoning, arguing, and demonstrating capabilities, in an articulate manner.
-Expressing oneself accurately by a rigorous use of syntax and phonology :
Activities requiring creative and reactive skills, ranging from debating, role-playing, individual oral presentations (PowerPoint), projects ... are based on scientific topics and current events.
-Building up specific skills in connection with the working world :
- writing e-mails
- conducting telephone conversations
- technical English
- intercultural contexts
In addition to the English course, a 90-minute remedial course takes place every week (over 10 weeks), in which students can update their various skills (listening and reading, writing, speaking and interacting) in small groups. Remedial classes are compulsory for all students that did poorly in their start-of-term placement test - and optional for those who feel they need to attend. There is no specific assessment for this course.

Bibliography :
- Dictionnaire Robert et Collins bilingue, or Collins Cobuild unilingue
- English Grammar in Use (Cambridge University Press)

Requirements :
A good command of the STPI curriculum is essential : B1/B2

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 students to work in a stimulating environment.
-Teaching resources include press articles, audio and video documents (TV reports, film and series extracts) as well as the Internet.
-Regular personal work is required. Students must be curious and practise their English outside the classroom.

Evaluation :
Two-hour written test.(2/3)
Individual oral presentation in class.(1/3)

Target :

Sport and physical Education	HUM05-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h, TD : 24.00 h	
Reference Teacher(s) :	

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 :

Human sciences project	HUM05-PSH
Number of hours : 26.00 h	2.50 ECTS credit
TD : 26.00 h	
Reference Teacher(s) : ECHARD Philippe	

Objectives :
Conduct a rigorous and synthetic reflection on a given topic dealing with one subject of interest developped by the Specialty Department. .
Learning outcomes expected:
- Knowing how to define a study subject and associate a relevant problematic.
- Knowing how to find relevant information by using the resources available from the Internet
- Knowing how to produce quality communication events and documents (written report, pwpt or prezi presentation, organization of professional meeting)
Knowing how to manage a collective project: planning and coordinating actions to produce documents to be delivered within a given time-limit.

Content :
The students will make up teams and choose a topic that will be approved by the teacher. Their documentary research shall lead to the definition of a problematic and a written report (comprising a synthetic note + commented bibliography + abstract/summary) in accordance with academic requirements.
Methodological gain :
- documentary search on the net. Acquisition of ZOTERO software
- brainstorming techniques and heuristic approach
- problematic definition
- academic-type writing of report or bibiography
- project management technique

Bibliography :
available on-line through the teacher

Requirements :

Organisation :
Alternately methodology courses and progress report sessions of the team projects

Evaluation :
Continuous assessment :
- 1 written report comprising : 1 synthetic note + 1 commented bibliography + abstract/summary)
- 1 oral submission (with pwpt or prezi presentation)

Target :

German: Confirmed Level	HUMF1-ALL
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

To consolidate secondary school level learning outcomes
To attain, as a basic minimum, the B1 level by the end of the first cycle
To practise written and oral comprehension through the use of contemporary supports and multimedia To develop level of oral expression through exercises in small groups and class discussions
To demonstrate and perfect your skills in German through project work
Support for foreign exchange and work placements

Content :
- Exercises to practise spoken German for everyday situations and professional life
- Study of newspaper articles, broadcasts, videos
- Study of current affairs (politics, economics, sociology and culture) in Germanophone countries
- Introduction to economic and professional German
- Grammar revision
- Cultural openness (film studies, exhibitions, music)

Bibliography :
- DUDEN Bilingual Dictionary (German-French/French-German)
Grammatik Aktiv A1-B1, Cornelsen (mit Audio CD)_- Schritte-Ubungsgrammatik A1-B1, Hueber-Verlag
- Übungsgrammatik für die Grundstufe, Hueber-Verlag (Moodle) - Na also!
Waltraud Legros, Ellipses_- Manuel : Menschen hier, Hueber-Verlag
- Deutsch perfekt (periodical) -
Deutsche Welle/ ZDF logo (web) -
multimedia supports (web)

Requirements :
Intermediate German: B1 level

Organisation :
1h30 per week; 21h face-to-face lessons per semester
Personal Study time: 14h
Total: 35 h

Students are encouraged to regularly read news articles in German and to view videos and film series in addition to work assigned between lessons.

Evaluation :
Basic level : continuous assessment
Intermediate level : continuous assessment
Advanced level : continouous assessment

Target :
S1: Final Grade

Spanish	HUMF1-ESP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : AMARGOS GUILLERAY Marine	

Objectives :
-Practising and strengthening of one's knowledge in the Spanish language and culture (Spanish culture, Spanish and
Latin-American civilizations, societal developments).
- How to manage team projects
- Adapting to multicultural environments
- Understanding social, technological and economical challenges in Spanish-speaking countries.

Content :
Written and oral expression and comprehension.

Bibliography :
1. PASTOR Enrique and PROST Gisèle : "La grammaire active de l'espagnol", Le livre de poche, collection Les Langues modernes.
2. BECHERELLE, "El arte de conjugar en espanol", Hatier.
3. Larousse bilingual dictionary, Le Grand Dictionnaire de Garcia y Pelayo et Testas, Dictionary Hispano Bordas.
4. "Passez-moi l'expression en espagnol", Belin.
5. "El espanol en la prensa", Belin.

Requirements :
B1 level

Organisation :
- Reinforcing grammar / conjugation
- Reading and oral comprehension
- Writing and speaking (debates, drama).

Advice : Read in Spanish : contemporary novels, comics (Tintin, Astérix, Mafalda), magazines (Cambio 16, Epoca, Vocable) available at the library.
Visit the Internet pages of the Spanish and Latin-American newspapers (lavanguardia.es, elpais.es...)
Listen to Spanish National Radio programmes (RNE) on Internet.
Watch TV programmes on RTVE.es.
Read tourist guides on Spanish-speaking countries available at the library.

Evaluation :
Continuous assessment

Target :
3rd, 4th, 5th year

Italian	HUMF1-ITA
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : KERSUSAN Sylvia	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Level 1 Beginner :
To introduce the Italian langugae and Italian culture, to express the fundamentals in writing and orally

Level 2 Advanced Beginner:
By the end of the course, students should be able to converse and write in Italian

Level 3 Intermediate:
To enable students to develop further on themes relating to art, civilisation, literature and cinema

Content :
Oral expression and comprehension:
reading with the teacher's guidance on phonetic and grammatical corrections
reading situations in the text, viewing films and reading literary texts and press articles

Written expression and Comprehension:
completing text-based exercises with particular attention to difficulties
summarising situations in available texts and films studied in class

Bibliography :
La lingua italiana per Stranieri 1°, 2°, 3°P K.Katerinov
La prova orale 1,2,3 T.Marin
Texts taken from newspapers and Italian magasines, films by famous film directors

Requirements :
Level 1 Beginner: none
Level 2 Advanced Beginner : to have attended the Italian Beginner lessons
Level3 Intermediate: to have a good knowledge of the Italian language

Organisation :
1h30 of face-face lessons per week; 21h per semester
Personal Study: 14h
To read the photocopied texts provided

Evaluation :
Final grade.

Target :
S1: Final Grade

Japanese	HUMF1-JAP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Niveau débutant (A1):
- awareness of particularities (phonetics, syntax)
- discovery of Japanese culture, traditions, customs
- learning the two systems of writing (Hiragana and Katakana)
- to be able to use spoken Japanese in everyday situations

Intermediate level (A2):
- introduction ideogrammes (60 kanji)
- reading simple texts (with Manga, etc...)
- writing simple texts
- to be able to use spoken Japanese in everyday situations

Advanced level (B1, B2):
- learning kanji (60-200)
- acquiring the four skills (written and oral comprehension, written and oral expression) for travel or study in Japan

Content :
Level 1 Beginner (A1):
- Perfecting Hiragana et Katakana - reading Manga
- Lesson 5: speaking about pastimes
- Lesson 6: using transport
- Lesson 7: shopping
- Lesson 8: expressing feelings

Level 2 Beginner (A2):
- learning 30 kanji - reading Manga
- basic Grammar
- reading and writing simple texts
- learning how to communicate in everyday situations

Intermediate level (B1, B2) :
- learning to use more than 30 kanji
- reading Manga
- acquiring the four skills (written and oral comprehension, written and oral expression)

Bibliography :
Level 1 Beginner (A1): Margot, 3A Network, to be published, Japan.
Level 2 Beginner (A2): Daichi, 1, 3A Network, 2008, Japan.
Level 3 Intermediate (B1, B2): Minna no Nihongo, I et II, 3A Network, 1998, Japan.
+ Satoru Koyama, J. Bridge, Bonjinsha, 2007, Japan.

Requirements :
Level 1: none.
Level 2: to have taken Level A1 Beginner course
Level 3: to have taken Beginner Levels A1 and A2

Organisation :
The teaching follows the TU format.

In each session there is an explanation of the structures which are then illustrated by examples and by exercises and conversation which the students participate in.

Evaluation :
S1: Final Grade

Target :

Portuguese	HUMF1-POR
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Portuguese Beginner Level : to obtain Level A1
Portuguse Intermediate Level: to obtain Level A2/B1

Content :
Acqusition of.basic grammar and everyday vocabulary
Practice of the five skills : oral and written comprehension, oral and written expression, interaction

Emphasis is placed on written and oral communication, first within the context of everyday situations, followed by progressive introduction to other themes and professional communication ;
Practice using various supportds (written, audio, video);
Individual exercises and group work presentations at Intermediate level;
Grammar programme according to each level;
Intercultural openness

Bibliography :
Novo Portugues sem Fronteiras 1

Requirements :
Level A1: none
Level A2: Level A1 competency

Organisation :
1h30 face-to-face lessons per week, personal study

Evaluation :
Final Grade

Target :

Chinese	HUMF1-CHI
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
To acquire the basics of Chinese, Essential structures and vocabulary, Comprehension, expression ans pronunciation, Use of
everyday Chinese.

Content :
Oral skills : corrective phonetics (pinyin system), listening to and analysis of complex sentences and simple texts, oral
exercises (student-student / student-teacher), introduction of new characters (pronunciation and tone accentuation).
Written skills : prose/translation, written production of complex sentences and simple texts, learning and reinforcement of
grammatical ans vocabulary mechanisms, oral and written Chinese, learning of new characters (order of lines, basic
ideograms), reading and analysis of texts, text commentary.

Bibliography :
1. Le chinois comme en Chine, Bernard Allanic, Presses Universitaires de Rennes, 2009
2. Le chinois contemporain, WU Zhongwei, Sinolingua, 2010
3. Faire l'expérience du chinois, ZHANG Rumei, AI Xin, Higher Education Press, 2006
Other documents will be added to these basic books to provide the students with a wide panel of practical exercises.

Requirements :

Organisation :
Students are required to read the texts from the lessons (in character form), to rewrite the new characters, to work on the
application exercices on grammar, lexical and morphological points, to ask questions on the texts from the lessons, to do prose
and translation exercises.

Evaluation :
Final mark

Target :

Semestre 5

Parcours FISP-Risq

1	**DMA05-MATHS**		**MATHEMATICS**	**8.50**
	DMA05-OMB	O	Basic Mathematics Tools	3.00
	DMA05-Proba	O	Probability	3.50
	DMA05-REMED	O	Remediation	2.00
2	**DMA05-MOD**		**MODELLING**	**5.00**
	DMA05-AD	O	Multivariate Data Analysis	2.50
	DMA05-MEDO	O	Modeling with ordinary differential equations	2.50
3	**DMA05-INFOS**		**SCIENTIFIC COMPUTING**	**8.50**
	DMA05-PYTHO	O	Python and Scientific Modules	2.50
	DMA05-ILM	O	Introduction to mathematical software	2.00
	DMA05-MNL	O	Numerical Methods for linear systems	2.50
	ESM05-INFOC	O	C language	1.50
4	**DMA05-SEM**		**SEMINAR**	**1.00**
	DMA05-SE	O	Business Seminar	1.00
5	**HUM05-ISP/RISQ**		**ENSEIGNEMENTS D'HUMANITE S5 - FISP / RISQ**	**6.00**
	HUM05-ANGL	O	English	2.00
	HUM05-RISQ	O	Risk Management. Sustainable Development	1.50
	HUM05-EPS	O	Sport and physical Education	1.00
	HUMF1-ALL	C	German: Confirmed Level	1.50
	HUMF1-ESP	C	Spanish	1.50
	HUMF1-CHI	C	Chinese	1.50
	HUMF1-ITA	C	Italian	1.50
	HUMF1-JAP	C	Japanese	1.50
	HUMF1-RUS	C	Russian	1.50

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

Basic Mathematics Tools	DMA05-OMB
Number of hours : 36.00 h	3.00 ECTS credit
CM : 18.00 h, TD : 18.00 h	
Reference Teacher(s) : BRIANE Marc	

Objectives :
This course will provide the basic mathematical tools necessary for the rest of the program.

Content :
LEBESGUE'S INTEGRAL on Rd (9h + 9h)
Definition and properties
Convergence theorems
Integral depending on a parameter
Fubini's theorems
Change of variables theorem

METRIC AND NORMED SPACES (9h + 9h)
Definitions, examples and properties
Complete and compact spaces
Continuityu and uniform continuity
Fixed point theorems

Bibliography :
M. Briane, G. Pagès, Théorie de l'intégration, convolution et transformée de Fourier, ouvrage de cours et d'exercices de Licence et Master de Mathématiques, 7ème édition, De Boeck, 2017.
J.-M. Monier. Analyse MP, Dunod, Paris, 2004.
C. Derschamps, A. Warusfel, J.-F. Ruaud, F. Moulin, J.-C. Sifre, A. Miquel. Mathématiques, tout-en- un, 2ème année MP. Dunod, Paris, 2004.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills.

Organisation :

Evaluation :
One written examination (2h) (1/2) and Continuous assessment (1/2)

Target :

Probability	DMA05-Proba
Number of hours : 44.00 h	3.50 ECTS credit
CM : 18.00 h, TD : 18.00 h, TP : 8.00 h	
Reference Teacher(s) : HERVE Loic	

Objectives :
To understand the various types of convergence of random variables, the basic principles of the conditional expectation, and the Monte Carlo simulation.

Content :
PROBABILITY SPACE ANS RANDOM VARIABLE
- Definition and properties of a probability space
- Real-valued random variables (definition, probability distribution)
- Independent random variables

MATHEMATICAL EXPECTATION OF A RANDOM VARIABLE
- Definition and properties of the expectation value of a real-valued random variable
- Convergence theorems
- Classical inequalities

CONVERGENCE OF A SEQUENCE OF RANDOM VARIABLES
- Convergence in probability and weak law of large numbers
- Almost sure convergence and strong law of large numbers
- Convergence in distribution and central limit theorem

RANDOM VECTORS
- Law of a random vector
- Expectation vector and covariance matrix of a random vector
- Convergence in law for a sequence of random vectors

RANDOM GAUSSIAN VECTORS
- Definition and characteristic function of a Gaussian random vector
- Density function of a Gaussian random vector
- Multi-dimensional central limit theorem
- Properties of Gaussian random vectors

CONDITIONAL EXPECTATION
- Linear regression
- Definition for discrete and absolutely continuous random variables
- Existence and uniqueness theorem (general case)
- Properties of the conditional expectation.

Laboratory work/Project with the software R
- Standard methods for simulation of r.v..
- Illustrations of the convergence of r.v. in probability and statistics

Bibliography :
- N. Bartoli, P. Del Moral. Simulation & Algorithmes stochastiques. Cépaduès, 2001.
- J-P. Delmas. Introduction aux probabilités. Ellipses, 1993.
- D. Foata, J. Franchi, A. Fuchs. Calcul des probabilités. Dunid, 2012. .
- R. Durrett Probability: Theory and Examples, Cambridge Series in Statistical and Probabilistic Mathematics
- C. P Robert, G. casela. Méthodes de Monte-Carlo avec R. Springer, 2011

Requirements :

Organisation :

Evaluation :
- Continuous assessment (Course evaluation) : 50%
- Personal work (solving problems and exercises) : 30%

- Evaluation on practical work/Project : 20%

Target :

Remediation	DMA05-REMED
Number of hours : 24.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 10.00 h	
Reference Teacher(s) : HERVE Loic	

Objectives :
To revise some important results of the mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills (STPI-2A).

Content :
- Linear algebra : matrix reduction, Euclidean space
- Reduction of symmetric matrices and applications to bilinear algebra
- Matrix norm
- Series and generalized integrals,
- Fubini’s theorem for sums and integrals
- Random variables with density
- Differentiation of functions of several Variables.

Bibliography :

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills (STPI-2A).

Organisation :

Evaluation :
Continuous assessment

Target :

Multivariate Data Analysis	DMA05-AD
Number of hours : 26.00 h	2.50 ECTS credit
CM : 10.00 h, TP : 16.00 h	
Reference Teacher(s) : GARES Valerie	

Objectives :
This course will introduce the main methods of multivariate statistical analysis. Students should be able to carry out some multivariate analysis of a dataset using appropriate methods. Students will be able to apply these methods using R software and interpret the results.

Content :
Descriptive statistics
Singular value decomposition Principal component analysis Correspondence analysis Multidimensional scaling
R functions dedicated to data analysis

Bibliography :
T.W. Anderson. An introduction to multivariate statistical analysis. Wiley, 2003.
B. Everitt, T. Hothorn. An introduction to applied multivariate analysis with R. Springer, 2011.
F. Husson et al. Analyse des données avec R. PUR, 2009.
J.D. Jobson. Applied multivariate data analysis. Springer, 1992.
L. Lebart, M. Piron, A. Morineau. Statistique exploratoire multidimensionnelle. Dunod, 2006.

Requirements :
Algebra courses from the undergraduate program of INSA (years 1-2) or equivalent skills. Introduction to mathematical software

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Modeling with ordinary differential equations	DMA05-MEDO
Number of hours : 28.00 h	2.50 ECTS credit
CM : 10.00 h, TD : 10.00 h, TP : 8.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The aim of this course is to introduce the tools and classical techniques to study ordinary differential equations which appear in some models in physics, biology, etc.

Content :
Ordinary Differential Equations (ODE)
Cauchy problem for ODEs
Gronwall Lemma. Existence and uniqueness theorems
Global and maximal solutions
Linear systems of ODEs in the plane
Linearization techniques

Bibliography :
V. Arnold. Équations différentielles ordinaires. MIR, Moscou, 1974.
S. Gourmelen, H. Wadi. Équations différentielles, Herman, 2009.
M.W. Hirsch, S. Smale, R.L. Devaney. Differential equations, Dynamical systems and an introduction to chaos. Elsevier, 2004.
J.-P. Demailly. Analyse numérique et équations différentielles. EDP Sciences, 2006.
M. Braun. Differential equations and their applications. Springer Verlag, 1993.
C. Chicone. Ordinary differential equations with applications. Springer Verlag, 1993.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills.

Organisation :

Evaluation :
1 written examination (2/3) and a practical examination and/or a project (1/3).

Target :

Python and Scientific Modules	DMA05-PYTHO
Number of hours : 26.00 h	2.50 ECTS credit
CM : 6.00 h, TP : 20.00 h	
Reference Teacher(s) : LEPLUMEY Ivan	

Objectives :
The goal of this training module is twofold. First, to provide students with the main elements of the Python language in order to get them autonomous with python coding. Provided lectures emphasis on the "pythonic" way of programming. Second this module makes a wide presentation of the large number of python modules related to science (i.e numpy,scipy,pandas,...) and graphics (i.e matplotlib,..) which are relevant for further work in the curriculum and giving readily data analysis skills. This module proposes different practical applications in two different development environment Spyder and the Ipython notebook. The proposed illustrations borrow example in various domains as : statistical analysis, geodata processing, data visualization, genealogical data processing,...

Content :
Basis of python language
Program structure
Classes (OO basic concepts)
Input/output
Handling text and binary file format
Modular decomposition
Regular expressions
Two different development environment
Interactivity : Ipython Notebook for sequential data analysis
IDE : Spyder
Extension module (mostly scientific purpose)
algebra : PyIMSL Studio, NumPy (the broadcasting concept)
modules scientifiques : SciPy (scipy.stats & scipy.interpolation)
Data vizualization : MatPlotLib
Symbolic calculus : SymPy
Data analysis : Pandas (R like module, Series and DataFrame processing)
GIS : gdal/ogr
Data format : csv, xml, beautifulsoup, json, numpy rich format
IHM : PyQt4
DataBase : psycopg2, SQLite

Bibliography :
E. Bressert. SciPy and NumPy: Optimizing & Boosting Your Python Programming. O'Reilly,2012
W. Chun. Au cœur de Python : Tome 1, Notions fondamentales. Campus Press, 2007.
W. Chun. Au Coeur de Python: Notions Avancées. Campus Press, 2007.
H. Langtangen. Python Scripting for Computational Science (3rd ed.). Springer, 2008.
W. McKinney. Python for Data Analysis. O'Reilly Media, 2012.
M. Lutz. Programming Python. O'Reilly Media, 2011.
G. Swinnen. Apprendre à programmer avec Python 3. Eyrolles, 2012.
M. Summerfield. Programming in Python 3. Addison-Wesley, 2009.
M. Summerfield. Rapid GUI Programming with Python and Qt. Prentice Hall, 2008.
A. Camasayou-Boucau, G. Conan, P. Chauvin. Programmation en Python pour les mathématiques. Dunod, 2012.
S. Tosi. Matplotlib for Python Developers. Packt Publishing Limited, 2009.

Requirements :
Basic knowledge in programming
Undergraduate mathematical background for being comfortable with proposed scientific illustrations.

Organisation :

Evaluation :
An evaluation on Practical work

Target :

Introduction to mathematical software	DMA05-ILM
Number of hours : 24.00 h	2.00 ECTS credit
TP : 24.00 h	
Reference Teacher(s) : CHAGNEAU Pierrette, MONIER Laurent	

Objectives :
The aim of this course is to familiarize students with the language and the programming environment of several mathematical software (Matlab, R).

Content :
Overview of mathematical software (Matlab, R)
User interfaces
Data management (importation, export)
Programming languages
Graphics procedures

Bibliography :
A. Biran, M. Breiner. MATLAB 6 for Engineers. Prentice Hall, 2002, 3th ed.
F. Gustafsson, N. Bergman. MATLAB for Engineers Explained. Springer-Verlag, 2003.
D.J. Higham, N. Higham. MATLAB Guide. SIAM, 2005, 2nd Ed.
T. Lyche, J.L. Merrien. Exercises in Computational Mathematics with MATLAB. Springer-Verlag, 2014.
A. Quarteroni, R. Sacco, F. Saleri. Scientific Computing with MATLAB. Springer-Verlag, 2003.
H.B. Wilson, L.H. Turcotte, D. Halpern. Advanced Mathematics and Mechanics Applications using MATLAB. Chapman and Hall, 2003, 3rd ed.
J. Adler. R-L'essentiel. Pearson, 2011.
P. Lafaye de Micheaux, R. Drouilhet, B. Liquet. Le logiciel R : Maîtriser le langage, Effectuer des analyses statistiques. Springer, 2010.
E. Paradis. R pour les débutants. 2005.

Requirements :
Basic understanding of algorithms and skills in programming languages

Organisation :

Evaluation :
Assignment on practical exercises

Target :

Numerical Methods for linear systems	DMA05-MNL
Number of hours : 30.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 10.00 h, TP : 8.00 h	
Reference Teacher(s) : CAMAR-EDDINE Mohamed	

Objectives :
The aim of this course is to provide numerical tools, methods and algorithms that can be used for solving linear systems of equations and for the computation of eigenvalues and eigenvectors of matrices. At the end of this course, students should be able to implement these methods and also interpret the obtained results.

Content :
- Matrix norms
- Review on Gauss method
- Direct methods for linear systems
- Iterative methods for linear systems
- Conditioning of a linear system
- Spectral problems. Power method, inverse power method and deflation method.
- MATLAB and/or SCILAB practical work : solving linear systems

Bibliography :
- G. Allaire, S.M. Kaber. Algèbre linéaire numérique. Ellipses, 2002.
- E. Hairer. consulter la page http ://www.unige.ch/ hairer/polycop.html.
- P. Lascaux, R. Theodor. Analyse numérique matricielle appliquée à l'art de l'ingénieur. Masson, 1987.
- A. Quarteroni, R. Sacco, F. Saleri. Méthodes numériques. Algorithmes, analyse et applications. Springer, 2007.
- M. Schatzmann. Numerical Analysis. A Mathematical Introduction. Oxford University Press, 2002.

Requirements :

Organisation :

Evaluation :
- One written examination (2/3), one practical test and/or a project report (1/3)

Target :

C language	ESM05-INFOC
Number of hours : 22.00 h	1.50 ECTS credit
CM : 6.00 h, TD : 4.00 h, TP : 12.00 h	
Reference Teacher(s) : ARNALDI Bruno	

Objectives :
Basic understanding of the C programming language.
Ability to resolve all common problems.
Find the minimal intersection of needs / C. language.
Writing and comprehension of the code. Syntax and associated semantic.

Content :
1. Introduction to C programming language:
   Introduction.
   Chain of production, from the code source to the executable.

2. Basic C:
   Lexical entities.
   Language syntax.
   Variable declaration.
   Predefined types.
   Operators and expressions.
   General structure of a program.
   Basic input/output.
   Control structures and instructions.
   Fields: 1st form.
   Functions and pass-by-value parameter passing.

3. Advanced C:
   Pointers.
   Functions and pass-by-address parameter passing.
   Standard library functions.
   Memory models for functions and pointers.
   Fields : 2nd form.
   New types and types constructor.
   Explicit type conversion.
   File input/output.
   Allocation class.
   Dynamic Allocation.
   Pointers to functions.

Bibliography :
J.P. BRAQUELAIRE. Méthodologie de la programmation en langage C - Principes et applications. Manuels Informatiques Masson. Masson, 1993.
J.P. BRAQUELAIRE. Méthodologie de la programmation en langage C - Norme C99 - API POSIX. Sciences Sup. Dunod, 2005.
C. DELANOY. Programmer en langage C, avec exercices corrigés. Eyrolles, 1997.
B.W. KERNIGHAN and D.M. RITCHIE. Le langage C. Manuels Informatiques Masson. Masson, 1990.
J.L NEBUT. Le langage C - définition de la norme ANSI. Technical Report Cours C81, IFSIC -Université de Rennes 1, juillet 1989.

Requirements :
Understanding of Algorithms Foundations

Organisation :
Revision of the lecture notes.
6 hours of course, 4 hours of directed work and 12 hours of practical work

Evaluation :
2-hour written examination at the middle of the first semester (documents allowed).

Target :

Business Seminar	DMA05-SE
Number of hours : 26.00 h	1.00 ECTS credit
CM : 26.00 h	
Reference Teacher(s) : GARES Valerie, MONIER Laurent	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
The module will offer (among others) :

- presentations of various career profiles and employment sectors of mathematical engineers ;
- specific mathematical skills (Bayesian networks, sensometry...), computational and software-related skills (specific softwares, computation codes, database management tools for heterogeneous, massive and unstructured data), specific operational skills (clinical trial protocol, banking regulations...) ;
- some awareness to managerial issues (such as business creation, industrial property...) and societal aspects (sustainable development, ethic...) of the profession of engineer.

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery. The obtained mark is independent.

Target :

English	HUM05-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :
Improve expression, comprehension and interaction skills within everyday contexts, with special emphasis on professional and social life.
Language Objectives
Obtain or reinforce B2 level (as required for graduation and defined by CECRL)

Content :
-Action-oriented approach - learning by doing :
students have to listen and speak, write documents while using their problem-solving, reasoning, arguing, and demonstrating capabilities, in an articulate manner.
-Expressing oneself accurately by a rigorous use of syntax and phonology :
Activities requiring creative and reactive skills, ranging from debating, role-playing, individual oral presentations (PowerPoint), projects ... are based on scientific topics and current events.
-Building up specific skills in connection with the working world :
- writing e-mails
- conducting telephone conversations
- technical English
- intercultural contexts
In addition to the English course, a 90-minute remedial course takes place every week (over 10 weeks), in which students can update their various skills (listening and reading, writing, speaking and interacting) in small groups. Remedial classes are compulsory for all students that did poorly in their start-of-term placement test - and optional for those who feel they need to attend. There is no specific assessment for this course.

Bibliography :
- Dictionnaire Robert et Collins bilingue, or Collins Cobuild unilingue
- English Grammar in Use (Cambridge University Press)

Requirements :
A good command of the STPI curriculum is essential : B1/B2

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 students to work in a stimulating environment.
-Teaching resources include press articles, audio and video documents (TV reports, film and series extracts) as well as the Internet.
-Regular personal work is required. Students must be curious and practise their English outside the classroom.

Evaluation :
Two-hour written test.(2/3)
Individual oral presentation in class.(1/3)

Target :

Risk Management. Sustainable Development	HUM05-RISQ
Number of hours : 22.00 h	1.50 ECTS credit
CM : 22.00 h, CM : 22.00 h	
Reference Teacher(s) : GALL Philippe	

Objectives :
To create awareness that the environment in which the engineer works is full of uncertainties and risks. The engineer must nevertheless be in control of his choices and actions within the limits that are defined by acceptable risk in the contemporary context of sustainable development
How do you position yourself as a scientist in relation to the 17 Sustainable Development Goals (SDGs)
Acquire the basics of risk prevention, in particular for healt
Learn about occupational risk prevention
Understand the links between work and health
Understand types of work accident
Professional risk assessment
Application of an occupational health and safety approach
Awareness of the impact of decisions
Talks given by Professionals

Content :
How do you position yourself as a scientist in relation to the 17 Sustainable Development Goals (SDGs)
Acquire the basics of risk prevention, in particular for healt
Learn about occupational risk prevention
Understand the links between work and health
Understand types of work accident
Professional risk assessment
Application of an occupational health and safety approach
Awareness of the impact of decisions
Talks given by Professionals

Bibliography :

Requirements :

Organisation :
Sulitest
2 Modules by distance learning (INRS)
Face to face meetings with professionals
MOOC – OpenClassroom: develop an OHS strategy
Hybrid training alternating face-to-face training and distance learning with validation tests and peer work evaluation

Evaluation :
Tests upon completion of each training module
Grade out of 20 is derived from the Sulitest test, 2 grades out of 10
A module is validated if the grade is superior or equal to 10/20for INRS modules and one grade out of for the MOOC (combining 3 quizzes and a peer evaluation)
_ Le rattrapage ne concerne que l'élément de module ayant une note inférieure à 10/20. La note du module après rattrapage ne peut en aucun cas excéder 10/20.
_ La note de rattrapage est prise en compte dans le calcul de la nouvelle note finale du module uniquement si elle améliore cette note.
Un module non validé (Moyenne finale inférieure à 10/20) peut être acquis par compensation à la fin du semestre si la moyenne générale du semestre (moyenne de tous les modules du semestre en cours) est supérieure ou égale à 10/20.

Target :

Sport and physical Education	HUM05-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h, TD : 24.00 h	
Reference Teacher(s) :	

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 :

German: Confirmed Level	HUMF1-ALL
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

To consolidate secondary school level learning outcomes
To attain, as a basic minimum, the B1 level by the end of the first cycle
To practise written and oral comprehension through the use of contemporary supports and multimedia To develop level of oral expression through exercises in small groups and class discussions
To demonstrate and perfect your skills in German through project work
Support for foreign exchange and work placements

Content :
- Exercises to practise spoken German for everyday situations and professional life
- Study of newspaper articles, broadcasts, videos
- Study of current affairs (politics, economics, sociology and culture) in Germanophone countries
- Introduction to economic and professional German
- Grammar revision
- Cultural openness (film studies, exhibitions, music)

Bibliography :
- DUDEN Bilingual Dictionary (German-French/French-German)
Grammatik Aktiv A1-B1, Cornelsen (mit Audio CD)_- Schritte-Ubungsgrammatik A1-B1, Hueber-Verlag
- Übungsgrammatik für die Grundstufe, Hueber-Verlag (Moodle) - Na also!
Waltraud Legros, Ellipses_- Manuel : Menschen hier, Hueber-Verlag
- Deutsch perfekt (periodical) -
Deutsche Welle/ ZDF logo (web) -
multimedia supports (web)

Requirements :
Intermediate German: B1 level

Organisation :
1h30 per week; 21h face-to-face lessons per semester
Personal Study time: 14h
Total: 35 h

Students are encouraged to regularly read news articles in German and to view videos and film series in addition to work assigned between lessons.

Evaluation :
Basic level : continuous assessment
Intermediate level : continuous assessment
Advanced level : continouous assessment

Target :
S1: Final Grade

Spanish	HUMF1-ESP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : AMARGOS GUILLERAY Marine	

Objectives :
-Practising and strengthening of one's knowledge in the Spanish language and culture (Spanish culture, Spanish and
Latin-American civilizations, societal developments).
- How to manage team projects
- Adapting to multicultural environments
- Understanding social, technological and economical challenges in Spanish-speaking countries.

Content :
Written and oral expression and comprehension.

Bibliography :
1. PASTOR Enrique and PROST Gisèle : "La grammaire active de l'espagnol", Le livre de poche, collection Les Langues modernes.
2. BECHERELLE, "El arte de conjugar en espanol", Hatier.
3. Larousse bilingual dictionary, Le Grand Dictionnaire de Garcia y Pelayo et Testas, Dictionary Hispano Bordas.
4. "Passez-moi l'expression en espagnol", Belin.
5. "El espanol en la prensa", Belin.

Requirements :
B1 level

Organisation :
- Reinforcing grammar / conjugation
- Reading and oral comprehension
- Writing and speaking (debates, drama).

Advice : Read in Spanish : contemporary novels, comics (Tintin, Astérix, Mafalda), magazines (Cambio 16, Epoca, Vocable) available at the library.
Visit the Internet pages of the Spanish and Latin-American newspapers (lavanguardia.es, elpais.es...)
Listen to Spanish National Radio programmes (RNE) on Internet.
Watch TV programmes on RTVE.es.
Read tourist guides on Spanish-speaking countries available at the library.

Evaluation :
Continuous assessment

Target :
3rd, 4th, 5th year

Chinese	HUMF1-CHI
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
To acquire the basics of Chinese, Essential structures and vocabulary, Comprehension, expression ans pronunciation, Use of
everyday Chinese.

Content :
Oral skills : corrective phonetics (pinyin system), listening to and analysis of complex sentences and simple texts, oral
exercises (student-student / student-teacher), introduction of new characters (pronunciation and tone accentuation).
Written skills : prose/translation, written production of complex sentences and simple texts, learning and reinforcement of
grammatical ans vocabulary mechanisms, oral and written Chinese, learning of new characters (order of lines, basic
ideograms), reading and analysis of texts, text commentary.

Bibliography :
1. Le chinois comme en Chine, Bernard Allanic, Presses Universitaires de Rennes, 2009
2. Le chinois contemporain, WU Zhongwei, Sinolingua, 2010
3. Faire l'expérience du chinois, ZHANG Rumei, AI Xin, Higher Education Press, 2006
Other documents will be added to these basic books to provide the students with a wide panel of practical exercises.

Requirements :

Organisation :
Students are required to read the texts from the lessons (in character form), to rewrite the new characters, to work on the
application exercices on grammar, lexical and morphological points, to ask questions on the texts from the lessons, to do prose
and translation exercises.

Evaluation :
Final mark

Target :

Italian	HUMF1-ITA
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : KERSUSAN Sylvia	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Level 1 Beginner :
To introduce the Italian langugae and Italian culture, to express the fundamentals in writing and orally

Level 2 Advanced Beginner:
By the end of the course, students should be able to converse and write in Italian

Level 3 Intermediate:
To enable students to develop further on themes relating to art, civilisation, literature and cinema

Content :
Oral expression and comprehension:
reading with the teacher's guidance on phonetic and grammatical corrections
reading situations in the text, viewing films and reading literary texts and press articles

Written expression and Comprehension:
completing text-based exercises with particular attention to difficulties
summarising situations in available texts and films studied in class

Bibliography :
La lingua italiana per Stranieri 1°, 2°, 3°P K.Katerinov
La prova orale 1,2,3 T.Marin
Texts taken from newspapers and Italian magasines, films by famous film directors

Requirements :
Level 1 Beginner: none
Level 2 Advanced Beginner : to have attended the Italian Beginner lessons
Level3 Intermediate: to have a good knowledge of the Italian language

Organisation :
1h30 of face-face lessons per week; 21h per semester
Personal Study: 14h
To read the photocopied texts provided

Evaluation :
Final grade.

Target :
S1: Final Grade

Japanese	HUMF1-JAP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Niveau débutant (A1):
- awareness of particularities (phonetics, syntax)
- discovery of Japanese culture, traditions, customs
- learning the two systems of writing (Hiragana and Katakana)
- to be able to use spoken Japanese in everyday situations

Intermediate level (A2):
- introduction ideogrammes (60 kanji)
- reading simple texts (with Manga, etc...)
- writing simple texts
- to be able to use spoken Japanese in everyday situations

Advanced level (B1, B2):
- learning kanji (60-200)
- acquiring the four skills (written and oral comprehension, written and oral expression) for travel or study in Japan

Content :
Level 1 Beginner (A1):
- Perfecting Hiragana et Katakana - reading Manga
- Lesson 5: speaking about pastimes
- Lesson 6: using transport
- Lesson 7: shopping
- Lesson 8: expressing feelings

Level 2 Beginner (A2):
- learning 30 kanji - reading Manga
- basic Grammar
- reading and writing simple texts
- learning how to communicate in everyday situations

Intermediate level (B1, B2) :
- learning to use more than 30 kanji
- reading Manga
- acquiring the four skills (written and oral comprehension, written and oral expression)

Bibliography :
Level 1 Beginner (A1): Margot, 3A Network, to be published, Japan.
Level 2 Beginner (A2): Daichi, 1, 3A Network, 2008, Japan.
Level 3 Intermediate (B1, B2): Minna no Nihongo, I et II, 3A Network, 1998, Japan.
+ Satoru Koyama, J. Bridge, Bonjinsha, 2007, Japan.

Requirements :
Level 1: none.
Level 2: to have taken Level A1 Beginner course
Level 3: to have taken Beginner Levels A1 and A2

Organisation :
The teaching follows the TU format.

In each session there is an explanation of the structures which are then illustrated by examples and by exercises and conversation which the students participate in.

Evaluation :
S1: Final Grade

Target :

Russian	HUMF1-RUS
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Russian beginner : acquire A1 level
Russian intermediary : acquire A2/B1 level

Content :
Acquisition of grammatical basis and commonplace vocabulary.
Training of the 5 skills, oral and written comprehension, oral and written expression, interaction.
The stress is put on written and oral communication, firstly in the frame of daily situations, then with a progressive introduction of other themes and opening on the professional communication.
Training with varied media (written, audio, video)
Individual exercices and works in groups, talks from the intermediate level on.
Grammar program depending on the level.
(Inter) cultural opening

Bibliography :
To be seen with the teacher

Requirements :

Organisation :
one hour -and-a-half courses per week in SUPELEc

Evaluation :
Final grade (overseen by SUPELEC).

Target :

Semestre 5

Parcours Formation initiale

1	**DMA05-MATHS**		**MATHEMATICS**	**8.50**
	DMA05-OMB	O	Basic Mathematics Tools	3.00
	DMA05-Proba	O	Probability	3.50
	DMA05-REMED	O	Remediation	2.00
2	**DMA05-MOD**		**MODELLING**	**5.00**
	DMA05-AD	O	Multivariate Data Analysis	2.50
	DMA05-MEDO	O	Modeling with ordinary differential equations	2.50
3	**DMA05-INFOS**		**SCIENTIFIC COMPUTING**	**8.50**
	DMA05-PYTHO	O	Python and Scientific Modules	2.50
	DMA05-ILM	O	Introduction to mathematical software	2.00
	DMA05-MNL	O	Numerical Methods for linear systems	2.50
	ESM05-INFOC	O	C language	1.50
4	**DMA05-SEM**		**SEMINAR**	**1.00**
	DMA05-SE	O	Business Seminar	1.00
5	**HUM05**		**Non-scientific syllabus S5**	**7.00**
	HUM05-RISQ	O	Risk Management. Sustainable Development	1.50
	HUM05-ANGL	O	English	2.00
	HUM05-PSH	O	Human sciences project	2.50
	HUM05-EPS	O	Sport and physical Education	1.00
6	**HUMF1-RIE**		**RIE : Recherche Innovation Entrepreneuriat**	**1.00**
	HUMF1- RI	F	Recherche Innovation	1.00
	HUMF1- IE	F	INNOVATION & ENTREPRENEURSHIP	1.00
7	**HUMF1-ELSA Mus**		**Music with studies**	**1.00**
	HUMF1-MUS	F	Music Studies	1.00

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

Basic Mathematics Tools	DMA05-OMB
Number of hours : 36.00 h	3.00 ECTS credit
CM : 18.00 h, TD : 18.00 h	
Reference Teacher(s) : BRIANE Marc	

Objectives :
This course will provide the basic mathematical tools necessary for the rest of the program.

Content :
LEBESGUE'S INTEGRAL on Rd (9h + 9h)
Definition and properties
Convergence theorems
Integral depending on a parameter
Fubini's theorems
Change of variables theorem

METRIC AND NORMED SPACES (9h + 9h)
Definitions, examples and properties
Complete and compact spaces
Continuityu and uniform continuity
Fixed point theorems

Bibliography :
M. Briane, G. Pagès, Théorie de l'intégration, convolution et transformée de Fourier, ouvrage de cours et d'exercices de Licence et Master de Mathématiques, 7ème édition, De Boeck, 2017.
J.-M. Monier. Analyse MP, Dunod, Paris, 2004.
C. Derschamps, A. Warusfel, J.-F. Ruaud, F. Moulin, J.-C. Sifre, A. Miquel. Mathématiques, tout-en- un, 2ème année MP. Dunod, Paris, 2004.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills.

Organisation :

Evaluation :
One written examination (2h) (1/2) and Continuous assessment (1/2)

Target :

Probability	DMA05-Proba
Number of hours : 44.00 h	3.50 ECTS credit
CM : 18.00 h, TD : 18.00 h, TP : 8.00 h	
Reference Teacher(s) : HERVE Loic	

Objectives :
To understand the various types of convergence of random variables, the basic principles of the conditional expectation, and the Monte Carlo simulation.

Content :
PROBABILITY SPACE ANS RANDOM VARIABLE
- Definition and properties of a probability space
- Real-valued random variables (definition, probability distribution)
- Independent random variables

MATHEMATICAL EXPECTATION OF A RANDOM VARIABLE
- Definition and properties of the expectation value of a real-valued random variable
- Convergence theorems
- Classical inequalities

CONVERGENCE OF A SEQUENCE OF RANDOM VARIABLES
- Convergence in probability and weak law of large numbers
- Almost sure convergence and strong law of large numbers
- Convergence in distribution and central limit theorem

RANDOM VECTORS
- Law of a random vector
- Expectation vector and covariance matrix of a random vector
- Convergence in law for a sequence of random vectors

RANDOM GAUSSIAN VECTORS
- Definition and characteristic function of a Gaussian random vector
- Density function of a Gaussian random vector
- Multi-dimensional central limit theorem
- Properties of Gaussian random vectors

CONDITIONAL EXPECTATION
- Linear regression
- Definition for discrete and absolutely continuous random variables
- Existence and uniqueness theorem (general case)
- Properties of the conditional expectation.

Laboratory work/Project with the software R
- Standard methods for simulation of r.v..
- Illustrations of the convergence of r.v. in probability and statistics

Bibliography :
- N. Bartoli, P. Del Moral. Simulation & Algorithmes stochastiques. Cépaduès, 2001.
- J-P. Delmas. Introduction aux probabilités. Ellipses, 1993.
- D. Foata, J. Franchi, A. Fuchs. Calcul des probabilités. Dunid, 2012. .
- R. Durrett Probability: Theory and Examples, Cambridge Series in Statistical and Probabilistic Mathematics
- C. P Robert, G. casela. Méthodes de Monte-Carlo avec R. Springer, 2011

Requirements :

Organisation :

Evaluation :
- Continuous assessment (Course evaluation) : 50%
- Personal work (solving problems and exercises) : 30%

- Evaluation on practical work/Project : 20%

Target :

Remediation	DMA05-REMED
Number of hours : 24.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 10.00 h	
Reference Teacher(s) : HERVE Loic	

Objectives :
To revise some important results of the mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills (STPI-2A).

Content :
- Linear algebra : matrix reduction, Euclidean space
- Reduction of symmetric matrices and applications to bilinear algebra
- Matrix norm
- Series and generalized integrals,
- Fubini’s theorem for sums and integrals
- Random variables with density
- Differentiation of functions of several Variables.

Bibliography :

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills (STPI-2A).

Organisation :

Evaluation :
Continuous assessment

Target :

Multivariate Data Analysis	DMA05-AD
Number of hours : 26.00 h	2.50 ECTS credit
CM : 10.00 h, TP : 16.00 h	
Reference Teacher(s) : GARES Valerie	

Objectives :
This course will introduce the main methods of multivariate statistical analysis. Students should be able to carry out some multivariate analysis of a dataset using appropriate methods. Students will be able to apply these methods using R software and interpret the results.

Content :
Descriptive statistics
Singular value decomposition Principal component analysis Correspondence analysis Multidimensional scaling
R functions dedicated to data analysis

Bibliography :
T.W. Anderson. An introduction to multivariate statistical analysis. Wiley, 2003.
B. Everitt, T. Hothorn. An introduction to applied multivariate analysis with R. Springer, 2011.
F. Husson et al. Analyse des données avec R. PUR, 2009.
J.D. Jobson. Applied multivariate data analysis. Springer, 1992.
L. Lebart, M. Piron, A. Morineau. Statistique exploratoire multidimensionnelle. Dunod, 2006.

Requirements :
Algebra courses from the undergraduate program of INSA (years 1-2) or equivalent skills. Introduction to mathematical software

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Modeling with ordinary differential equations	DMA05-MEDO
Number of hours : 28.00 h	2.50 ECTS credit
CM : 10.00 h, TD : 10.00 h, TP : 8.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The aim of this course is to introduce the tools and classical techniques to study ordinary differential equations which appear in some models in physics, biology, etc.

Content :
Ordinary Differential Equations (ODE)
Cauchy problem for ODEs
Gronwall Lemma. Existence and uniqueness theorems
Global and maximal solutions
Linear systems of ODEs in the plane
Linearization techniques

Bibliography :
V. Arnold. Équations différentielles ordinaires. MIR, Moscou, 1974.
S. Gourmelen, H. Wadi. Équations différentielles, Herman, 2009.
M.W. Hirsch, S. Smale, R.L. Devaney. Differential equations, Dynamical systems and an introduction to chaos. Elsevier, 2004.
J.-P. Demailly. Analyse numérique et équations différentielles. EDP Sciences, 2006.
M. Braun. Differential equations and their applications. Springer Verlag, 1993.
C. Chicone. Ordinary differential equations with applications. Springer Verlag, 1993.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills.

Organisation :

Evaluation :
1 written examination (2/3) and a practical examination and/or a project (1/3).

Target :

Python and Scientific Modules	DMA05-PYTHO
Number of hours : 26.00 h	2.50 ECTS credit
CM : 6.00 h, TP : 20.00 h	
Reference Teacher(s) : LEPLUMEY Ivan	

Objectives :
The goal of this training module is twofold. First, to provide students with the main elements of the Python language in order to get them autonomous with python coding. Provided lectures emphasis on the "pythonic" way of programming. Second this module makes a wide presentation of the large number of python modules related to science (i.e numpy,scipy,pandas,...) and graphics (i.e matplotlib,..) which are relevant for further work in the curriculum and giving readily data analysis skills. This module proposes different practical applications in two different development environment Spyder and the Ipython notebook. The proposed illustrations borrow example in various domains as : statistical analysis, geodata processing, data visualization, genealogical data processing,...

Content :
Basis of python language
Program structure
Classes (OO basic concepts)
Input/output
Handling text and binary file format
Modular decomposition
Regular expressions
Two different development environment
Interactivity : Ipython Notebook for sequential data analysis
IDE : Spyder
Extension module (mostly scientific purpose)
algebra : PyIMSL Studio, NumPy (the broadcasting concept)
modules scientifiques : SciPy (scipy.stats & scipy.interpolation)
Data vizualization : MatPlotLib
Symbolic calculus : SymPy
Data analysis : Pandas (R like module, Series and DataFrame processing)
GIS : gdal/ogr
Data format : csv, xml, beautifulsoup, json, numpy rich format
IHM : PyQt4
DataBase : psycopg2, SQLite

Bibliography :
E. Bressert. SciPy and NumPy: Optimizing & Boosting Your Python Programming. O'Reilly,2012
W. Chun. Au cœur de Python : Tome 1, Notions fondamentales. Campus Press, 2007.
W. Chun. Au Coeur de Python: Notions Avancées. Campus Press, 2007.
H. Langtangen. Python Scripting for Computational Science (3rd ed.). Springer, 2008.
W. McKinney. Python for Data Analysis. O'Reilly Media, 2012.
M. Lutz. Programming Python. O'Reilly Media, 2011.
G. Swinnen. Apprendre à programmer avec Python 3. Eyrolles, 2012.
M. Summerfield. Programming in Python 3. Addison-Wesley, 2009.
M. Summerfield. Rapid GUI Programming with Python and Qt. Prentice Hall, 2008.
A. Camasayou-Boucau, G. Conan, P. Chauvin. Programmation en Python pour les mathématiques. Dunod, 2012.
S. Tosi. Matplotlib for Python Developers. Packt Publishing Limited, 2009.

Requirements :
Basic knowledge in programming
Undergraduate mathematical background for being comfortable with proposed scientific illustrations.

Organisation :

Evaluation :
An evaluation on Practical work

Target :

Introduction to mathematical software	DMA05-ILM
Number of hours : 24.00 h	2.00 ECTS credit
TP : 24.00 h	
Reference Teacher(s) : CHAGNEAU Pierrette, MONIER Laurent	

Objectives :
The aim of this course is to familiarize students with the language and the programming environment of several mathematical software (Matlab, R).

Content :
Overview of mathematical software (Matlab, R)
User interfaces
Data management (importation, export)
Programming languages
Graphics procedures

Bibliography :
A. Biran, M. Breiner. MATLAB 6 for Engineers. Prentice Hall, 2002, 3th ed.
F. Gustafsson, N. Bergman. MATLAB for Engineers Explained. Springer-Verlag, 2003.
D.J. Higham, N. Higham. MATLAB Guide. SIAM, 2005, 2nd Ed.
T. Lyche, J.L. Merrien. Exercises in Computational Mathematics with MATLAB. Springer-Verlag, 2014.
A. Quarteroni, R. Sacco, F. Saleri. Scientific Computing with MATLAB. Springer-Verlag, 2003.
H.B. Wilson, L.H. Turcotte, D. Halpern. Advanced Mathematics and Mechanics Applications using MATLAB. Chapman and Hall, 2003, 3rd ed.
J. Adler. R-L'essentiel. Pearson, 2011.
P. Lafaye de Micheaux, R. Drouilhet, B. Liquet. Le logiciel R : Maîtriser le langage, Effectuer des analyses statistiques. Springer, 2010.
E. Paradis. R pour les débutants. 2005.

Requirements :
Basic understanding of algorithms and skills in programming languages

Organisation :

Evaluation :
Assignment on practical exercises

Target :

Numerical Methods for linear systems	DMA05-MNL
Number of hours : 30.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 10.00 h, TP : 8.00 h	
Reference Teacher(s) : CAMAR-EDDINE Mohamed	

Objectives :
The aim of this course is to provide numerical tools, methods and algorithms that can be used for solving linear systems of equations and for the computation of eigenvalues and eigenvectors of matrices. At the end of this course, students should be able to implement these methods and also interpret the obtained results.

Content :
- Matrix norms
- Review on Gauss method
- Direct methods for linear systems
- Iterative methods for linear systems
- Conditioning of a linear system
- Spectral problems. Power method, inverse power method and deflation method.
- MATLAB and/or SCILAB practical work : solving linear systems

Bibliography :
- G. Allaire, S.M. Kaber. Algèbre linéaire numérique. Ellipses, 2002.
- E. Hairer. consulter la page http ://www.unige.ch/ hairer/polycop.html.
- P. Lascaux, R. Theodor. Analyse numérique matricielle appliquée à l'art de l'ingénieur. Masson, 1987.
- A. Quarteroni, R. Sacco, F. Saleri. Méthodes numériques. Algorithmes, analyse et applications. Springer, 2007.
- M. Schatzmann. Numerical Analysis. A Mathematical Introduction. Oxford University Press, 2002.

Requirements :

Organisation :

Evaluation :
- One written examination (2/3), one practical test and/or a project report (1/3)

Target :

C language	ESM05-INFOC
Number of hours : 22.00 h	1.50 ECTS credit
CM : 6.00 h, TD : 4.00 h, TP : 12.00 h	
Reference Teacher(s) : ARNALDI Bruno	

Objectives :
Basic understanding of the C programming language.
Ability to resolve all common problems.
Find the minimal intersection of needs / C. language.
Writing and comprehension of the code. Syntax and associated semantic.

Content :
1. Introduction to C programming language:
   Introduction.
   Chain of production, from the code source to the executable.

2. Basic C:
   Lexical entities.
   Language syntax.
   Variable declaration.
   Predefined types.
   Operators and expressions.
   General structure of a program.
   Basic input/output.
   Control structures and instructions.
   Fields: 1st form.
   Functions and pass-by-value parameter passing.

3. Advanced C:
   Pointers.
   Functions and pass-by-address parameter passing.
   Standard library functions.
   Memory models for functions and pointers.
   Fields : 2nd form.
   New types and types constructor.
   Explicit type conversion.
   File input/output.
   Allocation class.
   Dynamic Allocation.
   Pointers to functions.

Bibliography :
J.P. BRAQUELAIRE. Méthodologie de la programmation en langage C - Principes et applications. Manuels Informatiques Masson. Masson, 1993.
J.P. BRAQUELAIRE. Méthodologie de la programmation en langage C - Norme C99 - API POSIX. Sciences Sup. Dunod, 2005.
C. DELANOY. Programmer en langage C, avec exercices corrigés. Eyrolles, 1997.
B.W. KERNIGHAN and D.M. RITCHIE. Le langage C. Manuels Informatiques Masson. Masson, 1990.
J.L NEBUT. Le langage C - définition de la norme ANSI. Technical Report Cours C81, IFSIC -Université de Rennes 1, juillet 1989.

Requirements :
Understanding of Algorithms Foundations

Organisation :
Revision of the lecture notes.
6 hours of course, 4 hours of directed work and 12 hours of practical work

Evaluation :
2-hour written examination at the middle of the first semester (documents allowed).

Target :

Business Seminar	DMA05-SE
Number of hours : 26.00 h	1.00 ECTS credit
CM : 26.00 h	
Reference Teacher(s) : GARES Valerie, MONIER Laurent	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
The module will offer (among others) :

- presentations of various career profiles and employment sectors of mathematical engineers ;
- specific mathematical skills (Bayesian networks, sensometry...), computational and software-related skills (specific softwares, computation codes, database management tools for heterogeneous, massive and unstructured data), specific operational skills (clinical trial protocol, banking regulations...) ;
- some awareness to managerial issues (such as business creation, industrial property...) and societal aspects (sustainable development, ethic...) of the profession of engineer.

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery. The obtained mark is independent.

Target :

Risk Management. Sustainable Development	HUM05-RISQ
Number of hours : 22.00 h	1.50 ECTS credit
CM : 22.00 h, CM : 22.00 h	
Reference Teacher(s) : GALL Philippe	

Objectives :
To create awareness that the environment in which the engineer works is full of uncertainties and risks. The engineer must nevertheless be in control of his choices and actions within the limits that are defined by acceptable risk in the contemporary context of sustainable development
How do you position yourself as a scientist in relation to the 17 Sustainable Development Goals (SDGs)
Acquire the basics of risk prevention, in particular for healt
Learn about occupational risk prevention
Understand the links between work and health
Understand types of work accident
Professional risk assessment
Application of an occupational health and safety approach
Awareness of the impact of decisions
Talks given by Professionals

Content :
How do you position yourself as a scientist in relation to the 17 Sustainable Development Goals (SDGs)
Acquire the basics of risk prevention, in particular for healt
Learn about occupational risk prevention
Understand the links between work and health
Understand types of work accident
Professional risk assessment
Application of an occupational health and safety approach
Awareness of the impact of decisions
Talks given by Professionals

Bibliography :

Requirements :

Organisation :
Sulitest
2 Modules by distance learning (INRS)
Face to face meetings with professionals
MOOC – OpenClassroom: develop an OHS strategy
Hybrid training alternating face-to-face training and distance learning with validation tests and peer work evaluation

Evaluation :
Tests upon completion of each training module
Grade out of 20 is derived from the Sulitest test, 2 grades out of 10
A module is validated if the grade is superior or equal to 10/20for INRS modules and one grade out of for the MOOC (combining 3 quizzes and a peer evaluation)
_ Le rattrapage ne concerne que l'élément de module ayant une note inférieure à 10/20. La note du module après rattrapage ne peut en aucun cas excéder 10/20.
_ La note de rattrapage est prise en compte dans le calcul de la nouvelle note finale du module uniquement si elle améliore cette note.
Un module non validé (Moyenne finale inférieure à 10/20) peut être acquis par compensation à la fin du semestre si la moyenne générale du semestre (moyenne de tous les modules du semestre en cours) est supérieure ou égale à 10/20.

Target :

English	HUM05-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :
Improve expression, comprehension and interaction skills within everyday contexts, with special emphasis on professional and social life.
Language Objectives
Obtain or reinforce B2 level (as required for graduation and defined by CECRL)

Content :
-Action-oriented approach - learning by doing :
students have to listen and speak, write documents while using their problem-solving, reasoning, arguing, and demonstrating capabilities, in an articulate manner.
-Expressing oneself accurately by a rigorous use of syntax and phonology :
Activities requiring creative and reactive skills, ranging from debating, role-playing, individual oral presentations (PowerPoint), projects ... are based on scientific topics and current events.
-Building up specific skills in connection with the working world :
- writing e-mails
- conducting telephone conversations
- technical English
- intercultural contexts
In addition to the English course, a 90-minute remedial course takes place every week (over 10 weeks), in which students can update their various skills (listening and reading, writing, speaking and interacting) in small groups. Remedial classes are compulsory for all students that did poorly in their start-of-term placement test - and optional for those who feel they need to attend. There is no specific assessment for this course.

Bibliography :
- Dictionnaire Robert et Collins bilingue, or Collins Cobuild unilingue
- English Grammar in Use (Cambridge University Press)

Requirements :
A good command of the STPI curriculum is essential : B1/B2

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 students to work in a stimulating environment.
-Teaching resources include press articles, audio and video documents (TV reports, film and series extracts) as well as the Internet.
-Regular personal work is required. Students must be curious and practise their English outside the classroom.

Evaluation :
Two-hour written test.(2/3)
Individual oral presentation in class.(1/3)

Target :

Human sciences project	HUM05-PSH
Number of hours : 26.00 h	2.50 ECTS credit
TD : 26.00 h	
Reference Teacher(s) : ECHARD Philippe	

Objectives :
Conduct a rigorous and synthetic reflection on a given topic dealing with one subject of interest developped by the Specialty Department. .
Learning outcomes expected:
- Knowing how to define a study subject and associate a relevant problematic.
- Knowing how to find relevant information by using the resources available from the Internet
- Knowing how to produce quality communication events and documents (written report, pwpt or prezi presentation, organization of professional meeting)
Knowing how to manage a collective project: planning and coordinating actions to produce documents to be delivered within a given time-limit.

Content :
The students will make up teams and choose a topic that will be approved by the teacher. Their documentary research shall lead to the definition of a problematic and a written report (comprising a synthetic note + commented bibliography + abstract/summary) in accordance with academic requirements.
Methodological gain :
- documentary search on the net. Acquisition of ZOTERO software
- brainstorming techniques and heuristic approach
- problematic definition
- academic-type writing of report or bibiography
- project management technique

Bibliography :
available on-line through the teacher

Requirements :

Organisation :
Alternately methodology courses and progress report sessions of the team projects

Evaluation :
Continuous assessment :
- 1 written report comprising : 1 synthetic note + 1 commented bibliography + abstract/summary)
- 1 oral submission (with pwpt or prezi presentation)

Target :

Sport and physical Education	HUM05-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h, TD : 24.00 h	
Reference Teacher(s) :	

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 :

Recherche Innovation	HUMF1- RI
Number of hours : 8.00 h	1.00 ECTS credit
TD : 8.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

INNOVATION & ENTREPRENEURSHIP	HUMF1- IE
Number of hours : 8.00 h	1.00 ECTS credit
TD : 8.00 h	
Reference Teacher(s) :	

Objectives :
The aim of this module is to inspire future engineers and stimulate their creativity and initiative, by instilling a spirit of entrepreneurship.
Expected skills:
- observe and consider what exists to generate new ideas,
- make the most of the environment to challenge new concepts,
- communicate and federate around an innovative project.

Content :
Using a list of preselected events, the students build their exploration program and choose to attend 1 to 2 events over semester 5.
Students have an academic coach and regularly report on their progress.

Bibliography :
Provided during the course.

Requirements :
None.

Organisation :
Students are encouraged to identify technologies or inspiring trends by taking advantage of events dealing with innovation and entrepreneurship (tradeshows, conferences, etc.).

Evaluation :
Students write post-event reports focusing on inspiring aspects of their experiences.

Target :

Music Studies	HUMF1-MUS
Number of hours : 25.00 h	1.00 ECTS credit
TD : 25.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- working and communicating in a team
- cultural openness
- listening to others
- managing stress

Students have the opportunity to combine their studies with their passion for music. By joining two Jazz and Classical orchestras, they can continue their instrumental practice and also participate in a quality musical training course supervised by teachers from the Rennes Regional Conservatory. Through group practice, they will be able to develop their skills in listening, collaboration and their ability to adapt, all of which are essential to every kind of teamwork. They will participate actively in the cultural life of the school and frequently perform in public. Collective artistic practice within the institution will promote the personal development of the student.

Content :
2h collective lessons per week in the JAZZ et classical music ensembles with instrumental practice
training in chamber music. Participation in festivals and organisation of cultural events at INSA. Several concerts and recitals over the year at INA and externally.

Bibliography :
Musical scores are distributed at the beginning of the year

Requirements :
Good instrumental ability, music studies in conservatory or school of music; ability to read music.
Admission to the programme is based on dossier and an audition organised at the beginning of the year.

Organisation :
2 hours group practice per week

Evaluation :
validation without grade

Target :
INSA students, INP, Centrale/Supélec and external students

Semestre 6

Parcours FISP

1	**DMA06-MATHS**		**MATHEMATICS**	**7.50**
	DMA06-Trans	O	Functional Transforms and Applications	2.50
	DMA06-SI	O	Inferential Statistics	2.50
	DMA06-OC	O	Continious Optimization	2.50
2	**DMA06-MOD**		**MODELLING**	**8.50**
	DMA06-MRL	O	Linear Regression Model	3.00
	DMA06-OD	O	Discrete Optimization	2.50
	DMA06-MM	O	Markov Models	3.00
3	**DMA06-INFOS**		**SCIENTIFIC COMPUTING**	**6.00**
	DMA06-BD	O	Databases	3.00
	DMA06-MNNL	O	Numerical Methods : nonlinear cases	3.00
4	**DMA06-SEM**		**SEMINAR**	**1.00**
	DMA06-SE	O	Business Seminar	1.00
5	**HUM06-ISP**		**Non-scientific syllabus S6**	**6.00**
	HUM06-ANGL	O	English	2.00
	HUM06-IMO	C	Introduction to Operational Management	1.50
	HUM06-IND	C	Introduction au Numérique Durable	1.50
	HUM06-IEB	C	Impact Environnemental des Batiments	1.50
	HUM06-SIM	C	BUSINESS SIMULATION GAME	1.50
	HUM06-EPS	O	Sport and physical Education	1.00
	HUMF2-ESP	C	Spanish	1.50
	HUMF2-CHI	C	Chinese	1.50
	HUMF2-ITA	C	Italian	1.50
	HUMF2-RUS	C	Russian	1.50
	HUMF2-JAP	C	Japanese	1.50
	HUMF2-ALL	C	German	1.50

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

Functional Transforms and Applications	DMA06-Trans
Number of hours : 36.00 h	2.50 ECTS credit
CM : 16.00 h, TD : 16.00 h, TP : 4.00 h	
Reference Teacher(s) : BRIANE Marc	

Objectives :
The aim of the course is to introduce complex analysis tools, and to present classical functional transforms and their applications to solve ordinary differential equations and partial differential equations, and to signal processing.

Content :
Holomorphic functions, Cauchy's formula, formula of residues
Fourier transform and application to solve differential equations
Laplace transform and application to solve equations
Notion of sampling (Shannon's theorem) and Fourier transform of a sampled signal
Discrete Fourier transform and Fast Fourier transform (FFT)

Bibliography :
P. Benoist-Gueutal, M. Courbage. Mathématiques pour la Physique, Tome 1. Eyrolles, 1992.
C. Gasquet, P. Witomski. Analyse de Fourier et applications, filtrage, calcul numérique, ondelette. Masson, 1990.
W. Rudin. Analyse réelle et complexe. Dunod, 2009.

Requirements :
Course « Outils mathématiques de base » (AROM-3A1S).

Organisation :

Evaluation :
One written examination (3/4) and one test on tutorial practises or project (1/4).

Target :

Inferential Statistics	DMA06-SI
Number of hours : 36.00 h	2.50 ECTS credit
CM : 16.00 h, TD : 16.00 h, TP : 4.00 h	
Reference Teacher(s) : LEDOUX James	

Objectives :
This course is intended to familiarize students with fundamental tools of information theory and statistical inference (point estimation, interval estimation, hypothesis testing) in parametric models. Basic concepts of bootstrap will also be introduced. Computational skills with software R will be developed.

Content :
Elements of information theory
Statistical models
Point estimation : moment method and maximum likelihood method
Interval estimation
Hypothesis testing
Resampling by bootstrap
Practical skills with R

Bibliography :
- D. Fourdrinier. Statistique inférentielle. Dunod, 2002.
- M. Lejeune. Statistique. La théorie et ses applications. Springer, 2010.
- A. Monfort. Cours de statistique mathématique. Economica, 1997.
- C. Robert. Le choix bayésien - Principes et pratique. Springer, 2006.
- J. Shao. Mathematical statistics. Springer, 2010.
- P. Tassi. Méthodes statistiques. Economica, 2004.

Requirements :
Probability courses from the undergraduate program of INSA (STPI), courses of “probability” and “Introduction to mathematical softwares” of AROM.

Organisation :
The course will be continuously illustrated with numerous practical examples arising from various application fields (health, services, industry, transport, management).

Evaluation :
One written examination of 2h (75%) and a practical examination and/or project (25%).

Target :
students in mathematical engineering

Continious Optimization	DMA06-OC
Number of hours : 34.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 10.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The goal of this course is to give a general presentation of the problems and methods concerned with numerical continuous optimization (differentiable and non-differentiable problems). The main part of the course is devoted to standard continuous optimization methods and algorithms. In addition to the classical methods, we will introduce some modern proximal algorithms, …

Content :
Linear and nonlinear optimization. Single and multiple variables problems. Optimality conditions and convexity.
Line search methods.
Equality and inequality constrained problems. Descent methods.
Newton type methods. Penalty methods.
Proximal methods.
Duality and lagrangian methods.
Introduction to AMPL, XPRESS, Local solver and practical with MATLAB .

Bibliography :
M. Bergounioux. Optimisation et contrôle des systèmes linéaires. Dunod, 2001.
J.F. Bonnans et al. Optimisation numérique. Aspects théoriques et pratiques. Springer, 1997.
J.F. Bonnans. Optimisation continue, Cours et problèmes corrigés. Dunod, 2006.
J.F. Bonnans et S. Gaubert. Recherche opérationnelle (aspects mathématiques et applications) 2015
M. Minoux. Programmation mathématique. Tec et Doc, 2007.

Requirements :
Courses of “Introduction to mathematical softwares”, ” Discrete optimization” and “numerical Analysis” (3rd year).

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Linear Regression Model	DMA06-MRL
Number of hours : 36.00 h	3.00 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
This course is intended to familiarize students with simple and multiple linear regression modeling, including estimation, model validation, diagnostic checking and interpretation of the outputs of statistical softwares.

Content :
Simple and multiple linear regression models
- Least squares estimation
- The Gaussian linear model
- Statistical inference (estimation, tests)

Model selection and validation
Analysis of variance
Penalized estimation
Practical skills with software R

Bibliography :
- J.-M. Azaïs, J.-M. Bardet. Le modèle linéaire par l'exemple. Dunod, 2012.
- P.-A. Cornillon, E. Matzner-Lober. Regression avec R. Springer, 2010.
- G.A.F. Seber, A.J. Lee. Linear regression analysis. Wiley, 2003.

Requirements :
Algebra courses from the undergraduate program of INSA (STPI), courses of "probability" and "Introduction to mathematical softwares" of AROM.

Organisation :
Practical sessions will be given by an industrial engineer.

Evaluation :
One written examination of 2h (75%) and a practical examination and/or project (25%).

Target :
students in mathematical engineering

Discrete Optimization	DMA06-OD
Number of hours : 28.00 h	2.50 ECTS credit
CM : 10.00 h, TD : 8.00 h, TP : 10.00 h	
Reference Teacher(s) : HADDOU Mounir	

Objectives :
The focus of this course is on the fundamental concepts of discrete optimization and the basics of linear programming. For this, a large majority of the lectures will deal with graph theory: basic definitions, introduction of the most classical polynomial graph problems and the associated solution algorithms, and practical modeling with graphs.
The course will also be an opportunity to introduce notions of computational complexity.

Content :
• Basic definitions and algorithms of graph theory: trees, depth-first and breadth-first searches, optimization algorithms
• Flows, networks and cover trees
• Transportation and assignment problems
• Introduction to linear programming (models and simplex algorithm) and to integer programming models
• Computational practice using Python, and introduction to a mathematical modeling language (AMPL / PuLP / Pyomo)

Bibliography :
[1] M. Gondran, M. Minoux. Graphes et algorithmes. Eyrolles, 1978.
[2] M. Minoux, Programmation mathématique : théorie et algorithmes, 2e édition. 2008.
[3] G. L. Nemhauser and L. A. Wolsey, “Integer and Combinatorial Optimization,” 1999.
[4] R. J. Vanderbei, Linear Programming - Foundations and Extensions, vol. 114. Boston, MA: Springer US, 2008.
[5] R. Faure. Précis de recherche opérationnelle. Dunod, 1979.

Requirements :
First and second year courses of mathematics, skills in programming with Python.

Organisation :

Evaluation :
Final exam (50 %) and project (50 %)

Target :

Markov Models	DMA06-MM
Number of hours : 36.00 h	3.00 ECTS credit
CM : 14.00 h, TD : 12.00 h, TP : 10.00 h	
Reference Teacher(s) : LEDOUX James	

Objectives :
Upon completion of this program, the student will be familiar with discrete time Markov evolutions and their use in simulation, and with basic concepts on partially observed Markov models.

Content :
MARKOV CHAINS WITH DISCRETE STATE SPACE
- Markov dynamics
- Application to stochastic operation research

MARKOV CHAIN MONTE CARLO (MCMC) METHODS
- Metropolis algorithm. Gibbs sampling
- Bayesian inference

HIDDEN MARKOV CHAINS.
- Partially observed models
- Filtering algorithms and MAP estimation

MARKOV CHAINS WITH CONTINUOUS STATE SPACE
- Markov kernel. Some examples.
- Hidden Markov Chains. Linear gaussian model and Kalman filter.

PRACTICAL WORK WITH R SOFTWARE

Bibliography :
P. Brémaud. Markov chains (Gibbs fields, Monte Carlo simulation, and queues). Springer, 1999.
J-F. Delmas, B. Jourdain. Modèles aléatoires : Applications aux sciences de l'ingénieur et du vivant. Springer, 2006.
C. Robert, G. Casella. Monte Carlo statistical methods. Springer, 1999.
B. Séricola. Chaînes de Markov. Hermès, 2003
K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley, 2001.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills; « Introduction to probability » (STPI-2A), « Introduction to mathematical software » and « Probability » (ARO05)

Organisation :

Evaluation :
One written examination , continuous assessment, Practical work/Project.

Target :

Databases	DMA06-BD
Number of hours : 36.00 h	3.00 ECTS credit
CM : 16.00 h, TD : 14.00 h, TP : 6.00 h	
Reference Teacher(s) : CELLIER-BELLINA Peggy	

Objectives :
This course unit has three main objectives. First, it aims to strengthen and extend students' capabilities in the manipulation and modeling of databases (DBs). Second, it focuses on the improvement of performance for relational Database Management Systems (DBMSs). Finally, it introduces the semantic web concepts, in particular the representation of the linked data (RDF) and the query language (SPARQL).

Content :
Databases modeling and manipulation
• Reminders about the creation and manipulation of relational DBs
• Modeling
• Reminders about the entity-relationship modeling
• Normal forms
Performance tuning
• In-depth presentation of fundamental aspects necessary for the practical management of relational DBMSs
• Tuning
Introduction to sematic web
• RDF, RDS
• OWL
• SPARQL

Bibliography :
• M. Jarke, M. Lenzerini, Y. Vassiliou, P. Vassiliadis. Fundamentals of Data Warehouses. Springer-Verlag, 2000.
• G. Gardarin. Bases de données. Eyrolles, 5e tirage, 2003.
• R. Ramakrishnan, J. Gehrke. Database Management Systems. McGraw-Hill Higher Education, 2003.
• XML, langage et applications, A. Michard, Eyrolles, 2000
• XML, des bases de donnÈes aux services Web, G. Gardarin, Dunod, 2002
Le web sémantique, F. Gandon, C. Faron-Zucker, O. Corby, Dunod, 2012

Requirements :
Basics of relational DBMSs (Course: BD 2A).

Organisation :

Evaluation :
A two-hour written examination.

Target :

Numerical Methods : nonlinear cases	DMA06-MNNL
Number of hours : 36.00 h	3.00 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
This course aims at initiate students to basic notions in numerical analysis: compute the approximated solution of non-linear equation
and system of equations, interpolate a sequence of nodes in a plan, numerically approximate the derivatives of a given function,
numerically approximate an integral, numerically solve differential equations with initial conditions.

Content :
- Non linear equations: secant method, Newton method, ...
- Interpolation: Lagrange, splines.
- Numerical integration.
- Differential equations. Approximated resolution of the Cauchy problem: explicit and implicit methods, one step methods,
multi-step methods. Notion of stability.
- Introduction to the Finite Difference method for the Poisson equation.
- Practical work with MATLAB.

Bibliography :
- A. Quarteroni, F. Saleri, P. Gervasio, Calcul Scientifique. Cours, exercices corrigés et illustrations en MATLAB et Octave.
Springer, 2008.
- J. Rappaz, M. Picasso, Introduction à l'analyse numérique. Presses polytechniques et universitaires romandes, 2004.
- F. Filbet, Analyse numérique. Algorithme et étude mathématique. Dunod, 2013.
- T. Lyche, J.L. Merrien, Exercises in Computational Mathematics with MATLAB. Springer, 2014.

Requirements :
- Analysis and Algebra classes from STPI.
- Numerical Methods for linear systems (S5, Camar-Eddine Mohamed).
- Introduction to mathematical software (S5, Chagneau Pierrette, Monier Laurent).
- Modeling with ordinary differential equations (S5, Ley Olivier).

Organisation :

Evaluation :
Written exam (1/2) and pratical evaluation (1/2).

Target :

Business Seminar	DMA06-SE
Number of hours : 20.00 h	1.00 ECTS credit
CM : 20.00 h	
Reference Teacher(s) : GARES Valerie, MONIER Laurent	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
The module will offer (among others) :

- presentations of various career profiles and employment sectors of mathematical engineers ;
- specific mathematical skills (Bayesian networks, sensometry...), computational and software-related skills (specific softwares, computation codes, database management tools for heterogeneous, massive and unstructured data), specific operational skills (clinical trial protocol, banking regulations...) ;
some awareness to managerial issues (such as business creation, industrial property...) and societal aspects (sustainable development, ethic...) of the profession of engineer.

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery . The obtained mark is independent.

Target :

English	HUM06-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :
Improve expression, comprehension and interaction skills within everyday contexts, with special emphasis on professional and social life.
Language Objectives
Obtain or reinforce B2 level (as required for graduation and defined by CECRL)

Content :
-Action-oriented approach - learning by doing :
students have to listen and speak, write documents while using their problem-solving, reasoning, arguing, and demonstrating capabilities, in an articulate manner.
-Expressing oneself accurately by a rigorous use of syntax and phonology :
Activities requiring creative and reactive skills, ranging from debating, role-playing, individual oral presentations (PowerPoint), projects ... are based on scientific topics and current events.
-Building up specific skills in connection with the working world :
- writing e-mails
- conducting telephone conversations
- technical English
- intercultural contexts
In addition to the English course, a 90-minute remedial course takes place every week (over 10 weeks), in which students can update their various skills (listening and reading, writing, speaking and interacting) in small groups. Remedial classes are compulsory for all students that did poorly in their start-of-term placement test - and optional for those who feel they need to attend. There is no specific assessment for this course.

Bibliography :
- Dictionnaire Robert et Collins bilingue, or Collins Cobuild unilingue
- English Grammar in Use (Cambridge University Press)

Requirements :
A good command of the STPI curriculum is essential : B1/B2

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 students to work in a stimulating environment.
-Teaching resources include press articles, audio and video documents (TV reports, film and series extracts) as well as the Internet.
-Regular personal work is required. Students must be curious and practise their English outside the classroom.

Evaluation :
Two-hour written test (50%)
Individual oral presentation (50%)

Target :

Introduction to Operational Management	HUM06-IMO
Number of hours : 24.00 h	1.50 ECTS credit
CM : 10.00 h, TD : 10.00 h, TP : 4.00 h	
Reference Teacher(s) : SORRE Frederic	

Objectives :
A company in its field of application must adopt methods associated with tools, allowing it to manage value creation. This module is an introduction to the notion of operational management (produiction management, quality management, continuous improvement process). This module should enable students to develop a systematic overview of company organisation.

Content :
I - INTRODUCTION:
The aim of a company, changes in socio-economic context, operational excellence, typological analysis, notion of flow and process.

II - PERMANENT PROGRESS:
Notion of waste, the basic tools, processes of problem solving, management of materials.

III – PLANNING AND PILOTING FLOWS:
Planning for component requirement needs, principles of MRP2 (SOP / PIC, MPS / PDP, MRP / CBN), load-capacity management, Concept of ERP.

IV – PLANNING IN THE WORLD OF VUCA: Presentation of DDMRP methodology.

V – OPERATIONAL MANAGEMENT:
Operations Management, Theory of Constraints, Kanban Methods

VI - NOTION OF QUALITY :
Quality tools; statistical control of processes

Bibliography :
Gestion de la production - Blondel - DUNOD
La gestion de production - Bénassy - HERMES
Contrôle de la qualité - Jaupi - DUNOD
Lean Management - Hohmann - Eyrolles

Requirements :

Organisation :

Evaluation :
1 written test (2h) – continuous assessment in PR

Target :

Introduction au Numérique Durable	HUM06-IND
Number of hours : 21.00 h	1.50 ECTS credit
CM : 10.00 h, TA : 5.00 h, TD : 6.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Impact Environnemental des Batiments	HUM06-IEB
Number of hours : 24.00 h	1.50 ECTS credit
TD : 24.00 h	
Reference Teacher(s) : SOMJA Hugues	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

BUSINESS SIMULATION GAME	HUM06-SIM
Number of hours : 16.00 h	1.50 ECTS credit
TD : 16.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :
This course focuses on the complexity of the decision-making process in a company.
Main learning outcomes:
- Understanding information relative to marketing and finance
- The ability to use specific tools and vocabulary in the field of management
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :
The course is mainly focused around a Business simulation, which empowers participants to run their own virtual businesses. Just like in real life, the teams compete against each other in order to gain market shares. The right decisions lead to success while the wrong ones engender invaluable problem solving experiences. The learning process becomes efficient and fun, and allows “learning by doing” as well as “learning from mistakes”.
As an outcome of the simulation exercise, participants will fully comprehend the different aspects of the marketing decision making process, their relationship with each other, and their impact on the company’s overall results. In addition, participants will gain invaluable experience in teamwork and problem solving.
The simulation is based on an online platform that allows students to make some decisions outside the classroom.

Bibliography :
Provided during the course

Requirements :
None

Organisation :
2 hours per week

Evaluation :
Continuous assessment (collective work)

Target :

Sport and physical Education	HUM06-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h	
Reference Teacher(s) :	

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 :

Spanish	HUMF2-ESP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : AMARGOS GUILLERAY Marine	

Objectives :
- Practising and strengthening of one's knowledge in the Spanish language and culture (Spanish culture, Spanish and
Latin- American civilizations, societal developments).
- How to manage team projects
- Acquiring, developing know-how and knowledge in a professional and multicultural environment
- Understanding social, technological and economical challenges in Spanish-speaking countries.

Content :

Bibliography :
1. PASTOR Enrique and PROST Gisèle : "La grammaire active de l'espagnol", Le livre de poche, collection Les Langues modernes.
2. BECHERELLE, "El arte de conjugar en espanol", Hatier.
3. Larousse bilingual dictionary, Le Grand Dictionnaire de Garcia y Pelayo et Testas, Dictionary Hispano Bordas.
4. "Passez-moi l'expression en espagnol", Belin.
5. "El espanol en la prensa", Belin.

Requirements :
B1 level

Organisation :
- Reinforcing grammar / conjugation
- Reading and oral comprehension
- Writing and speaking (debates, drama).

Advice : Read in Spanish : contemporary novels, comics (Tintin, Astérix, Mafalda), magazines (Cambio 16, Epoca, Vocable and Don Balon) available at the library.
Visit the Internet pages of the Spanish and Latin-American newspapers (lavanguardia.es, elpais.es...)
Listen to Spanish National Radio programmes (RNE) on Internet.
Watch TV programmes on RTVE.es.
Read tourist guides on Spanish-speaking countries available at the library.

Evaluation :
15 mn face to face oral

Target :
3rd, 4th, 5th year

Chinese	HUMF2-CHI
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) :	

Objectives :
Objectives, aims:
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

To acquire the basics of the Chinese language in terms of grammatical structures and essential vocabulary
Comprehension, expression, pronunciation
Use of the language in everyday contexts

Content :
Oral skills:
Corrective Phonetics corrective (pinyin system),
Listening and analysis of simple texts and complex phrases
Oral exercises (peer learning / learners with teacher)
Learning new characters (pronunciation and tonal stress)

Writing skills:
Translation (Chinese to French and French to Chinese)
Written production of simple texts and complex phrases
Learning and consolidation of grammatical and lexical structures for oraland written production,
Learning new characters (order of strokes, keys),
Reading and analysis of texts, text commentary

Bibliography :
1. Le chinois comme en Chine, Bernard Allanci, Presses Universitaires de Rennes, 2009_2. Le chinois contemporain, WU Zhongwei, Sinolingua, 2010_3. Faire l'expérience du chinois, ZHANG Rumei, AI Xin, Higher Education Press, 2006
Other tools will complement these basic learning manuals in order to provide students witha wide range of practical exercises

Requirements :
Chinois 1 : none
Chinois 2 : to have attended lessons in Chinois 1
Chinois 3 : to have attended lessons in Chinois 2

Organisation :
Reading lesson text materials (in characters), rewriting new characters, applied exercises on grammatical points, lexical points and morphology
Exercises in translation: from Chinese to French and French to Chinese
19 h TU equivalent in STPI

Evaluation :
S2 : Oral

Target :
Engineering students

Italian	HUMF2-ITA
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : KERSUSAN Sylvia	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Level 1 Beginner :
To introduce the Italian langugae and Italian culture, to express the fundamentals in writing and orally

Level 2 Advanced Beginner:
By the end of the course, students should be able to converse and write in Italian

Level 3 Intermediate:
To enable students to develop further on themes relating to art, civilisation, literature and cinema

Content :
Oral expression and comprehension:
reading with the teacher's guidance on phonetic and grammatical corrections
reading situations in the text, viewing films and reading literary texts and press articles

Written expression and Comprehension:
completing text-based exercises with particular attention to difficulties
summarising situations in available texts and films studied in class

Bibliography :
La lingua italiana per Stranieri 1°, 2°, 3°P K.Katerinov
La prova orale 1,2,3 T.Marin
Texts taken from newspapers and Italian magasines, films by famous film directors

Requirements :
Level 1 Beginner: none
Level 2 Advanced Beginner : to have attended the Italian Beginner lessons
Level3 Intermediate: to have a good knowledge of the Italian language

Organisation :
1h30 of face-face lessons per week; 21h per semester
Personal Study: 14h
To read the photocopied texts provided

Evaluation :
S2 : Oral

Target :
Engineering students

Russian	HUMF2-RUS
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
According to level: Beginners (A1), Intermediate (A2/B1), Advanced (B1-B2). Help the students to progress autonomously.

Content :
Written and oral communication. Firstly in everyday life situations, and secondly in other fields such as professional topics.
-Films and book extracts are used as a learning aid
-Individual exercices and group work, oral presentations for intermediates
-Grammar
-Cinema, literature and civilization.

Bibliography :

Requirements :

Organisation :
Classes take place at SUPELEC (Campus de Beaulieu)

Evaluation :
Final grade (overseen by SUPELEC).

Target :

Japanese	HUMF2-JAP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Niveau débutant (A1):
- awareness of particularities (phonetics, syntax)
- discovery of Japanese culture, traditions, customs
- learning the two systems of writing (Hiragana and Katakana)
- to be able to use spoken Japanese in everyday situations

Intermediate level (A2):
- introduction ideogrammes (60 kanji)
- reading simple texts (with Manga, etc...)
- writing simple texts
- to be able to use spoken Japanese in everyday situations

Advanced level (B1, B2):
- learning kanji (60-200)
- acquiring the four skills (written and oral comprehension, written and oral expression) for travel or study in Japan

Content :
Level 1 Beginner (A1):
- Perfecting Hiragana et Katakana - reading Manga
- Lesson 5: speaking about pastimes
- Lesson 6: using transport
- Lesson 7: shopping
- Lesson 8: expressing feelings

Level 2 Beginner (A2):
- learning 30 kanji - reading Manga
- basic Grammar
- reading and writing simple texts
- learning how to communicate in everyday situations

Intermediate level (B1, B2) :
- learning to use more than 30 kanji
- reading Manga
- acquiring the four skills (written and oral comprehension, written and oral expression)

Bibliography :
Level 1 Beginner (A1): Margot, 3A Network, to be published, Japan.
Level 2 Beginner (A2): Daichi, 1, 3A Network, 2008, Japan.
Level 3 Intermediate (B1, B2): Minna no Nihongo, I et II, 3A Network, 1998, Japan.
+ Satoru Koyama, J. Bridge, Bonjinsha, 2007, Japan.

Requirements :
Level 1: none.
Level 2: to have taken Level A1 Beginner course
Level 3: to have taken Beginner Levels A1 and A2

Organisation :
The teaching follows the TU format.

In each session there is an explanation of the structures which are then illustrated by examples and by exercises and conversation which the students participate in.

Evaluation :
S2 : Oral

Target :
Engineering students

German	HUMF2-ALL
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

To consolidate secondary school level learning outcomes
To attain, as a basic minimum, the B1 level by the end of the first cycle
To practise written and oral comprehension through the use of contemporary supports and multimedia
To develop level of oral expression through exercises in small groups and class discussions
To demonstrate and perfect your skills in German through project work
Support for foreign exchange and work placements

Content :
Contents:
- Exercises to practise spoken German for everyday situations and professional life
- Study of newspaper articles, broadcasts, videos
- Study of current affairs (politics, economics, sociology and culture) in Germanophone countries
- Introduction to economic and professional German
- Grammar revision
- Cultural openness (film studies, exhibitions, music)

Bibliography :
(available in the INSA Rennes library):
- DUDEN Bilingual Dictionary (German-French/French-German)
Grammatik Aktiv A1-B1, Cornelsen (mit Audio CD)_- Schritte-Ubungsgrammatik A1-B1, Hueber-Verlag
- Übungsgrammatik für die Grundstufe, Hueber-Verlag (Moodle) - Na also!
Waltraud Legros, Ellipses_- Manuel : Menschen hier, Hueber-Verlag
- Deutsch perfekt (periodical) -
Deutsche Welle/ ZDF logo (web) -
multimedia supports (web)

Requirements :
Intermediate German: B1 level

Organisation :
1h30 per week; 21h face-to-face lessons per semester
Personal Study time: 14h
Total: 35 h

Students are encouraged to regularly read news articles in German and to view videos and film series in addition to work assigned between lessons.

Evaluation :
S2 : Oral

Target :
Engineering students

INSA RENNES - Mathématiques appliquées (MA) : 2023/2024

Semestre 6

Parcours FISP-Risq

1	**DMA06-MATHS**		**MATHEMATICS**	**7.50**
	DMA06-Trans	O	Functional Transforms and Applications	2.50
	DMA06-SI	O	Inferential Statistics	2.50
	DMA06-OC	O	Continious Optimization	2.50
2	**DMA06-MOD**		**MODELLING**	**8.50**
	DMA06-MRL	O	Linear Regression Model	3.00
	DMA06-OD	O	Discrete Optimization	2.50
	DMA06-MM	O	Markov Models	3.00
3	**DMA06-INFOS**		**SCIENTIFIC COMPUTING**	**6.00**
	DMA06-BD	O	Databases	3.00
	DMA06-MNNL	O	Numerical Methods : nonlinear cases	3.00
4	**DMA06-SEM**		**SEMINAR**	**1.00**
	DMA06-SE	O	Business Seminar	1.00
5	**HUM06-ISP**		**Non-scientific syllabus S6**	**6.00**
	HUM06-ANGL	O	English	2.00
	HUM06-IMO	C	Introduction to Operational Management	1.50
	HUM06-IND	C	Introduction au Numérique Durable	1.50
	HUM06-IEB	C	Impact Environnemental des Batiments	1.50
	HUM06-SIM	C	BUSINESS SIMULATION GAME	1.50
	HUM06-EPS	O	Sport and physical Education	1.00
	HUMF2-ESP	C	Spanish	1.50
	HUMF2-CHI	C	Chinese	1.50
	HUMF2-ITA	C	Italian	1.50
	HUMF2-RUS	C	Russian	1.50
	HUMF2-JAP	C	Japanese	1.50
	HUMF2-ALL	C	German	1.50

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

Functional Transforms and Applications	DMA06-Trans
Number of hours : 36.00 h	2.50 ECTS credit
CM : 16.00 h, TD : 16.00 h, TP : 4.00 h	
Reference Teacher(s) : BRIANE Marc	

Objectives :
The aim of the course is to introduce complex analysis tools, and to present classical functional transforms and their applications to solve ordinary differential equations and partial differential equations, and to signal processing.

Content :
Holomorphic functions, Cauchy's formula, formula of residues
Fourier transform and application to solve differential equations
Laplace transform and application to solve equations
Notion of sampling (Shannon's theorem) and Fourier transform of a sampled signal
Discrete Fourier transform and Fast Fourier transform (FFT)

Bibliography :
P. Benoist-Gueutal, M. Courbage. Mathématiques pour la Physique, Tome 1. Eyrolles, 1992.
C. Gasquet, P. Witomski. Analyse de Fourier et applications, filtrage, calcul numérique, ondelette. Masson, 1990.
W. Rudin. Analyse réelle et complexe. Dunod, 2009.

Requirements :
Course « Outils mathématiques de base » (AROM-3A1S).

Organisation :

Evaluation :
One written examination (3/4) and one test on tutorial practises or project (1/4).

Target :

Inferential Statistics	DMA06-SI
Number of hours : 36.00 h	2.50 ECTS credit
CM : 16.00 h, TD : 16.00 h, TP : 4.00 h	
Reference Teacher(s) : LEDOUX James	

Objectives :
This course is intended to familiarize students with fundamental tools of information theory and statistical inference (point estimation, interval estimation, hypothesis testing) in parametric models. Basic concepts of bootstrap will also be introduced. Computational skills with software R will be developed.

Content :
Elements of information theory
Statistical models
Point estimation : moment method and maximum likelihood method
Interval estimation
Hypothesis testing
Resampling by bootstrap
Practical skills with R

Bibliography :
- D. Fourdrinier. Statistique inférentielle. Dunod, 2002.
- M. Lejeune. Statistique. La théorie et ses applications. Springer, 2010.
- A. Monfort. Cours de statistique mathématique. Economica, 1997.
- C. Robert. Le choix bayésien - Principes et pratique. Springer, 2006.
- J. Shao. Mathematical statistics. Springer, 2010.
- P. Tassi. Méthodes statistiques. Economica, 2004.

Requirements :
Probability courses from the undergraduate program of INSA (STPI), courses of “probability” and “Introduction to mathematical softwares” of AROM.

Organisation :
The course will be continuously illustrated with numerous practical examples arising from various application fields (health, services, industry, transport, management).

Evaluation :
One written examination of 2h (75%) and a practical examination and/or project (25%).

Target :
students in mathematical engineering

Continious Optimization	DMA06-OC
Number of hours : 34.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 10.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The goal of this course is to give a general presentation of the problems and methods concerned with numerical continuous optimization (differentiable and non-differentiable problems). The main part of the course is devoted to standard continuous optimization methods and algorithms. In addition to the classical methods, we will introduce some modern proximal algorithms, …

Content :
Linear and nonlinear optimization. Single and multiple variables problems. Optimality conditions and convexity.
Line search methods.
Equality and inequality constrained problems. Descent methods.
Newton type methods. Penalty methods.
Proximal methods.
Duality and lagrangian methods.
Introduction to AMPL, XPRESS, Local solver and practical with MATLAB .

Bibliography :
M. Bergounioux. Optimisation et contrôle des systèmes linéaires. Dunod, 2001.
J.F. Bonnans et al. Optimisation numérique. Aspects théoriques et pratiques. Springer, 1997.
J.F. Bonnans. Optimisation continue, Cours et problèmes corrigés. Dunod, 2006.
J.F. Bonnans et S. Gaubert. Recherche opérationnelle (aspects mathématiques et applications) 2015
M. Minoux. Programmation mathématique. Tec et Doc, 2007.

Requirements :
Courses of “Introduction to mathematical softwares”, ” Discrete optimization” and “numerical Analysis” (3rd year).

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Linear Regression Model	DMA06-MRL
Number of hours : 36.00 h	3.00 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
This course is intended to familiarize students with simple and multiple linear regression modeling, including estimation, model validation, diagnostic checking and interpretation of the outputs of statistical softwares.

Content :
Simple and multiple linear regression models
- Least squares estimation
- The Gaussian linear model
- Statistical inference (estimation, tests)

Model selection and validation
Analysis of variance
Penalized estimation
Practical skills with software R

Bibliography :
- J.-M. Azaïs, J.-M. Bardet. Le modèle linéaire par l'exemple. Dunod, 2012.
- P.-A. Cornillon, E. Matzner-Lober. Regression avec R. Springer, 2010.
- G.A.F. Seber, A.J. Lee. Linear regression analysis. Wiley, 2003.

Requirements :
Algebra courses from the undergraduate program of INSA (STPI), courses of "probability" and "Introduction to mathematical softwares" of AROM.

Organisation :
Practical sessions will be given by an industrial engineer.

Evaluation :
One written examination of 2h (75%) and a practical examination and/or project (25%).

Target :
students in mathematical engineering

Discrete Optimization	DMA06-OD
Number of hours : 28.00 h	2.50 ECTS credit
CM : 10.00 h, TD : 8.00 h, TP : 10.00 h	
Reference Teacher(s) : HADDOU Mounir	

Objectives :
The focus of this course is on the fundamental concepts of discrete optimization and the basics of linear programming. For this, a large majority of the lectures will deal with graph theory: basic definitions, introduction of the most classical polynomial graph problems and the associated solution algorithms, and practical modeling with graphs.
The course will also be an opportunity to introduce notions of computational complexity.

Content :
• Basic definitions and algorithms of graph theory: trees, depth-first and breadth-first searches, optimization algorithms
• Flows, networks and cover trees
• Transportation and assignment problems
• Introduction to linear programming (models and simplex algorithm) and to integer programming models
• Computational practice using Python, and introduction to a mathematical modeling language (AMPL / PuLP / Pyomo)

Bibliography :
[1] M. Gondran, M. Minoux. Graphes et algorithmes. Eyrolles, 1978.
[2] M. Minoux, Programmation mathématique : théorie et algorithmes, 2e édition. 2008.
[3] G. L. Nemhauser and L. A. Wolsey, “Integer and Combinatorial Optimization,” 1999.
[4] R. J. Vanderbei, Linear Programming - Foundations and Extensions, vol. 114. Boston, MA: Springer US, 2008.
[5] R. Faure. Précis de recherche opérationnelle. Dunod, 1979.

Requirements :
First and second year courses of mathematics, skills in programming with Python.

Organisation :

Evaluation :
Final exam (50 %) and project (50 %)

Target :

Markov Models	DMA06-MM
Number of hours : 36.00 h	3.00 ECTS credit
CM : 14.00 h, TD : 12.00 h, TP : 10.00 h	
Reference Teacher(s) : LEDOUX James	

Objectives :
Upon completion of this program, the student will be familiar with discrete time Markov evolutions and their use in simulation, and with basic concepts on partially observed Markov models.

Content :
MARKOV CHAINS WITH DISCRETE STATE SPACE
- Markov dynamics
- Application to stochastic operation research

MARKOV CHAIN MONTE CARLO (MCMC) METHODS
- Metropolis algorithm. Gibbs sampling
- Bayesian inference

HIDDEN MARKOV CHAINS.
- Partially observed models
- Filtering algorithms and MAP estimation

MARKOV CHAINS WITH CONTINUOUS STATE SPACE
- Markov kernel. Some examples.
- Hidden Markov Chains. Linear gaussian model and Kalman filter.

PRACTICAL WORK WITH R SOFTWARE

Bibliography :
P. Brémaud. Markov chains (Gibbs fields, Monte Carlo simulation, and queues). Springer, 1999.
J-F. Delmas, B. Jourdain. Modèles aléatoires : Applications aux sciences de l'ingénieur et du vivant. Springer, 2006.
C. Robert, G. Casella. Monte Carlo statistical methods. Springer, 1999.
B. Séricola. Chaînes de Markov. Hermès, 2003
K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley, 2001.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills; « Introduction to probability » (STPI-2A), « Introduction to mathematical software » and « Probability » (ARO05)

Organisation :

Evaluation :
One written examination , continuous assessment, Practical work/Project.

Target :

Databases	DMA06-BD
Number of hours : 36.00 h	3.00 ECTS credit
CM : 16.00 h, TD : 14.00 h, TP : 6.00 h	
Reference Teacher(s) : CELLIER-BELLINA Peggy	

Objectives :
This course unit has three main objectives. First, it aims to strengthen and extend students' capabilities in the manipulation and modeling of databases (DBs). Second, it focuses on the improvement of performance for relational Database Management Systems (DBMSs). Finally, it introduces the semantic web concepts, in particular the representation of the linked data (RDF) and the query language (SPARQL).

Content :
Databases modeling and manipulation
• Reminders about the creation and manipulation of relational DBs
• Modeling
• Reminders about the entity-relationship modeling
• Normal forms
Performance tuning
• In-depth presentation of fundamental aspects necessary for the practical management of relational DBMSs
• Tuning
Introduction to sematic web
• RDF, RDS
• OWL
• SPARQL

Bibliography :
• M. Jarke, M. Lenzerini, Y. Vassiliou, P. Vassiliadis. Fundamentals of Data Warehouses. Springer-Verlag, 2000.
• G. Gardarin. Bases de données. Eyrolles, 5e tirage, 2003.
• R. Ramakrishnan, J. Gehrke. Database Management Systems. McGraw-Hill Higher Education, 2003.
• XML, langage et applications, A. Michard, Eyrolles, 2000
• XML, des bases de donnÈes aux services Web, G. Gardarin, Dunod, 2002
Le web sémantique, F. Gandon, C. Faron-Zucker, O. Corby, Dunod, 2012

Requirements :
Basics of relational DBMSs (Course: BD 2A).

Organisation :

Evaluation :
A two-hour written examination.

Target :

Numerical Methods : nonlinear cases	DMA06-MNNL
Number of hours : 36.00 h	3.00 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
This course aims at initiate students to basic notions in numerical analysis: compute the approximated solution of non-linear equation
and system of equations, interpolate a sequence of nodes in a plan, numerically approximate the derivatives of a given function,
numerically approximate an integral, numerically solve differential equations with initial conditions.

Content :
- Non linear equations: secant method, Newton method, ...
- Interpolation: Lagrange, splines.
- Numerical integration.
- Differential equations. Approximated resolution of the Cauchy problem: explicit and implicit methods, one step methods,
multi-step methods. Notion of stability.
- Introduction to the Finite Difference method for the Poisson equation.
- Practical work with MATLAB.

Bibliography :
- A. Quarteroni, F. Saleri, P. Gervasio, Calcul Scientifique. Cours, exercices corrigés et illustrations en MATLAB et Octave.
Springer, 2008.
- J. Rappaz, M. Picasso, Introduction à l'analyse numérique. Presses polytechniques et universitaires romandes, 2004.
- F. Filbet, Analyse numérique. Algorithme et étude mathématique. Dunod, 2013.
- T. Lyche, J.L. Merrien, Exercises in Computational Mathematics with MATLAB. Springer, 2014.

Requirements :
- Analysis and Algebra classes from STPI.
- Numerical Methods for linear systems (S5, Camar-Eddine Mohamed).
- Introduction to mathematical software (S5, Chagneau Pierrette, Monier Laurent).
- Modeling with ordinary differential equations (S5, Ley Olivier).

Organisation :

Evaluation :
Written exam (1/2) and pratical evaluation (1/2).

Target :

Business Seminar	DMA06-SE
Number of hours : 20.00 h	1.00 ECTS credit
CM : 20.00 h	
Reference Teacher(s) : GARES Valerie, MONIER Laurent	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
The module will offer (among others) :

- presentations of various career profiles and employment sectors of mathematical engineers ;
- specific mathematical skills (Bayesian networks, sensometry...), computational and software-related skills (specific softwares, computation codes, database management tools for heterogeneous, massive and unstructured data), specific operational skills (clinical trial protocol, banking regulations...) ;
some awareness to managerial issues (such as business creation, industrial property...) and societal aspects (sustainable development, ethic...) of the profession of engineer.

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery . The obtained mark is independent.

Target :

English	HUM06-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :
Improve expression, comprehension and interaction skills within everyday contexts, with special emphasis on professional and social life.
Language Objectives
Obtain or reinforce B2 level (as required for graduation and defined by CECRL)

Content :
-Action-oriented approach - learning by doing :
students have to listen and speak, write documents while using their problem-solving, reasoning, arguing, and demonstrating capabilities, in an articulate manner.
-Expressing oneself accurately by a rigorous use of syntax and phonology :
Activities requiring creative and reactive skills, ranging from debating, role-playing, individual oral presentations (PowerPoint), projects ... are based on scientific topics and current events.
-Building up specific skills in connection with the working world :
- writing e-mails
- conducting telephone conversations
- technical English
- intercultural contexts
In addition to the English course, a 90-minute remedial course takes place every week (over 10 weeks), in which students can update their various skills (listening and reading, writing, speaking and interacting) in small groups. Remedial classes are compulsory for all students that did poorly in their start-of-term placement test - and optional for those who feel they need to attend. There is no specific assessment for this course.

Bibliography :
- Dictionnaire Robert et Collins bilingue, or Collins Cobuild unilingue
- English Grammar in Use (Cambridge University Press)

Requirements :
A good command of the STPI curriculum is essential : B1/B2

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 students to work in a stimulating environment.
-Teaching resources include press articles, audio and video documents (TV reports, film and series extracts) as well as the Internet.
-Regular personal work is required. Students must be curious and practise their English outside the classroom.

Evaluation :
Two-hour written test (50%)
Individual oral presentation (50%)

Target :

Introduction to Operational Management	HUM06-IMO
Number of hours : 24.00 h	1.50 ECTS credit
CM : 10.00 h, TD : 10.00 h, TP : 4.00 h	
Reference Teacher(s) : SORRE Frederic	

Objectives :
A company in its field of application must adopt methods associated with tools, allowing it to manage value creation. This module is an introduction to the notion of operational management (produiction management, quality management, continuous improvement process). This module should enable students to develop a systematic overview of company organisation.

Content :
I - INTRODUCTION:
The aim of a company, changes in socio-economic context, operational excellence, typological analysis, notion of flow and process.

II - PERMANENT PROGRESS:
Notion of waste, the basic tools, processes of problem solving, management of materials.

III – PLANNING AND PILOTING FLOWS:
Planning for component requirement needs, principles of MRP2 (SOP / PIC, MPS / PDP, MRP / CBN), load-capacity management, Concept of ERP.

IV – PLANNING IN THE WORLD OF VUCA: Presentation of DDMRP methodology.

V – OPERATIONAL MANAGEMENT:
Operations Management, Theory of Constraints, Kanban Methods

VI - NOTION OF QUALITY :
Quality tools; statistical control of processes

Bibliography :
Gestion de la production - Blondel - DUNOD
La gestion de production - Bénassy - HERMES
Contrôle de la qualité - Jaupi - DUNOD
Lean Management - Hohmann - Eyrolles

Requirements :

Organisation :

Evaluation :
1 written test (2h) – continuous assessment in PR

Target :

Introduction au Numérique Durable	HUM06-IND
Number of hours : 21.00 h	1.50 ECTS credit
CM : 10.00 h, TA : 5.00 h, TD : 6.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Impact Environnemental des Batiments	HUM06-IEB
Number of hours : 24.00 h	1.50 ECTS credit
TD : 24.00 h	
Reference Teacher(s) : SOMJA Hugues	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

BUSINESS SIMULATION GAME	HUM06-SIM
Number of hours : 16.00 h	1.50 ECTS credit
TD : 16.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :
This course focuses on the complexity of the decision-making process in a company.
Main learning outcomes:
- Understanding information relative to marketing and finance
- The ability to use specific tools and vocabulary in the field of management
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :
The course is mainly focused around a Business simulation, which empowers participants to run their own virtual businesses. Just like in real life, the teams compete against each other in order to gain market shares. The right decisions lead to success while the wrong ones engender invaluable problem solving experiences. The learning process becomes efficient and fun, and allows “learning by doing” as well as “learning from mistakes”.
As an outcome of the simulation exercise, participants will fully comprehend the different aspects of the marketing decision making process, their relationship with each other, and their impact on the company’s overall results. In addition, participants will gain invaluable experience in teamwork and problem solving.
The simulation is based on an online platform that allows students to make some decisions outside the classroom.

Bibliography :
Provided during the course

Requirements :
None

Organisation :
2 hours per week

Evaluation :
Continuous assessment (collective work)

Target :

Sport and physical Education	HUM06-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h	
Reference Teacher(s) :	

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 :

Spanish	HUMF2-ESP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : AMARGOS GUILLERAY Marine	

Objectives :
- Practising and strengthening of one's knowledge in the Spanish language and culture (Spanish culture, Spanish and
Latin- American civilizations, societal developments).
- How to manage team projects
- Acquiring, developing know-how and knowledge in a professional and multicultural environment
- Understanding social, technological and economical challenges in Spanish-speaking countries.

Content :

Bibliography :
1. PASTOR Enrique and PROST Gisèle : "La grammaire active de l'espagnol", Le livre de poche, collection Les Langues modernes.
2. BECHERELLE, "El arte de conjugar en espanol", Hatier.
3. Larousse bilingual dictionary, Le Grand Dictionnaire de Garcia y Pelayo et Testas, Dictionary Hispano Bordas.
4. "Passez-moi l'expression en espagnol", Belin.
5. "El espanol en la prensa", Belin.

Requirements :
B1 level

Organisation :
- Reinforcing grammar / conjugation
- Reading and oral comprehension
- Writing and speaking (debates, drama).

Advice : Read in Spanish : contemporary novels, comics (Tintin, Astérix, Mafalda), magazines (Cambio 16, Epoca, Vocable and Don Balon) available at the library.
Visit the Internet pages of the Spanish and Latin-American newspapers (lavanguardia.es, elpais.es...)
Listen to Spanish National Radio programmes (RNE) on Internet.
Watch TV programmes on RTVE.es.
Read tourist guides on Spanish-speaking countries available at the library.

Evaluation :
15 mn face to face oral

Target :
3rd, 4th, 5th year

Chinese	HUMF2-CHI
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) :	

Objectives :
Objectives, aims:
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

To acquire the basics of the Chinese language in terms of grammatical structures and essential vocabulary
Comprehension, expression, pronunciation
Use of the language in everyday contexts

Content :
Oral skills:
Corrective Phonetics corrective (pinyin system),
Listening and analysis of simple texts and complex phrases
Oral exercises (peer learning / learners with teacher)
Learning new characters (pronunciation and tonal stress)

Writing skills:
Translation (Chinese to French and French to Chinese)
Written production of simple texts and complex phrases
Learning and consolidation of grammatical and lexical structures for oraland written production,
Learning new characters (order of strokes, keys),
Reading and analysis of texts, text commentary

Bibliography :
1. Le chinois comme en Chine, Bernard Allanci, Presses Universitaires de Rennes, 2009_2. Le chinois contemporain, WU Zhongwei, Sinolingua, 2010_3. Faire l'expérience du chinois, ZHANG Rumei, AI Xin, Higher Education Press, 2006
Other tools will complement these basic learning manuals in order to provide students witha wide range of practical exercises

Requirements :
Chinois 1 : none
Chinois 2 : to have attended lessons in Chinois 1
Chinois 3 : to have attended lessons in Chinois 2

Organisation :
Reading lesson text materials (in characters), rewriting new characters, applied exercises on grammatical points, lexical points and morphology
Exercises in translation: from Chinese to French and French to Chinese
19 h TU equivalent in STPI

Evaluation :
S2 : Oral

Target :
Engineering students

Italian	HUMF2-ITA
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : KERSUSAN Sylvia	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Level 1 Beginner :
To introduce the Italian langugae and Italian culture, to express the fundamentals in writing and orally

Level 2 Advanced Beginner:
By the end of the course, students should be able to converse and write in Italian

Level 3 Intermediate:
To enable students to develop further on themes relating to art, civilisation, literature and cinema

Content :
Oral expression and comprehension:
reading with the teacher's guidance on phonetic and grammatical corrections
reading situations in the text, viewing films and reading literary texts and press articles

Written expression and Comprehension:
completing text-based exercises with particular attention to difficulties
summarising situations in available texts and films studied in class

Bibliography :
La lingua italiana per Stranieri 1°, 2°, 3°P K.Katerinov
La prova orale 1,2,3 T.Marin
Texts taken from newspapers and Italian magasines, films by famous film directors

Requirements :
Level 1 Beginner: none
Level 2 Advanced Beginner : to have attended the Italian Beginner lessons
Level3 Intermediate: to have a good knowledge of the Italian language

Organisation :
1h30 of face-face lessons per week; 21h per semester
Personal Study: 14h
To read the photocopied texts provided

Evaluation :
S2 : Oral

Target :
Engineering students

Russian	HUMF2-RUS
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
According to level: Beginners (A1), Intermediate (A2/B1), Advanced (B1-B2). Help the students to progress autonomously.

Content :
Written and oral communication. Firstly in everyday life situations, and secondly in other fields such as professional topics.
-Films and book extracts are used as a learning aid
-Individual exercices and group work, oral presentations for intermediates
-Grammar
-Cinema, literature and civilization.

Bibliography :

Requirements :

Organisation :
Classes take place at SUPELEC (Campus de Beaulieu)

Evaluation :
Final grade (overseen by SUPELEC).

Target :

Japanese	HUMF2-JAP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Niveau débutant (A1):
- awareness of particularities (phonetics, syntax)
- discovery of Japanese culture, traditions, customs
- learning the two systems of writing (Hiragana and Katakana)
- to be able to use spoken Japanese in everyday situations

Intermediate level (A2):
- introduction ideogrammes (60 kanji)
- reading simple texts (with Manga, etc...)
- writing simple texts
- to be able to use spoken Japanese in everyday situations

Advanced level (B1, B2):
- learning kanji (60-200)
- acquiring the four skills (written and oral comprehension, written and oral expression) for travel or study in Japan

Content :
Level 1 Beginner (A1):
- Perfecting Hiragana et Katakana - reading Manga
- Lesson 5: speaking about pastimes
- Lesson 6: using transport
- Lesson 7: shopping
- Lesson 8: expressing feelings

Level 2 Beginner (A2):
- learning 30 kanji - reading Manga
- basic Grammar
- reading and writing simple texts
- learning how to communicate in everyday situations

Intermediate level (B1, B2) :
- learning to use more than 30 kanji
- reading Manga
- acquiring the four skills (written and oral comprehension, written and oral expression)

Bibliography :
Level 1 Beginner (A1): Margot, 3A Network, to be published, Japan.
Level 2 Beginner (A2): Daichi, 1, 3A Network, 2008, Japan.
Level 3 Intermediate (B1, B2): Minna no Nihongo, I et II, 3A Network, 1998, Japan.
+ Satoru Koyama, J. Bridge, Bonjinsha, 2007, Japan.

Requirements :
Level 1: none.
Level 2: to have taken Level A1 Beginner course
Level 3: to have taken Beginner Levels A1 and A2

Organisation :
The teaching follows the TU format.

In each session there is an explanation of the structures which are then illustrated by examples and by exercises and conversation which the students participate in.

Evaluation :
S2 : Oral

Target :
Engineering students

German	HUMF2-ALL
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

To consolidate secondary school level learning outcomes
To attain, as a basic minimum, the B1 level by the end of the first cycle
To practise written and oral comprehension through the use of contemporary supports and multimedia
To develop level of oral expression through exercises in small groups and class discussions
To demonstrate and perfect your skills in German through project work
Support for foreign exchange and work placements

Content :
Contents:
- Exercises to practise spoken German for everyday situations and professional life
- Study of newspaper articles, broadcasts, videos
- Study of current affairs (politics, economics, sociology and culture) in Germanophone countries
- Introduction to economic and professional German
- Grammar revision
- Cultural openness (film studies, exhibitions, music)

Bibliography :
(available in the INSA Rennes library):
- DUDEN Bilingual Dictionary (German-French/French-German)
Grammatik Aktiv A1-B1, Cornelsen (mit Audio CD)_- Schritte-Ubungsgrammatik A1-B1, Hueber-Verlag
- Übungsgrammatik für die Grundstufe, Hueber-Verlag (Moodle) - Na also!
Waltraud Legros, Ellipses_- Manuel : Menschen hier, Hueber-Verlag
- Deutsch perfekt (periodical) -
Deutsche Welle/ ZDF logo (web) -
multimedia supports (web)

Requirements :
Intermediate German: B1 level

Organisation :
1h30 per week; 21h face-to-face lessons per semester
Personal Study time: 14h
Total: 35 h

Students are encouraged to regularly read news articles in German and to view videos and film series in addition to work assigned between lessons.

Evaluation :
S2 : Oral

Target :
Engineering students

Semestre 6

Parcours Formation initiale

1	**DMA06-MATHS**		**MATHEMATICS**	**7.50**
	DMA06-Trans	O	Functional Transforms and Applications	2.50
	DMA06-SI	O	Inferential Statistics	2.50
	DMA06-OC	O	Continious Optimization	2.50
2	**DMA06-MOD**		**MODELLING**	**8.50**
	DMA06-MRL	O	Linear Regression Model	3.00
	DMA06-OD	O	Discrete Optimization	2.50
	DMA06-MM	O	Markov Models	3.00
3	**DMA06-INFOS**		**SCIENTIFIC COMPUTING**	**6.00**
	DMA06-BD	O	Databases	3.00
	DMA06-MNNL	O	Numerical Methods : nonlinear cases	3.00
4	**DMA06-SEM**		**SEMINAR**	**1.00**
	DMA06-SE	O	Business Seminar	1.00
5	**HUM06**		**Non-scientific syllabus S6**	**7.00**
	HUM06-IMO	C	Introduction to Operational Management	1.50
	HUM06-IND	C	Introduction au Numérique Durable	1.50
	HUM06-ANGL	O	English	2.00
	HUM06-SIM	O	BUSINESS SIMULATION GAME	1.50
	HUM06-EPS	O	Sport and physical Education	1.00
	HUM06-PPI	O	Professional Project	1.00
6	**HUMF2-RIE**		**RIE : Recherche Innovation Entrepreneuriat**	**1.00**
	HUMF2- RI	F	Recherche Innovation	1.00
	HUMF2- IE	F	PARCOURS INNOVATION & ENTREPRENEURIAT	1.00

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

Functional Transforms and Applications	DMA06-Trans
Number of hours : 36.00 h	2.50 ECTS credit
CM : 16.00 h, TD : 16.00 h, TP : 4.00 h	
Reference Teacher(s) : BRIANE Marc	

Objectives :
The aim of the course is to introduce complex analysis tools, and to present classical functional transforms and their applications to solve ordinary differential equations and partial differential equations, and to signal processing.

Content :
Holomorphic functions, Cauchy's formula, formula of residues
Fourier transform and application to solve differential equations
Laplace transform and application to solve equations
Notion of sampling (Shannon's theorem) and Fourier transform of a sampled signal
Discrete Fourier transform and Fast Fourier transform (FFT)

Bibliography :
P. Benoist-Gueutal, M. Courbage. Mathématiques pour la Physique, Tome 1. Eyrolles, 1992.
C. Gasquet, P. Witomski. Analyse de Fourier et applications, filtrage, calcul numérique, ondelette. Masson, 1990.
W. Rudin. Analyse réelle et complexe. Dunod, 2009.

Requirements :
Course « Outils mathématiques de base » (AROM-3A1S).

Organisation :

Evaluation :
One written examination (3/4) and one test on tutorial practises or project (1/4).

Target :

Inferential Statistics	DMA06-SI
Number of hours : 36.00 h	2.50 ECTS credit
CM : 16.00 h, TD : 16.00 h, TP : 4.00 h	
Reference Teacher(s) : LEDOUX James	

Objectives :
This course is intended to familiarize students with fundamental tools of information theory and statistical inference (point estimation, interval estimation, hypothesis testing) in parametric models. Basic concepts of bootstrap will also be introduced. Computational skills with software R will be developed.

Content :
Elements of information theory
Statistical models
Point estimation : moment method and maximum likelihood method
Interval estimation
Hypothesis testing
Resampling by bootstrap
Practical skills with R

Bibliography :
- D. Fourdrinier. Statistique inférentielle. Dunod, 2002.
- M. Lejeune. Statistique. La théorie et ses applications. Springer, 2010.
- A. Monfort. Cours de statistique mathématique. Economica, 1997.
- C. Robert. Le choix bayésien - Principes et pratique. Springer, 2006.
- J. Shao. Mathematical statistics. Springer, 2010.
- P. Tassi. Méthodes statistiques. Economica, 2004.

Requirements :
Probability courses from the undergraduate program of INSA (STPI), courses of “probability” and “Introduction to mathematical softwares” of AROM.

Organisation :
The course will be continuously illustrated with numerous practical examples arising from various application fields (health, services, industry, transport, management).

Evaluation :
One written examination of 2h (75%) and a practical examination and/or project (25%).

Target :
students in mathematical engineering

Continious Optimization	DMA06-OC
Number of hours : 34.00 h	2.50 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 10.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The goal of this course is to give a general presentation of the problems and methods concerned with numerical continuous optimization (differentiable and non-differentiable problems). The main part of the course is devoted to standard continuous optimization methods and algorithms. In addition to the classical methods, we will introduce some modern proximal algorithms, …

Content :
Linear and nonlinear optimization. Single and multiple variables problems. Optimality conditions and convexity.
Line search methods.
Equality and inequality constrained problems. Descent methods.
Newton type methods. Penalty methods.
Proximal methods.
Duality and lagrangian methods.
Introduction to AMPL, XPRESS, Local solver and practical with MATLAB .

Bibliography :
M. Bergounioux. Optimisation et contrôle des systèmes linéaires. Dunod, 2001.
J.F. Bonnans et al. Optimisation numérique. Aspects théoriques et pratiques. Springer, 1997.
J.F. Bonnans. Optimisation continue, Cours et problèmes corrigés. Dunod, 2006.
J.F. Bonnans et S. Gaubert. Recherche opérationnelle (aspects mathématiques et applications) 2015
M. Minoux. Programmation mathématique. Tec et Doc, 2007.

Requirements :
Courses of “Introduction to mathematical softwares”, ” Discrete optimization” and “numerical Analysis” (3rd year).

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Linear Regression Model	DMA06-MRL
Number of hours : 36.00 h	3.00 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
This course is intended to familiarize students with simple and multiple linear regression modeling, including estimation, model validation, diagnostic checking and interpretation of the outputs of statistical softwares.

Content :
Simple and multiple linear regression models
- Least squares estimation
- The Gaussian linear model
- Statistical inference (estimation, tests)

Model selection and validation
Analysis of variance
Penalized estimation
Practical skills with software R

Bibliography :
- J.-M. Azaïs, J.-M. Bardet. Le modèle linéaire par l'exemple. Dunod, 2012.
- P.-A. Cornillon, E. Matzner-Lober. Regression avec R. Springer, 2010.
- G.A.F. Seber, A.J. Lee. Linear regression analysis. Wiley, 2003.

Requirements :
Algebra courses from the undergraduate program of INSA (STPI), courses of "probability" and "Introduction to mathematical softwares" of AROM.

Organisation :
Practical sessions will be given by an industrial engineer.

Evaluation :
One written examination of 2h (75%) and a practical examination and/or project (25%).

Target :
students in mathematical engineering

Discrete Optimization	DMA06-OD
Number of hours : 28.00 h	2.50 ECTS credit
CM : 10.00 h, TD : 8.00 h, TP : 10.00 h	
Reference Teacher(s) : HADDOU Mounir	

Objectives :
The focus of this course is on the fundamental concepts of discrete optimization and the basics of linear programming. For this, a large majority of the lectures will deal with graph theory: basic definitions, introduction of the most classical polynomial graph problems and the associated solution algorithms, and practical modeling with graphs.
The course will also be an opportunity to introduce notions of computational complexity.

Content :
• Basic definitions and algorithms of graph theory: trees, depth-first and breadth-first searches, optimization algorithms
• Flows, networks and cover trees
• Transportation and assignment problems
• Introduction to linear programming (models and simplex algorithm) and to integer programming models
• Computational practice using Python, and introduction to a mathematical modeling language (AMPL / PuLP / Pyomo)

Bibliography :
[1] M. Gondran, M. Minoux. Graphes et algorithmes. Eyrolles, 1978.
[2] M. Minoux, Programmation mathématique : théorie et algorithmes, 2e édition. 2008.
[3] G. L. Nemhauser and L. A. Wolsey, “Integer and Combinatorial Optimization,” 1999.
[4] R. J. Vanderbei, Linear Programming - Foundations and Extensions, vol. 114. Boston, MA: Springer US, 2008.
[5] R. Faure. Précis de recherche opérationnelle. Dunod, 1979.

Requirements :
First and second year courses of mathematics, skills in programming with Python.

Organisation :

Evaluation :
Final exam (50 %) and project (50 %)

Target :

Markov Models	DMA06-MM
Number of hours : 36.00 h	3.00 ECTS credit
CM : 14.00 h, TD : 12.00 h, TP : 10.00 h	
Reference Teacher(s) : LEDOUX James	

Objectives :
Upon completion of this program, the student will be familiar with discrete time Markov evolutions and their use in simulation, and with basic concepts on partially observed Markov models.

Content :
MARKOV CHAINS WITH DISCRETE STATE SPACE
- Markov dynamics
- Application to stochastic operation research

MARKOV CHAIN MONTE CARLO (MCMC) METHODS
- Metropolis algorithm. Gibbs sampling
- Bayesian inference

HIDDEN MARKOV CHAINS.
- Partially observed models
- Filtering algorithms and MAP estimation

MARKOV CHAINS WITH CONTINUOUS STATE SPACE
- Markov kernel. Some examples.
- Hidden Markov Chains. Linear gaussian model and Kalman filter.

PRACTICAL WORK WITH R SOFTWARE

Bibliography :
P. Brémaud. Markov chains (Gibbs fields, Monte Carlo simulation, and queues). Springer, 1999.
J-F. Delmas, B. Jourdain. Modèles aléatoires : Applications aux sciences de l'ingénieur et du vivant. Springer, 2006.
C. Robert, G. Casella. Monte Carlo statistical methods. Springer, 1999.
B. Séricola. Chaînes de Markov. Hermès, 2003
K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley, 2001.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills; « Introduction to probability » (STPI-2A), « Introduction to mathematical software » and « Probability » (ARO05)

Organisation :

Evaluation :
One written examination , continuous assessment, Practical work/Project.

Target :

Databases	DMA06-BD
Number of hours : 36.00 h	3.00 ECTS credit
CM : 16.00 h, TD : 14.00 h, TP : 6.00 h	
Reference Teacher(s) : CELLIER-BELLINA Peggy	

Objectives :
This course unit has three main objectives. First, it aims to strengthen and extend students' capabilities in the manipulation and modeling of databases (DBs). Second, it focuses on the improvement of performance for relational Database Management Systems (DBMSs). Finally, it introduces the semantic web concepts, in particular the representation of the linked data (RDF) and the query language (SPARQL).

Content :
Databases modeling and manipulation
• Reminders about the creation and manipulation of relational DBs
• Modeling
• Reminders about the entity-relationship modeling
• Normal forms
Performance tuning
• In-depth presentation of fundamental aspects necessary for the practical management of relational DBMSs
• Tuning
Introduction to sematic web
• RDF, RDS
• OWL
• SPARQL

Bibliography :
• M. Jarke, M. Lenzerini, Y. Vassiliou, P. Vassiliadis. Fundamentals of Data Warehouses. Springer-Verlag, 2000.
• G. Gardarin. Bases de données. Eyrolles, 5e tirage, 2003.
• R. Ramakrishnan, J. Gehrke. Database Management Systems. McGraw-Hill Higher Education, 2003.
• XML, langage et applications, A. Michard, Eyrolles, 2000
• XML, des bases de donnÈes aux services Web, G. Gardarin, Dunod, 2002
Le web sémantique, F. Gandon, C. Faron-Zucker, O. Corby, Dunod, 2012

Requirements :
Basics of relational DBMSs (Course: BD 2A).

Organisation :

Evaluation :
A two-hour written examination.

Target :

Numerical Methods : nonlinear cases	DMA06-MNNL
Number of hours : 36.00 h	3.00 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
This course aims at initiate students to basic notions in numerical analysis: compute the approximated solution of non-linear equation
and system of equations, interpolate a sequence of nodes in a plan, numerically approximate the derivatives of a given function,
numerically approximate an integral, numerically solve differential equations with initial conditions.

Content :
- Non linear equations: secant method, Newton method, ...
- Interpolation: Lagrange, splines.
- Numerical integration.
- Differential equations. Approximated resolution of the Cauchy problem: explicit and implicit methods, one step methods,
multi-step methods. Notion of stability.
- Introduction to the Finite Difference method for the Poisson equation.
- Practical work with MATLAB.

Bibliography :
- A. Quarteroni, F. Saleri, P. Gervasio, Calcul Scientifique. Cours, exercices corrigés et illustrations en MATLAB et Octave.
Springer, 2008.
- J. Rappaz, M. Picasso, Introduction à l'analyse numérique. Presses polytechniques et universitaires romandes, 2004.
- F. Filbet, Analyse numérique. Algorithme et étude mathématique. Dunod, 2013.
- T. Lyche, J.L. Merrien, Exercises in Computational Mathematics with MATLAB. Springer, 2014.

Requirements :
- Analysis and Algebra classes from STPI.
- Numerical Methods for linear systems (S5, Camar-Eddine Mohamed).
- Introduction to mathematical software (S5, Chagneau Pierrette, Monier Laurent).
- Modeling with ordinary differential equations (S5, Ley Olivier).

Organisation :

Evaluation :
Written exam (1/2) and pratical evaluation (1/2).

Target :

Business Seminar	DMA06-SE
Number of hours : 20.00 h	1.00 ECTS credit
CM : 20.00 h	
Reference Teacher(s) : GARES Valerie, MONIER Laurent	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
The module will offer (among others) :

- presentations of various career profiles and employment sectors of mathematical engineers ;
- specific mathematical skills (Bayesian networks, sensometry...), computational and software-related skills (specific softwares, computation codes, database management tools for heterogeneous, massive and unstructured data), specific operational skills (clinical trial protocol, banking regulations...) ;
some awareness to managerial issues (such as business creation, industrial property...) and societal aspects (sustainable development, ethic...) of the profession of engineer.

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery . The obtained mark is independent.

Target :

Introduction to Operational Management	HUM06-IMO
Number of hours : 24.00 h	1.50 ECTS credit
CM : 10.00 h, TD : 10.00 h, TP : 4.00 h	
Reference Teacher(s) : SORRE Frederic	

Objectives :
A company in its field of application must adopt methods associated with tools, allowing it to manage value creation. This module is an introduction to the notion of operational management (produiction management, quality management, continuous improvement process). This module should enable students to develop a systematic overview of company organisation.

Content :
I - INTRODUCTION:
The aim of a company, changes in socio-economic context, operational excellence, typological analysis, notion of flow and process.

II - PERMANENT PROGRESS:
Notion of waste, the basic tools, processes of problem solving, management of materials.

III – PLANNING AND PILOTING FLOWS:
Planning for component requirement needs, principles of MRP2 (SOP / PIC, MPS / PDP, MRP / CBN), load-capacity management, Concept of ERP.

IV – PLANNING IN THE WORLD OF VUCA: Presentation of DDMRP methodology.

V – OPERATIONAL MANAGEMENT:
Operations Management, Theory of Constraints, Kanban Methods

VI - NOTION OF QUALITY :
Quality tools; statistical control of processes

Bibliography :
Gestion de la production - Blondel - DUNOD
La gestion de production - Bénassy - HERMES
Contrôle de la qualité - Jaupi - DUNOD
Lean Management - Hohmann - Eyrolles

Requirements :

Organisation :

Evaluation :
1 written test (2h) – continuous assessment in PR

Target :

Introduction au Numérique Durable	HUM06-IND
Number of hours : 21.00 h	1.50 ECTS credit
CM : 10.00 h, TA : 5.00 h, TD : 6.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

English	HUM06-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : LE VOT Philippe	

Objectives :
Improve expression, comprehension and interaction skills within everyday contexts, with special emphasis on professional and social life.
Language Objectives
Obtain or reinforce B2 level (as required for graduation and defined by CECRL)

Content :
-Action-oriented approach - learning by doing :
students have to listen and speak, write documents while using their problem-solving, reasoning, arguing, and demonstrating capabilities, in an articulate manner.
-Expressing oneself accurately by a rigorous use of syntax and phonology :
Activities requiring creative and reactive skills, ranging from debating, role-playing, individual oral presentations (PowerPoint), projects ... are based on scientific topics and current events.
-Building up specific skills in connection with the working world :
- writing e-mails
- conducting telephone conversations
- technical English
- intercultural contexts
In addition to the English course, a 90-minute remedial course takes place every week (over 10 weeks), in which students can update their various skills (listening and reading, writing, speaking and interacting) in small groups. Remedial classes are compulsory for all students that did poorly in their start-of-term placement test - and optional for those who feel they need to attend. There is no specific assessment for this course.

Bibliography :
- Dictionnaire Robert et Collins bilingue, or Collins Cobuild unilingue
- English Grammar in Use (Cambridge University Press)

Requirements :
A good command of the STPI curriculum is essential : B1/B2

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 students to work in a stimulating environment.
-Teaching resources include press articles, audio and video documents (TV reports, film and series extracts) as well as the Internet.
-Regular personal work is required. Students must be curious and practise their English outside the classroom.

Evaluation :
Two-hour written test (50%)
Individual oral presentation (50%)

Target :

BUSINESS SIMULATION GAME	HUM06-SIM
Number of hours : 16.00 h	1.50 ECTS credit
TD : 16.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :
This course focuses on the complexity of the decision-making process in a company.
Main learning outcomes:
- Understanding information relative to marketing and finance
- The ability to use specific tools and vocabulary in the field of management
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :
The course is mainly focused around a Business simulation, which empowers participants to run their own virtual businesses. Just like in real life, the teams compete against each other in order to gain market shares. The right decisions lead to success while the wrong ones engender invaluable problem solving experiences. The learning process becomes efficient and fun, and allows “learning by doing” as well as “learning from mistakes”.
As an outcome of the simulation exercise, participants will fully comprehend the different aspects of the marketing decision making process, their relationship with each other, and their impact on the company’s overall results. In addition, participants will gain invaluable experience in teamwork and problem solving.
The simulation is based on an online platform that allows students to make some decisions outside the classroom.

Bibliography :
Provided during the course

Requirements :
None

Organisation :
2 hours per week

Evaluation :
Continuous assessment (collective work)

Target :

Sport and physical Education	HUM06-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h	
Reference Teacher(s) :	

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 :

Professional Project	HUM06-PPI
Number of hours : 6.00 h	1.00 ECTS credit
TD : 6.00 h	
Reference Teacher(s) :	

Objectives :
Third Year PPI aims at training students to the job interview, thanks to specialits in Human Ressources.

Content :

Bibliography :

Requirements :
Being able to write a CV and cover letter

Organisation :
The course is organised as follows :
First course PPI third year- group of 24 to 28 students
- The job interview as seen by the HR : goals, expectations, proceeding of the interviews, ...

Second course PPI third year-group of 12 to 14 students
How to get ready for an interview?
Tests
Trailer

Third course PPI third year-group of 4 or 5 students
mock job interviews

The contributors for this course are professionals in Human Resources
- Advisors in Human Resources in recruitment offices
- Responsible for Human Resources in companies

Evaluation :
A mark will be given by the contributor

Target :
All the 3rd-year-students

Recherche Innovation	HUMF2- RI
Number of hours : 12.00 h	1.00 ECTS credit
TD : 12.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

PARCOURS INNOVATION & ENTREPRENEURIAT	HUMF2- IE
Number of hours : 12.00 h	1.00 ECTS credit
TD : 12.00 h	
Reference Teacher(s) :	

Objectives :
The aim of this module is to inspire future engineers and stimulate their creativity and initiative, by instilling a spirit of entrepreneurship.
Expected skills:
- observe and consider what exists to generate new ideas,
- make the most of the environment to challenge new concepts,
- communicate and federate around an innovative project.

Content :
Using a list of preselected events, the students build their exploration program over two semesters and choose to attend globally 2 to 3 events.
Students have an academic coach and regularly report on their progress.

Bibliography :
Provided during the course.

Requirements :
None.

Organisation :
Students are encouraged to identify technologies or inspiring trends by taking advantage of events dealing with innovation and entrepreneurship (tradeshows, conferences, etc.).

Evaluation :
Students write post-event reports focusing on inspiring aspects of their experiences.
Final pitch and discussions.

Target :

INSA RENNES - Mathématiques appliquées (MA) : 2023/2024

Semestre 7

Parcours FISP

1	**DMA07-MA**		**APPLIED MATHEMATICS**	**7.00**
	DMA07-OHA	O	Hilbertian Tools and Applications	3.50
	DMA07-MSSD	O	Stochastic Models of Dynamical Systems	3.50
2	**DMA07-MODS**		**STATISTICAL MODELLING**	**6.50**
	DMA07-MSRS	O	Risk Analysis and Scoring	3.50
	DMA07-ST	O	Time Series	3.00
3	**DMA07-INFOS-ISP**		**INFORMATIQUE SCIENTIFIQUE ET MATHEMATIQUES DISCRETES**	**6.00**
	DMA07-RO	O	Operational research methods	3.50
	DMA07-POO	O	Object Oriented Programming in C++	2.50
4	**DMA07-SEMP-ISP**		**SEMINAIRE ENTREPRISE ET PROJET**	**4.00**
	DMA07-PI	O	Interdisciplinary Project	3.50
	DMA07-SE-ISP	O	Séminaire entreprise	0.50
5	**HUM07-ISP**		**Non-scientific syllabus S7**	**4.50**
	HUM07-ANGL	O	English	2.00
	HUM07-EPS	O	Sport and physical education	1.00
	HUMF1-ALL	C	German: Confirmed Level	1.50
	HUMF1-ESP	C	Spanish	1.50
	HUMF1-CHI	C	Chinese	1.50
	HUMF1-JAP	C	Japanese	1.50
	HUMF1-RUS	C	Russian	1.50

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

Hilbertian Tools and Applications	DMA07-OHA
Number of hours : 36.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 16.00 h, TP : 6.00 h	handout in English
Reference Teacher(s) : BRIANE Marc	

Objectives :
This teaching delivers notions of Functional Analysis which are essential in mathematical engineering.

Content :
Inner product, Cauchy-Schwarz inequality
Definition and examples of Hilbert spaces
Theorem of the orthogonal projection
The Riesz representation theorem
The weak convergence in a Hilbert space
Hilbert bases and Gram-Schmidt process
Fourier series and orthogonal polynomials
Minimization of a convex functional
Introduction to wavelets.

Bibliography :
H. Brezis. Functional Analysis, Sobolev Spaces and Partial Differential Equations. Springer, New York, 2011.
J. M. Bony. Cours d'analyse, théorie des distributions et analyse de Fourier. Édition de l'école Polytechnique, 2001.
B. Maury. Analyse fonctionnelle, exercices et problèmes corrigés. Ellipse, 2004.
W. Rudin, Real and complex analysis, Third edition, McGraw-Hill Book Co., New York, 1987.
M. Willem, Analyse harmonique réelle, Collection Méthodes, Hermann, Paris, 1995.

Requirements :
This teaching needs the knowledge of the basic mathematics of the Bachelor.

Organisation :

Evaluation :
One written test (3/4) and one test on tutorial practises or project (1/4).

Target :

Stochastic Models of Dynamical Systems	DMA07-MSSD
Number of hours : 42.00 h	3.50 ECTS credit
CM : 18.00 h, TD : 14.00 h, TP : 10.00 h	handout in English
Reference Teacher(s) : LEDOUX James	

Objectives :
Objectives of this course are to make students acquainted with stochastic models of dynamical systems together with their simulation and numerical implementation. Students are aware of various application areas through the examples.

Content :
Martingale
Discrete-time martingale. Asymptotic convergence. Applications
Standard Markov processes
Poisson process. Markov jump processes
Applications to stochastic operation research
Introduction to stochastic differential equations (SDE)
Brownian motion
Diffusions
Numerical methods for SDE
Practical implementation with R

Bibliography :
D. Foata and A. Fuchs. Processus stochastique : processus de Poisson, chaînes de Markov et martingales. Dunod, 2002.
F. Comets and T. Meyre. Calcul stochastique et modèles de diffusions. Dunod, 2006.
P. Kloeden, E. Peter, E. Platen and H. Schurz. Numerical Solution of SDE Through Computer Experiments. Springer, 2003.
F. Klebaner. Introduction to stochastic calculus with applications. Imperial College Press, 1998
S. I. Resnick
Adventures in stochastic processes.
Birkhäuser, 2002

Requirements :
Courses of “Introduction aux probability” (STPI-2nd), “Tools for stochastic modelling” (TC-3rd), “Probability” (ARO05), “Markov models” (ARO06).

Organisation :

Evaluation :
Two written examinations (2/3) and a practical examination and/or project (1/3).

Target :

Risk Analysis and Scoring	DMA07-MSRS
Number of hours : 36.00 h	3.50 ECTS credit
CM : 20.00 h, TP : 16.00 h	handout in English
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
The objective of this course is to make students acquainted with fundamental tools for risk analysis and scoring and with related SAS/R skills.

Content :
Regression models for binary data
Statistical inference in the logistic model
Variable selection and model validation in the logistic model
Confusion matrix and ROC curve
Overdispersed data
Zero-inflated regression models
Practical with SAS, R

Bibliography :
Dupuy J.-F. Modèles linéaires généralisés - problèmes de censure, données manquantes, excès de zéros. ISTE Press – Elsevier, London, UK, 2023.
J.M. Hilbe. Logistic regression models. Chapman & Hall, 2009.

Requirements :
Courses of "Linear regression models" and "inferential statistics" (3rd year).

Organisation :

Evaluation :
One written examination.

Target :

Time Series	DMA07-ST
Number of hours : 30.00 h	3.00 ECTS credit
CM : 8.00 h, TD : 10.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : CHAGNEAU Pierrette	

Objectives :
The aim of this course is to provide fundamentals tools for the analysis of univariate time series and associated skills in R.

Content :
Basic tools for time series analysis : moving average, exponential smoothing
Discrete-time stationary processes : stationarity, autocorrelation function and partial autocorrelation function, ARMA processes and related statistical inference
SARIMA models : identification, estimation, validation
Unit root test
Practical skills with R.

Bibliography :
P.J. Brockwell, R.A. Davis. Times series: theory and methods. Springer, 1991.
P.J. Brockwell, R.A. Davis. Introduction to time series and forecast (2nd ed.). Springer, 2002.
P.S.P Cowpertwait, A.V. Metcallfe. Introductory Time Series with R. Springer, 2009.
C. Gouriéroux. Séries temporelles et modèles dynamiques (2nd ed). Economica, 1995.
J.D. Hamilton. Time series analysis. Princeton University Press, 1994.

Requirements :
Courses of “Probability” (DMA05-Proba), “Introduction to mathematical softwares” (DMA05-ILM) and “Inferential statistics” (DMA06-SI) of 3rd year.

Organisation :

Evaluation :
Project.

Target :

Operational research methods	DMA07-RO
Number of hours : 36.00 h	3.50 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course is a general presentation of operations research techniques for the solution of integer linear optimization
problems. The main objectives are:
• To understand standard solution methods and complexity issues in integer linear programming.
• To be able to analyze a practical problem, identify its variables, model it as a mathematical program, propose and apply a solution method and discuss the results.
• To know and recognize the most classical problems of operational research.
• To be able to analyze the ethical stakes of using mathematical decision aid tools, in particular those developed with operational research methods.

Content :
• Introduction to combinatorial optimization
• Duality in linear programming and geometrical interpretation of the simplex algorithm
• Modeling a practical problem using integer programming
• Solving an integer program with the branch-and-bound algorithm
• Linear and Lagrangian relaxations; duality in integer programming
• Geometrical interpretations and approaches in integer programming
• Application to classical problems of operational research stated as practical cases
• Modeling and solution of problems using the language Julia and its modeling library JuMP to call the optimization codes GLPK, Gurobi and Coin CBC.
• Implementation of a branch-and bound algorithm using Julia language.
• Sensitization to the main ethical matters of optimization.

Bibliography :
[1] A. Billionnet, Optimisation discrète : de la modélisation à la résolution par des logiciels de programmation mathématique. 2007.
[2] M. Minoux, Programmation mathématique : théorie et algorithmes, 2e édition. 2008.
[3] G. L. Nemhauser and L. A. Wolsey, “Integer and Combinatorial Optimization,” 1999
[4] R. J. Vanderbei, Linear Programming - Foundations and Extensions, vol. 114. Boston, MA: Springer US, 2008.
[5] L. A. Wolsey, Integer programming. 1998

Requirements :
First and second year courses of linear algebra, courses of "Optimization", "Discrete optimization" and "Numerical Analysis" (3rd year).

Organisation :

Evaluation :
One test (40%), one Julia project (45 %) and several CC on ethical matters (15 %)

Target :

Object Oriented Programming in C++	DMA07-POO
Number of hours : 28.00 h	2.50 ECTS credit
CM : 14.00 h, TP : 14.00 h	
Reference Teacher(s) : ANQUETIL Eric	

Objectives :
Object-oriented programming is a powerful tool to cope with the development of real applications. It helps to define projects with an effective monitoring of the different phases of evolution. This course emphasizes the fundamental principles associated with object-oriented programming. It is performed in C++ and introduce all the fundamental concepts of object programming.

Content :
Object-oriented programming in C++.
* Notion of object in C++: Construction of objects, Interfaces, Encapsulation, etc.
* Memory management: Dynamic memory allocation, Destructor, Assignment statement…
* Basic elements of C++: Input/Output management, String, etc.
* Object conception in C++: Aggregation, Inheritance, Polymorphism, Access control, etc.
* Multiple inheritance
* Generic programming, Template class.
* Internal class.
* Standard Template Library (STL),
* Run Time Type Identification (RTTI)
* Exceptions handling.
* Introduction to IHM programming (DotNET, wpf and MVVM…)

Bibliography :
G. Booch. Conception orientée objets et applications. Addison-Wesley, 1996.
B. Stroustrup. The C++ programming language (third edition). Addison-Wesley, 1997.

Requirements :
Basic understanding of algorithmic.
C programming
Optional: Basic object-oriented programming in Java (STPI 2A).

Organisation :
Revision of class notes (1h per week)

Evaluation :
A practical TP exam with several questions on the course.

Target :

Interdisciplinary Project	DMA07-PI
Number of hours : 36.00 h	3.50 ECTS credit
EP : 36.00 h	
Reference Teacher(s) : LE GRUYER Yves	

Objectives :
The objective of this project is to make students familiar with its future professional environment. They must manage mathematical modelling in another scientific disciplinary framework. Thus, the progress of the project is ensured in collaboration with a teacher of another department (EII, GCU, GMA, INFO, SGM, SRC). Additional learning outcomes are to manage a collaborative project and to find relevant bibliographic resources.

Content :
From the proposal by a department (EII, GCU, GMA, INFO, SGM, SRC), the student must produce a bibliography, a written report and an oral presentation.

Bibliography :

Requirements :

Organisation :

Evaluation :
a written report and an oral presentation

Target :

Séminaire entreprise	DMA07-SE-ISP
Number of hours : 12.00 h	0.50 ECTS credit
CM : 12.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

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 :

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 :

German: Confirmed Level	HUMF1-ALL
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

To consolidate secondary school level learning outcomes
To attain, as a basic minimum, the B1 level by the end of the first cycle
To practise written and oral comprehension through the use of contemporary supports and multimedia To develop level of oral expression through exercises in small groups and class discussions
To demonstrate and perfect your skills in German through project work
Support for foreign exchange and work placements

Content :
- Exercises to practise spoken German for everyday situations and professional life
- Study of newspaper articles, broadcasts, videos
- Study of current affairs (politics, economics, sociology and culture) in Germanophone countries
- Introduction to economic and professional German
- Grammar revision
- Cultural openness (film studies, exhibitions, music)

Bibliography :
- DUDEN Bilingual Dictionary (German-French/French-German)
Grammatik Aktiv A1-B1, Cornelsen (mit Audio CD)_- Schritte-Ubungsgrammatik A1-B1, Hueber-Verlag
- Übungsgrammatik für die Grundstufe, Hueber-Verlag (Moodle) - Na also!
Waltraud Legros, Ellipses_- Manuel : Menschen hier, Hueber-Verlag
- Deutsch perfekt (periodical) -
Deutsche Welle/ ZDF logo (web) -
multimedia supports (web)

Requirements :
Intermediate German: B1 level

Organisation :
1h30 per week; 21h face-to-face lessons per semester
Personal Study time: 14h
Total: 35 h

Students are encouraged to regularly read news articles in German and to view videos and film series in addition to work assigned between lessons.

Evaluation :
Basic level : continuous assessment
Intermediate level : continuous assessment
Advanced level : continouous assessment

Target :
S1: Final Grade

Spanish	HUMF1-ESP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : AMARGOS GUILLERAY Marine	

Objectives :
-Practising and strengthening of one's knowledge in the Spanish language and culture (Spanish culture, Spanish and
Latin-American civilizations, societal developments).
- How to manage team projects
- Adapting to multicultural environments
- Understanding social, technological and economical challenges in Spanish-speaking countries.

Content :
Written and oral expression and comprehension.

Bibliography :
1. PASTOR Enrique and PROST Gisèle : "La grammaire active de l'espagnol", Le livre de poche, collection Les Langues modernes.
2. BECHERELLE, "El arte de conjugar en espanol", Hatier.
3. Larousse bilingual dictionary, Le Grand Dictionnaire de Garcia y Pelayo et Testas, Dictionary Hispano Bordas.
4. "Passez-moi l'expression en espagnol", Belin.
5. "El espanol en la prensa", Belin.

Requirements :
B1 level

Organisation :
- Reinforcing grammar / conjugation
- Reading and oral comprehension
- Writing and speaking (debates, drama).

Advice : Read in Spanish : contemporary novels, comics (Tintin, Astérix, Mafalda), magazines (Cambio 16, Epoca, Vocable) available at the library.
Visit the Internet pages of the Spanish and Latin-American newspapers (lavanguardia.es, elpais.es...)
Listen to Spanish National Radio programmes (RNE) on Internet.
Watch TV programmes on RTVE.es.
Read tourist guides on Spanish-speaking countries available at the library.

Evaluation :
Continuous assessment

Target :
3rd, 4th, 5th year

Chinese	HUMF1-CHI
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
To acquire the basics of Chinese, Essential structures and vocabulary, Comprehension, expression ans pronunciation, Use of
everyday Chinese.

Content :
Oral skills : corrective phonetics (pinyin system), listening to and analysis of complex sentences and simple texts, oral
exercises (student-student / student-teacher), introduction of new characters (pronunciation and tone accentuation).
Written skills : prose/translation, written production of complex sentences and simple texts, learning and reinforcement of
grammatical ans vocabulary mechanisms, oral and written Chinese, learning of new characters (order of lines, basic
ideograms), reading and analysis of texts, text commentary.

Bibliography :
1. Le chinois comme en Chine, Bernard Allanic, Presses Universitaires de Rennes, 2009
2. Le chinois contemporain, WU Zhongwei, Sinolingua, 2010
3. Faire l'expérience du chinois, ZHANG Rumei, AI Xin, Higher Education Press, 2006
Other documents will be added to these basic books to provide the students with a wide panel of practical exercises.

Requirements :

Organisation :
Students are required to read the texts from the lessons (in character form), to rewrite the new characters, to work on the
application exercices on grammar, lexical and morphological points, to ask questions on the texts from the lessons, to do prose
and translation exercises.

Evaluation :
Final mark

Target :

Japanese	HUMF1-JAP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Niveau débutant (A1):
- awareness of particularities (phonetics, syntax)
- discovery of Japanese culture, traditions, customs
- learning the two systems of writing (Hiragana and Katakana)
- to be able to use spoken Japanese in everyday situations

Intermediate level (A2):
- introduction ideogrammes (60 kanji)
- reading simple texts (with Manga, etc...)
- writing simple texts
- to be able to use spoken Japanese in everyday situations

Advanced level (B1, B2):
- learning kanji (60-200)
- acquiring the four skills (written and oral comprehension, written and oral expression) for travel or study in Japan

Content :
Level 1 Beginner (A1):
- Perfecting Hiragana et Katakana - reading Manga
- Lesson 5: speaking about pastimes
- Lesson 6: using transport
- Lesson 7: shopping
- Lesson 8: expressing feelings

Level 2 Beginner (A2):
- learning 30 kanji - reading Manga
- basic Grammar
- reading and writing simple texts
- learning how to communicate in everyday situations

Intermediate level (B1, B2) :
- learning to use more than 30 kanji
- reading Manga
- acquiring the four skills (written and oral comprehension, written and oral expression)

Bibliography :
Level 1 Beginner (A1): Margot, 3A Network, to be published, Japan.
Level 2 Beginner (A2): Daichi, 1, 3A Network, 2008, Japan.
Level 3 Intermediate (B1, B2): Minna no Nihongo, I et II, 3A Network, 1998, Japan.
+ Satoru Koyama, J. Bridge, Bonjinsha, 2007, Japan.

Requirements :
Level 1: none.
Level 2: to have taken Level A1 Beginner course
Level 3: to have taken Beginner Levels A1 and A2

Organisation :
The teaching follows the TU format.

In each session there is an explanation of the structures which are then illustrated by examples and by exercises and conversation which the students participate in.

Evaluation :
S1: Final Grade

Target :

Russian	HUMF1-RUS
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Russian beginner : acquire A1 level
Russian intermediary : acquire A2/B1 level

Content :
Acquisition of grammatical basis and commonplace vocabulary.
Training of the 5 skills, oral and written comprehension, oral and written expression, interaction.
The stress is put on written and oral communication, firstly in the frame of daily situations, then with a progressive introduction of other themes and opening on the professional communication.
Training with varied media (written, audio, video)
Individual exercices and works in groups, talks from the intermediate level on.
Grammar program depending on the level.
(Inter) cultural opening

Bibliography :
To be seen with the teacher

Requirements :

Organisation :
one hour -and-a-half courses per week in SUPELEc

Evaluation :
Final grade (overseen by SUPELEC).

Target :

Semestre 7

Parcours Formation initiale

1	**DMA07-MA**		**APPLIED MATHEMATICS**	**7.00**
	DMA07-OHA	O	Hilbertian Tools and Applications	3.50
	DMA07-MSSD	O	Stochastic Models of Dynamical Systems	3.50
2	**DMA07-MODS**		**STATISTICAL MODELLING**	**6.50**
	DMA07-MSRS	O	Risk Analysis and Scoring	3.50
	DMA07-ST	O	Time Series	3.00
3	**DMA07-INFOS**		**SCIENTIFIC COMPUTING AND DISCRETE MATHEMATICS**	**6.00**
	DMA07-POO	O	Object Oriented Programming in C++	2.50
	DMA07-RO	O	Operational research methods	3.50
4	**DMA07-SEMP**		**SEMINAR AND PROJECT**	**4.50**
	DMA07-PI	C	Interdisciplinary Project	3.50
	DMA07-PR1	C	Research Project	3.50
	DMA07-SE	O	Business Seminar	1.00
5	**HUM07**		**Non-scientific syllabus S7**	**6.00**
	HUM07-ANGL	O	English	2.00
	HUM07-EI	C	Entrepreneurship and Innovation	3.00
	HUM07-IE	C	INNOVATION & ENTREPRENEURSHIP (RIE)	3.00
	HUM07-EPS	O	Sport and physical education	1.00
6	**DEIF1-MOB15**		**PROJET RECHERCHE MOBILITE ENTRANTE 1/3 SEMESTRE**	**15.00**
	DEIF1-MOB15	C	Projet de recherche pour la mobilité entrante 1/3 semestre	15.00
9	**HUMF1-SAM STMA**		**3rd year industrial Placement**	**2.00**
	DMA07-STA3-2	C	3rd year industrial Placement	2.00
10	**HUMF1-SAM STMA3**		**3rd year industrial Placement**	**3.00**
	DMA07-STA3-3	C	3rd year industrial Placement	3.00

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

Hilbertian Tools and Applications	DMA07-OHA
Number of hours : 36.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 16.00 h, TP : 6.00 h	handout in English
Reference Teacher(s) : BRIANE Marc	

Objectives :
This teaching delivers notions of Functional Analysis which are essential in mathematical engineering.

Content :
Inner product, Cauchy-Schwarz inequality
Definition and examples of Hilbert spaces
Theorem of the orthogonal projection
The Riesz representation theorem
The weak convergence in a Hilbert space
Hilbert bases and Gram-Schmidt process
Fourier series and orthogonal polynomials
Minimization of a convex functional
Introduction to wavelets.

Bibliography :
H. Brezis. Functional Analysis, Sobolev Spaces and Partial Differential Equations. Springer, New York, 2011.
J. M. Bony. Cours d'analyse, théorie des distributions et analyse de Fourier. Édition de l'école Polytechnique, 2001.
B. Maury. Analyse fonctionnelle, exercices et problèmes corrigés. Ellipse, 2004.
W. Rudin, Real and complex analysis, Third edition, McGraw-Hill Book Co., New York, 1987.
M. Willem, Analyse harmonique réelle, Collection Méthodes, Hermann, Paris, 1995.

Requirements :
This teaching needs the knowledge of the basic mathematics of the Bachelor.

Organisation :

Evaluation :
One written test (3/4) and one test on tutorial practises or project (1/4).

Target :

Stochastic Models of Dynamical Systems	DMA07-MSSD
Number of hours : 42.00 h	3.50 ECTS credit
CM : 18.00 h, TD : 14.00 h, TP : 10.00 h	handout in English
Reference Teacher(s) : LEDOUX James	

Objectives :
Objectives of this course are to make students acquainted with stochastic models of dynamical systems together with their simulation and numerical implementation. Students are aware of various application areas through the examples.

Content :
Martingale
Discrete-time martingale. Asymptotic convergence. Applications
Standard Markov processes
Poisson process. Markov jump processes
Applications to stochastic operation research
Introduction to stochastic differential equations (SDE)
Brownian motion
Diffusions
Numerical methods for SDE
Practical implementation with R

Bibliography :
D. Foata and A. Fuchs. Processus stochastique : processus de Poisson, chaînes de Markov et martingales. Dunod, 2002.
F. Comets and T. Meyre. Calcul stochastique et modèles de diffusions. Dunod, 2006.
P. Kloeden, E. Peter, E. Platen and H. Schurz. Numerical Solution of SDE Through Computer Experiments. Springer, 2003.
F. Klebaner. Introduction to stochastic calculus with applications. Imperial College Press, 1998
S. I. Resnick
Adventures in stochastic processes.
Birkhäuser, 2002

Requirements :
Courses of “Introduction aux probability” (STPI-2nd), “Tools for stochastic modelling” (TC-3rd), “Probability” (ARO05), “Markov models” (ARO06).

Organisation :

Evaluation :
Two written examinations (2/3) and a practical examination and/or project (1/3).

Target :

Risk Analysis and Scoring	DMA07-MSRS
Number of hours : 36.00 h	3.50 ECTS credit
CM : 20.00 h, TP : 16.00 h	handout in English
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
The objective of this course is to make students acquainted with fundamental tools for risk analysis and scoring and with related SAS/R skills.

Content :
Regression models for binary data
Statistical inference in the logistic model
Variable selection and model validation in the logistic model
Confusion matrix and ROC curve
Overdispersed data
Zero-inflated regression models
Practical with SAS, R

Bibliography :
Dupuy J.-F. Modèles linéaires généralisés - problèmes de censure, données manquantes, excès de zéros. ISTE Press – Elsevier, London, UK, 2023.
J.M. Hilbe. Logistic regression models. Chapman & Hall, 2009.

Requirements :
Courses of "Linear regression models" and "inferential statistics" (3rd year).

Organisation :

Evaluation :
One written examination.

Target :

Time Series	DMA07-ST
Number of hours : 30.00 h	3.00 ECTS credit
CM : 8.00 h, TD : 10.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : CHAGNEAU Pierrette	

Objectives :
The aim of this course is to provide fundamentals tools for the analysis of univariate time series and associated skills in R.

Content :
Basic tools for time series analysis : moving average, exponential smoothing
Discrete-time stationary processes : stationarity, autocorrelation function and partial autocorrelation function, ARMA processes and related statistical inference
SARIMA models : identification, estimation, validation
Unit root test
Practical skills with R.

Bibliography :
P.J. Brockwell, R.A. Davis. Times series: theory and methods. Springer, 1991.
P.J. Brockwell, R.A. Davis. Introduction to time series and forecast (2nd ed.). Springer, 2002.
P.S.P Cowpertwait, A.V. Metcallfe. Introductory Time Series with R. Springer, 2009.
C. Gouriéroux. Séries temporelles et modèles dynamiques (2nd ed). Economica, 1995.
J.D. Hamilton. Time series analysis. Princeton University Press, 1994.

Requirements :
Courses of “Probability” (DMA05-Proba), “Introduction to mathematical softwares” (DMA05-ILM) and “Inferential statistics” (DMA06-SI) of 3rd year.

Organisation :

Evaluation :
Project.

Target :

Object Oriented Programming in C++	DMA07-POO
Number of hours : 28.00 h	2.50 ECTS credit
CM : 14.00 h, TP : 14.00 h	
Reference Teacher(s) : ANQUETIL Eric	

Objectives :
Object-oriented programming is a powerful tool to cope with the development of real applications. It helps to define projects with an effective monitoring of the different phases of evolution. This course emphasizes the fundamental principles associated with object-oriented programming. It is performed in C++ and introduce all the fundamental concepts of object programming.

Content :
Object-oriented programming in C++.
* Notion of object in C++: Construction of objects, Interfaces, Encapsulation, etc.
* Memory management: Dynamic memory allocation, Destructor, Assignment statement…
* Basic elements of C++: Input/Output management, String, etc.
* Object conception in C++: Aggregation, Inheritance, Polymorphism, Access control, etc.
* Multiple inheritance
* Generic programming, Template class.
* Internal class.
* Standard Template Library (STL),
* Run Time Type Identification (RTTI)
* Exceptions handling.
* Introduction to IHM programming (DotNET, wpf and MVVM…)

Bibliography :
G. Booch. Conception orientée objets et applications. Addison-Wesley, 1996.
B. Stroustrup. The C++ programming language (third edition). Addison-Wesley, 1997.

Requirements :
Basic understanding of algorithmic.
C programming
Optional: Basic object-oriented programming in Java (STPI 2A).

Organisation :
Revision of class notes (1h per week)

Evaluation :
A practical TP exam with several questions on the course.

Target :

Operational research methods	DMA07-RO
Number of hours : 36.00 h	3.50 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course is a general presentation of operations research techniques for the solution of integer linear optimization
problems. The main objectives are:
• To understand standard solution methods and complexity issues in integer linear programming.
• To be able to analyze a practical problem, identify its variables, model it as a mathematical program, propose and apply a solution method and discuss the results.
• To know and recognize the most classical problems of operational research.
• To be able to analyze the ethical stakes of using mathematical decision aid tools, in particular those developed with operational research methods.

Content :
• Introduction to combinatorial optimization
• Duality in linear programming and geometrical interpretation of the simplex algorithm
• Modeling a practical problem using integer programming
• Solving an integer program with the branch-and-bound algorithm
• Linear and Lagrangian relaxations; duality in integer programming
• Geometrical interpretations and approaches in integer programming
• Application to classical problems of operational research stated as practical cases
• Modeling and solution of problems using the language Julia and its modeling library JuMP to call the optimization codes GLPK, Gurobi and Coin CBC.
• Implementation of a branch-and bound algorithm using Julia language.
• Sensitization to the main ethical matters of optimization.

Bibliography :
[1] A. Billionnet, Optimisation discrète : de la modélisation à la résolution par des logiciels de programmation mathématique. 2007.
[2] M. Minoux, Programmation mathématique : théorie et algorithmes, 2e édition. 2008.
[3] G. L. Nemhauser and L. A. Wolsey, “Integer and Combinatorial Optimization,” 1999
[4] R. J. Vanderbei, Linear Programming - Foundations and Extensions, vol. 114. Boston, MA: Springer US, 2008.
[5] L. A. Wolsey, Integer programming. 1998

Requirements :
First and second year courses of linear algebra, courses of "Optimization", "Discrete optimization" and "Numerical Analysis" (3rd year).

Organisation :

Evaluation :
One test (40%), one Julia project (45 %) and several CC on ethical matters (15 %)

Target :

Interdisciplinary Project	DMA07-PI
Number of hours : 36.00 h	3.50 ECTS credit
EP : 36.00 h	
Reference Teacher(s) : LE GRUYER Yves	

Objectives :
The objective of this project is to make students familiar with its future professional environment. They must manage mathematical modelling in another scientific disciplinary framework. Thus, the progress of the project is ensured in collaboration with a teacher of another department (EII, GCU, GMA, INFO, SGM, SRC). Additional learning outcomes are to manage a collaborative project and to find relevant bibliographic resources.

Content :
From the proposal by a department (EII, GCU, GMA, INFO, SGM, SRC), the student must produce a bibliography, a written report and an oral presentation.

Bibliography :

Requirements :

Organisation :

Evaluation :
a written report and an oral presentation

Target :

Research Project	DMA07-PR1
Number of hours : 36.00 h	3.50 ECTS credit
EP : 36.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The objective is to propose a discovery of the profession of researcher and its professional environment in an academic or industrial context.

Content :
A project exploring one of the themes favored by the student will be proposed by a researcher from an academic/industrial laboratory in Rennes. It is adapted to the skills acquired until then by the student.
It is requested to conduct an interview with a researcher from at least three different laboratories. The project can be accompanied by any initiative of discovery of the world of research (visit of academic or industrial laboratory, participation in meetings of follow-up of research projects, process of publication of a scientific article ...)

Bibliography :
Each project is based on a specific bibliographic study.

Requirements :
36h are reserved in the timetable of the semester. Each session is an opportunity to discuss with his tutor.

Organisation :

Evaluation :
A report of not more than 25 pages which can be written in English. A 20 minutes defense in English.

Target :
3 students with strong academic results

Business Seminar	DMA07-SE
Number of hours : 24.00 h	1.00 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : ARSLAN Ayse Nur, NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 4th year, the module will offer (among others) :
- Specific software training ;
- some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing...).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

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 :
The aim of this module is to assemble a team of students on a business start-up project or product development plan (business plan).

Content :
Through conferences, interviews and lectures, students gather the information and advice necessary to set out a business plan. Working in small work groups, the students find, develop and formulate their own business start-up project or product-development plan. Progress is evaluated through progress reports in the form of oral presentations.

Groups also benefit from tutorial sessions.

Bibliography :
Provided during the course

Requirements :
management simulation module S6

Organisation :
4 hours per week

Evaluation :
Oral defense and written deliverable

Target :

INNOVATION & ENTREPRENEURSHIP (RIE)	HUM07-IE
Number of hours : 54.00 h	3.00 ECTS credit
TD : 54.00 h	
Reference Teacher(s) :	

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 :

Projet de recherche pour la mobilité entrante 1/3 semestre	DEIF1-MOB15
Number of hours : 190.00 h	15.00 ECTS credit
PR : 15.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

3rd year industrial Placement	DMA07-STA3-2
Number of hours : 240.00 h	2.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

3rd year industrial Placement	DMA07-STA3-3
Number of hours : 240.00 h	3.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 7

Parcours interne semestre impair-externe semestre pair

1	**DMA07-MA**		**APPLIED MATHEMATICS**	**7.00**
	DMA07-OHA	O	Hilbertian Tools and Applications	3.50
	DMA07-MSSD	O	Stochastic Models of Dynamical Systems	3.50
2	**DMA07-MODS**		**STATISTICAL MODELLING**	**6.50**
	DMA07-MSRS	O	Risk Analysis and Scoring	3.50
	DMA07-ST	O	Time Series	3.00
3	**DMA07-INFOS**		**SCIENTIFIC COMPUTING AND DISCRETE MATHEMATICS**	**6.00**
	DMA07-POO	O	Object Oriented Programming in C++	2.50
	DMA07-RO	O	Operational research methods	3.50
4	**DMA07-SEMP**		**SEMINAR AND PROJECT**	**4.50**
	DMA07-PI	C	Interdisciplinary Project	3.50
	DMA07-PR1	C	Research Project	3.50
	DMA07-SE	O	Business Seminar	1.00
5	**HUM07**		**Non-scientific syllabus S7**	**6.00**
	HUM07-ANGL	O	English	2.00
	HUM07-EI	C	Entrepreneurship and Innovation	3.00
	HUM07-IE	C	INNOVATION & ENTREPRENEURSHIP (RIE)	3.00
	HUM07-EPS	O	Sport and physical education	1.00
6	**HUMF1-ELSA Mus**		**Music with studies**	**1.00**
	HUMF1-MUS	F	Music Studies	1.00
8	**HUMF1-SAM STMA**		**3rd year industrial Placement**	**2.00**
	DMA07-STA3-2	C	3rd year industrial Placement	2.00

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

Hilbertian Tools and Applications	DMA07-OHA
Number of hours : 36.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 16.00 h, TP : 6.00 h	handout in English
Reference Teacher(s) : BRIANE Marc	

Objectives :
This teaching delivers notions of Functional Analysis which are essential in mathematical engineering.

Content :
Inner product, Cauchy-Schwarz inequality
Definition and examples of Hilbert spaces
Theorem of the orthogonal projection
The Riesz representation theorem
The weak convergence in a Hilbert space
Hilbert bases and Gram-Schmidt process
Fourier series and orthogonal polynomials
Minimization of a convex functional
Introduction to wavelets.

Bibliography :
H. Brezis. Functional Analysis, Sobolev Spaces and Partial Differential Equations. Springer, New York, 2011.
J. M. Bony. Cours d'analyse, théorie des distributions et analyse de Fourier. Édition de l'école Polytechnique, 2001.
B. Maury. Analyse fonctionnelle, exercices et problèmes corrigés. Ellipse, 2004.
W. Rudin, Real and complex analysis, Third edition, McGraw-Hill Book Co., New York, 1987.
M. Willem, Analyse harmonique réelle, Collection Méthodes, Hermann, Paris, 1995.

Requirements :
This teaching needs the knowledge of the basic mathematics of the Bachelor.

Organisation :

Evaluation :
One written test (3/4) and one test on tutorial practises or project (1/4).

Target :

Stochastic Models of Dynamical Systems	DMA07-MSSD
Number of hours : 42.00 h	3.50 ECTS credit
CM : 18.00 h, TD : 14.00 h, TP : 10.00 h	handout in English
Reference Teacher(s) : LEDOUX James	

Objectives :
Objectives of this course are to make students acquainted with stochastic models of dynamical systems together with their simulation and numerical implementation. Students are aware of various application areas through the examples.

Content :
Martingale
Discrete-time martingale. Asymptotic convergence. Applications
Standard Markov processes
Poisson process. Markov jump processes
Applications to stochastic operation research
Introduction to stochastic differential equations (SDE)
Brownian motion
Diffusions
Numerical methods for SDE
Practical implementation with R

Bibliography :
D. Foata and A. Fuchs. Processus stochastique : processus de Poisson, chaînes de Markov et martingales. Dunod, 2002.
F. Comets and T. Meyre. Calcul stochastique et modèles de diffusions. Dunod, 2006.
P. Kloeden, E. Peter, E. Platen and H. Schurz. Numerical Solution of SDE Through Computer Experiments. Springer, 2003.
F. Klebaner. Introduction to stochastic calculus with applications. Imperial College Press, 1998
S. I. Resnick
Adventures in stochastic processes.
Birkhäuser, 2002

Requirements :
Courses of “Introduction aux probability” (STPI-2nd), “Tools for stochastic modelling” (TC-3rd), “Probability” (ARO05), “Markov models” (ARO06).

Organisation :

Evaluation :
Two written examinations (2/3) and a practical examination and/or project (1/3).

Target :

Risk Analysis and Scoring	DMA07-MSRS
Number of hours : 36.00 h	3.50 ECTS credit
CM : 20.00 h, TP : 16.00 h	handout in English
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
The objective of this course is to make students acquainted with fundamental tools for risk analysis and scoring and with related SAS/R skills.

Content :
Regression models for binary data
Statistical inference in the logistic model
Variable selection and model validation in the logistic model
Confusion matrix and ROC curve
Overdispersed data
Zero-inflated regression models
Practical with SAS, R

Bibliography :
Dupuy J.-F. Modèles linéaires généralisés - problèmes de censure, données manquantes, excès de zéros. ISTE Press – Elsevier, London, UK, 2023.
J.M. Hilbe. Logistic regression models. Chapman & Hall, 2009.

Requirements :
Courses of "Linear regression models" and "inferential statistics" (3rd year).

Organisation :

Evaluation :
One written examination.

Target :

Time Series	DMA07-ST
Number of hours : 30.00 h	3.00 ECTS credit
CM : 8.00 h, TD : 10.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : CHAGNEAU Pierrette	

Objectives :
The aim of this course is to provide fundamentals tools for the analysis of univariate time series and associated skills in R.

Content :
Basic tools for time series analysis : moving average, exponential smoothing
Discrete-time stationary processes : stationarity, autocorrelation function and partial autocorrelation function, ARMA processes and related statistical inference
SARIMA models : identification, estimation, validation
Unit root test
Practical skills with R.

Bibliography :
P.J. Brockwell, R.A. Davis. Times series: theory and methods. Springer, 1991.
P.J. Brockwell, R.A. Davis. Introduction to time series and forecast (2nd ed.). Springer, 2002.
P.S.P Cowpertwait, A.V. Metcallfe. Introductory Time Series with R. Springer, 2009.
C. Gouriéroux. Séries temporelles et modèles dynamiques (2nd ed). Economica, 1995.
J.D. Hamilton. Time series analysis. Princeton University Press, 1994.

Requirements :
Courses of “Probability” (DMA05-Proba), “Introduction to mathematical softwares” (DMA05-ILM) and “Inferential statistics” (DMA06-SI) of 3rd year.

Organisation :

Evaluation :
Project.

Target :

Object Oriented Programming in C++	DMA07-POO
Number of hours : 28.00 h	2.50 ECTS credit
CM : 14.00 h, TP : 14.00 h	
Reference Teacher(s) : ANQUETIL Eric	

Objectives :
Object-oriented programming is a powerful tool to cope with the development of real applications. It helps to define projects with an effective monitoring of the different phases of evolution. This course emphasizes the fundamental principles associated with object-oriented programming. It is performed in C++ and introduce all the fundamental concepts of object programming.

Content :
Object-oriented programming in C++.
* Notion of object in C++: Construction of objects, Interfaces, Encapsulation, etc.
* Memory management: Dynamic memory allocation, Destructor, Assignment statement…
* Basic elements of C++: Input/Output management, String, etc.
* Object conception in C++: Aggregation, Inheritance, Polymorphism, Access control, etc.
* Multiple inheritance
* Generic programming, Template class.
* Internal class.
* Standard Template Library (STL),
* Run Time Type Identification (RTTI)
* Exceptions handling.
* Introduction to IHM programming (DotNET, wpf and MVVM…)

Bibliography :
G. Booch. Conception orientée objets et applications. Addison-Wesley, 1996.
B. Stroustrup. The C++ programming language (third edition). Addison-Wesley, 1997.

Requirements :
Basic understanding of algorithmic.
C programming
Optional: Basic object-oriented programming in Java (STPI 2A).

Organisation :
Revision of class notes (1h per week)

Evaluation :
A practical TP exam with several questions on the course.

Target :

Operational research methods	DMA07-RO
Number of hours : 36.00 h	3.50 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course is a general presentation of operations research techniques for the solution of integer linear optimization
problems. The main objectives are:
• To understand standard solution methods and complexity issues in integer linear programming.
• To be able to analyze a practical problem, identify its variables, model it as a mathematical program, propose and apply a solution method and discuss the results.
• To know and recognize the most classical problems of operational research.
• To be able to analyze the ethical stakes of using mathematical decision aid tools, in particular those developed with operational research methods.

Content :
• Introduction to combinatorial optimization
• Duality in linear programming and geometrical interpretation of the simplex algorithm
• Modeling a practical problem using integer programming
• Solving an integer program with the branch-and-bound algorithm
• Linear and Lagrangian relaxations; duality in integer programming
• Geometrical interpretations and approaches in integer programming
• Application to classical problems of operational research stated as practical cases
• Modeling and solution of problems using the language Julia and its modeling library JuMP to call the optimization codes GLPK, Gurobi and Coin CBC.
• Implementation of a branch-and bound algorithm using Julia language.
• Sensitization to the main ethical matters of optimization.

Bibliography :
[1] A. Billionnet, Optimisation discrète : de la modélisation à la résolution par des logiciels de programmation mathématique. 2007.
[2] M. Minoux, Programmation mathématique : théorie et algorithmes, 2e édition. 2008.
[3] G. L. Nemhauser and L. A. Wolsey, “Integer and Combinatorial Optimization,” 1999
[4] R. J. Vanderbei, Linear Programming - Foundations and Extensions, vol. 114. Boston, MA: Springer US, 2008.
[5] L. A. Wolsey, Integer programming. 1998

Requirements :
First and second year courses of linear algebra, courses of "Optimization", "Discrete optimization" and "Numerical Analysis" (3rd year).

Organisation :

Evaluation :
One test (40%), one Julia project (45 %) and several CC on ethical matters (15 %)

Target :

Interdisciplinary Project	DMA07-PI
Number of hours : 36.00 h	3.50 ECTS credit
EP : 36.00 h	
Reference Teacher(s) : LE GRUYER Yves	

Objectives :
The objective of this project is to make students familiar with its future professional environment. They must manage mathematical modelling in another scientific disciplinary framework. Thus, the progress of the project is ensured in collaboration with a teacher of another department (EII, GCU, GMA, INFO, SGM, SRC). Additional learning outcomes are to manage a collaborative project and to find relevant bibliographic resources.

Content :
From the proposal by a department (EII, GCU, GMA, INFO, SGM, SRC), the student must produce a bibliography, a written report and an oral presentation.

Bibliography :

Requirements :

Organisation :

Evaluation :
a written report and an oral presentation

Target :

Research Project	DMA07-PR1
Number of hours : 36.00 h	3.50 ECTS credit
EP : 36.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The objective is to propose a discovery of the profession of researcher and its professional environment in an academic or industrial context.

Content :
A project exploring one of the themes favored by the student will be proposed by a researcher from an academic/industrial laboratory in Rennes. It is adapted to the skills acquired until then by the student.
It is requested to conduct an interview with a researcher from at least three different laboratories. The project can be accompanied by any initiative of discovery of the world of research (visit of academic or industrial laboratory, participation in meetings of follow-up of research projects, process of publication of a scientific article ...)

Bibliography :
Each project is based on a specific bibliographic study.

Requirements :
36h are reserved in the timetable of the semester. Each session is an opportunity to discuss with his tutor.

Organisation :

Evaluation :
A report of not more than 25 pages which can be written in English. A 20 minutes defense in English.

Target :
3 students with strong academic results

Business Seminar	DMA07-SE
Number of hours : 24.00 h	1.00 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : ARSLAN Ayse Nur, NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 4th year, the module will offer (among others) :
- Specific software training ;
- some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing...).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

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 :
The aim of this module is to assemble a team of students on a business start-up project or product development plan (business plan).

Content :
Through conferences, interviews and lectures, students gather the information and advice necessary to set out a business plan. Working in small work groups, the students find, develop and formulate their own business start-up project or product-development plan. Progress is evaluated through progress reports in the form of oral presentations.

Groups also benefit from tutorial sessions.

Bibliography :
Provided during the course

Requirements :
management simulation module S6

Organisation :
4 hours per week

Evaluation :
Oral defense and written deliverable

Target :

INNOVATION & ENTREPRENEURSHIP (RIE)	HUM07-IE
Number of hours : 54.00 h	3.00 ECTS credit
TD : 54.00 h	
Reference Teacher(s) :	

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 :

Music Studies	HUMF1-MUS
Number of hours : 25.00 h	1.00 ECTS credit
TD : 25.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- working and communicating in a team
- cultural openness
- listening to others
- managing stress

Students have the opportunity to combine their studies with their passion for music. By joining two Jazz and Classical orchestras, they can continue their instrumental practice and also participate in a quality musical training course supervised by teachers from the Rennes Regional Conservatory. Through group practice, they will be able to develop their skills in listening, collaboration and their ability to adapt, all of which are essential to every kind of teamwork. They will participate actively in the cultural life of the school and frequently perform in public. Collective artistic practice within the institution will promote the personal development of the student.

Content :
2h collective lessons per week in the JAZZ et classical music ensembles with instrumental practice
training in chamber music. Participation in festivals and organisation of cultural events at INSA. Several concerts and recitals over the year at INA and externally.

Bibliography :
Musical scores are distributed at the beginning of the year

Requirements :
Good instrumental ability, music studies in conservatory or school of music; ability to read music.
Admission to the programme is based on dossier and an audition organised at the beginning of the year.

Organisation :
2 hours group practice per week

Evaluation :
validation without grade

Target :
INSA students, INP, Centrale/Supélec and external students

3rd year industrial Placement	DMA07-STA3-2
Number of hours : 240.00 h	2.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 7

Parcours Recherche

1	**DMA07-MA**		**APPLIED MATHEMATICS**	**7.00**
	DMA07-OHA	O	Hilbertian Tools and Applications	3.50
	DMA07-MSSD	O	Stochastic Models of Dynamical Systems	3.50
2	**DMA07-MODS**		**STATISTICAL MODELLING**	**6.50**
	DMA07-MSRS	O	Risk Analysis and Scoring	3.50
	DMA07-ST	O	Time Series	3.00
3	**DMA07-INFOS**		**SCIENTIFIC COMPUTING AND DISCRETE MATHEMATICS**	**6.00**
	DMA07-POO	O	Object Oriented Programming in C++	2.50
	DMA07-RO	O	Operational research methods	3.50
4	**DMA07-SEMP-2**		**SEMINAR AND PROJECT**	**4.50**
	DMA07-PR1	O	Research Project	3.50
	DMA07-SE	O	Business Seminar	1.00
5	**HUM07**		**Non-scientific syllabus S7**	**6.00**
	HUM07-ANGL	O	English	2.00
	HUM07-EI	C	Entrepreneurship and Innovation	3.00
	HUM07-IE	C	INNOVATION & ENTREPRENEURSHIP (RIE)	3.00
	HUM07-EPS	O	Sport and physical education	1.00
8	**HUMF1-SAM STMA**		**3rd year industrial Placement**	**2.00**
	DMA07-STA3-2	C	3rd year industrial Placement	2.00
9	**HUMF1-SAM STMA3**		**3rd year industrial Placement**	**3.00**
	DMA07-STA3-3	C	3rd year industrial Placement	3.00

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

Hilbertian Tools and Applications	DMA07-OHA
Number of hours : 36.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 16.00 h, TP : 6.00 h	handout in English
Reference Teacher(s) : BRIANE Marc	

Objectives :
This teaching delivers notions of Functional Analysis which are essential in mathematical engineering.

Content :
Inner product, Cauchy-Schwarz inequality
Definition and examples of Hilbert spaces
Theorem of the orthogonal projection
The Riesz representation theorem
The weak convergence in a Hilbert space
Hilbert bases and Gram-Schmidt process
Fourier series and orthogonal polynomials
Minimization of a convex functional
Introduction to wavelets.

Bibliography :
H. Brezis. Functional Analysis, Sobolev Spaces and Partial Differential Equations. Springer, New York, 2011.
J. M. Bony. Cours d'analyse, théorie des distributions et analyse de Fourier. Édition de l'école Polytechnique, 2001.
B. Maury. Analyse fonctionnelle, exercices et problèmes corrigés. Ellipse, 2004.
W. Rudin, Real and complex analysis, Third edition, McGraw-Hill Book Co., New York, 1987.
M. Willem, Analyse harmonique réelle, Collection Méthodes, Hermann, Paris, 1995.

Requirements :
This teaching needs the knowledge of the basic mathematics of the Bachelor.

Organisation :

Evaluation :
One written test (3/4) and one test on tutorial practises or project (1/4).

Target :

Stochastic Models of Dynamical Systems	DMA07-MSSD
Number of hours : 42.00 h	3.50 ECTS credit
CM : 18.00 h, TD : 14.00 h, TP : 10.00 h	handout in English
Reference Teacher(s) : LEDOUX James	

Objectives :
Objectives of this course are to make students acquainted with stochastic models of dynamical systems together with their simulation and numerical implementation. Students are aware of various application areas through the examples.

Content :
Martingale
Discrete-time martingale. Asymptotic convergence. Applications
Standard Markov processes
Poisson process. Markov jump processes
Applications to stochastic operation research
Introduction to stochastic differential equations (SDE)
Brownian motion
Diffusions
Numerical methods for SDE
Practical implementation with R

Bibliography :
D. Foata and A. Fuchs. Processus stochastique : processus de Poisson, chaînes de Markov et martingales. Dunod, 2002.
F. Comets and T. Meyre. Calcul stochastique et modèles de diffusions. Dunod, 2006.
P. Kloeden, E. Peter, E. Platen and H. Schurz. Numerical Solution of SDE Through Computer Experiments. Springer, 2003.
F. Klebaner. Introduction to stochastic calculus with applications. Imperial College Press, 1998
S. I. Resnick
Adventures in stochastic processes.
Birkhäuser, 2002

Requirements :
Courses of “Introduction aux probability” (STPI-2nd), “Tools for stochastic modelling” (TC-3rd), “Probability” (ARO05), “Markov models” (ARO06).

Organisation :

Evaluation :
Two written examinations (2/3) and a practical examination and/or project (1/3).

Target :

Risk Analysis and Scoring	DMA07-MSRS
Number of hours : 36.00 h	3.50 ECTS credit
CM : 20.00 h, TP : 16.00 h	handout in English
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
The objective of this course is to make students acquainted with fundamental tools for risk analysis and scoring and with related SAS/R skills.

Content :
Regression models for binary data
Statistical inference in the logistic model
Variable selection and model validation in the logistic model
Confusion matrix and ROC curve
Overdispersed data
Zero-inflated regression models
Practical with SAS, R

Bibliography :
Dupuy J.-F. Modèles linéaires généralisés - problèmes de censure, données manquantes, excès de zéros. ISTE Press – Elsevier, London, UK, 2023.
J.M. Hilbe. Logistic regression models. Chapman & Hall, 2009.

Requirements :
Courses of "Linear regression models" and "inferential statistics" (3rd year).

Organisation :

Evaluation :
One written examination.

Target :

Time Series	DMA07-ST
Number of hours : 30.00 h	3.00 ECTS credit
CM : 8.00 h, TD : 10.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : CHAGNEAU Pierrette	

Objectives :
The aim of this course is to provide fundamentals tools for the analysis of univariate time series and associated skills in R.

Content :
Basic tools for time series analysis : moving average, exponential smoothing
Discrete-time stationary processes : stationarity, autocorrelation function and partial autocorrelation function, ARMA processes and related statistical inference
SARIMA models : identification, estimation, validation
Unit root test
Practical skills with R.

Bibliography :
P.J. Brockwell, R.A. Davis. Times series: theory and methods. Springer, 1991.
P.J. Brockwell, R.A. Davis. Introduction to time series and forecast (2nd ed.). Springer, 2002.
P.S.P Cowpertwait, A.V. Metcallfe. Introductory Time Series with R. Springer, 2009.
C. Gouriéroux. Séries temporelles et modèles dynamiques (2nd ed). Economica, 1995.
J.D. Hamilton. Time series analysis. Princeton University Press, 1994.

Requirements :
Courses of “Probability” (DMA05-Proba), “Introduction to mathematical softwares” (DMA05-ILM) and “Inferential statistics” (DMA06-SI) of 3rd year.

Organisation :

Evaluation :
Project.

Target :

Object Oriented Programming in C++	DMA07-POO
Number of hours : 28.00 h	2.50 ECTS credit
CM : 14.00 h, TP : 14.00 h	
Reference Teacher(s) : ANQUETIL Eric	

Objectives :
Object-oriented programming is a powerful tool to cope with the development of real applications. It helps to define projects with an effective monitoring of the different phases of evolution. This course emphasizes the fundamental principles associated with object-oriented programming. It is performed in C++ and introduce all the fundamental concepts of object programming.

Content :
Object-oriented programming in C++.
* Notion of object in C++: Construction of objects, Interfaces, Encapsulation, etc.
* Memory management: Dynamic memory allocation, Destructor, Assignment statement…
* Basic elements of C++: Input/Output management, String, etc.
* Object conception in C++: Aggregation, Inheritance, Polymorphism, Access control, etc.
* Multiple inheritance
* Generic programming, Template class.
* Internal class.
* Standard Template Library (STL),
* Run Time Type Identification (RTTI)
* Exceptions handling.
* Introduction to IHM programming (DotNET, wpf and MVVM…)

Bibliography :
G. Booch. Conception orientée objets et applications. Addison-Wesley, 1996.
B. Stroustrup. The C++ programming language (third edition). Addison-Wesley, 1997.

Requirements :
Basic understanding of algorithmic.
C programming
Optional: Basic object-oriented programming in Java (STPI 2A).

Organisation :
Revision of class notes (1h per week)

Evaluation :
A practical TP exam with several questions on the course.

Target :

Operational research methods	DMA07-RO
Number of hours : 36.00 h	3.50 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course is a general presentation of operations research techniques for the solution of integer linear optimization
problems. The main objectives are:
• To understand standard solution methods and complexity issues in integer linear programming.
• To be able to analyze a practical problem, identify its variables, model it as a mathematical program, propose and apply a solution method and discuss the results.
• To know and recognize the most classical problems of operational research.
• To be able to analyze the ethical stakes of using mathematical decision aid tools, in particular those developed with operational research methods.

Content :
• Introduction to combinatorial optimization
• Duality in linear programming and geometrical interpretation of the simplex algorithm
• Modeling a practical problem using integer programming
• Solving an integer program with the branch-and-bound algorithm
• Linear and Lagrangian relaxations; duality in integer programming
• Geometrical interpretations and approaches in integer programming
• Application to classical problems of operational research stated as practical cases
• Modeling and solution of problems using the language Julia and its modeling library JuMP to call the optimization codes GLPK, Gurobi and Coin CBC.
• Implementation of a branch-and bound algorithm using Julia language.
• Sensitization to the main ethical matters of optimization.

Bibliography :
[1] A. Billionnet, Optimisation discrète : de la modélisation à la résolution par des logiciels de programmation mathématique. 2007.
[2] M. Minoux, Programmation mathématique : théorie et algorithmes, 2e édition. 2008.
[3] G. L. Nemhauser and L. A. Wolsey, “Integer and Combinatorial Optimization,” 1999
[4] R. J. Vanderbei, Linear Programming - Foundations and Extensions, vol. 114. Boston, MA: Springer US, 2008.
[5] L. A. Wolsey, Integer programming. 1998

Requirements :
First and second year courses of linear algebra, courses of "Optimization", "Discrete optimization" and "Numerical Analysis" (3rd year).

Organisation :

Evaluation :
One test (40%), one Julia project (45 %) and several CC on ethical matters (15 %)

Target :

Research Project	DMA07-PR1
Number of hours : 36.00 h	3.50 ECTS credit
EP : 36.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The objective is to propose a discovery of the profession of researcher and its professional environment in an academic or industrial context.

Content :
A project exploring one of the themes favored by the student will be proposed by a researcher from an academic/industrial laboratory in Rennes. It is adapted to the skills acquired until then by the student.
It is requested to conduct an interview with a researcher from at least three different laboratories. The project can be accompanied by any initiative of discovery of the world of research (visit of academic or industrial laboratory, participation in meetings of follow-up of research projects, process of publication of a scientific article ...)

Bibliography :
Each project is based on a specific bibliographic study.

Requirements :
36h are reserved in the timetable of the semester. Each session is an opportunity to discuss with his tutor.

Organisation :

Evaluation :
A report of not more than 25 pages which can be written in English. A 20 minutes defense in English.

Target :
3 students with strong academic results

Business Seminar	DMA07-SE
Number of hours : 24.00 h	1.00 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : ARSLAN Ayse Nur, NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 4th year, the module will offer (among others) :
- Specific software training ;
- some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing...).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

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 :
The aim of this module is to assemble a team of students on a business start-up project or product development plan (business plan).

Content :
Through conferences, interviews and lectures, students gather the information and advice necessary to set out a business plan. Working in small work groups, the students find, develop and formulate their own business start-up project or product-development plan. Progress is evaluated through progress reports in the form of oral presentations.

Groups also benefit from tutorial sessions.

Bibliography :
Provided during the course

Requirements :
management simulation module S6

Organisation :
4 hours per week

Evaluation :
Oral defense and written deliverable

Target :

INNOVATION & ENTREPRENEURSHIP (RIE)	HUM07-IE
Number of hours : 54.00 h	3.00 ECTS credit
TD : 54.00 h	
Reference Teacher(s) :	

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 :

3rd year industrial Placement	DMA07-STA3-2
Number of hours : 240.00 h	2.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

3rd year industrial Placement	DMA07-STA3-3
Number of hours : 240.00 h	3.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 8

Parcours FISP

1	**DMA08-PROJ**		**PROJET**	**2.50**
	DMA08-BE	O	Engineering Practical and Realistic Study	2.50
2	**HUM08-ISP**		**Non-scientific syllabus S8**	**3.50**
	HUM08-ANGL	O	English	2.00
	HUMF2-ALL	C	German	1.50
	HUMF2-ESP	C	Spanish	1.50
	HUMF2-ITA	C	Italian	1.50
	HUMF2-JAP	C	Japanese	1.50
	HUMF2-RUS	C	Russian	1.50

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

Engineering Practical and Realistic Study	DMA08-BE
Number of hours : 36.00 h	2.50 ECTS credit
EP : 36.00 h	
Reference Teacher(s) : LE GRUYER Yves	

Objectives :
Our main aim is to offer to an experience of realization of project in relation to industrial partners.
This experience will contribute to develop the aptitude of the students to find the relevant mathematical tools and to adapt them to deal with realistic problems. This work is done by group to reinforce the aptitudes of each student to « Team work ».

Content :
Multiple discussions with industrial and teaching supervisors.

Bibliography :
depends on the subject.

Requirements :
All courses from S5 to S7 in applied mathematics.

Organisation :
The students work is supervised by an industrial partner and a researcher from INSA (Applied department) «Mathématiques Appliquées».

Each group of students must propose an adapted solution, write a report and defend orally it’s work in front of a committee. Several meetings are planned to ensure a complete and effective follow-up.

Evaluation :
A mark is awarded by the committee and the industrial advisor after the defense. This mark corresponds to the quality of the work, the report and the oral defense.

Target :
S8 students (except “parcours recherche “).

English	HUM08-ANGL
Number of hours : 24.00 h	2.00 ECTS credit
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 :

German	HUMF2-ALL
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

To consolidate secondary school level learning outcomes
To attain, as a basic minimum, the B1 level by the end of the first cycle
To practise written and oral comprehension through the use of contemporary supports and multimedia
To develop level of oral expression through exercises in small groups and class discussions
To demonstrate and perfect your skills in German through project work
Support for foreign exchange and work placements

Content :
Contents:
- Exercises to practise spoken German for everyday situations and professional life
- Study of newspaper articles, broadcasts, videos
- Study of current affairs (politics, economics, sociology and culture) in Germanophone countries
- Introduction to economic and professional German
- Grammar revision
- Cultural openness (film studies, exhibitions, music)

Bibliography :
(available in the INSA Rennes library):
- DUDEN Bilingual Dictionary (German-French/French-German)
Grammatik Aktiv A1-B1, Cornelsen (mit Audio CD)_- Schritte-Ubungsgrammatik A1-B1, Hueber-Verlag
- Übungsgrammatik für die Grundstufe, Hueber-Verlag (Moodle) - Na also!
Waltraud Legros, Ellipses_- Manuel : Menschen hier, Hueber-Verlag
- Deutsch perfekt (periodical) -
Deutsche Welle/ ZDF logo (web) -
multimedia supports (web)

Requirements :
Intermediate German: B1 level

Organisation :
1h30 per week; 21h face-to-face lessons per semester
Personal Study time: 14h
Total: 35 h

Students are encouraged to regularly read news articles in German and to view videos and film series in addition to work assigned between lessons.

Evaluation :
S2 : Oral

Target :
Engineering students

Spanish	HUMF2-ESP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : AMARGOS GUILLERAY Marine	

Objectives :
- Practising and strengthening of one's knowledge in the Spanish language and culture (Spanish culture, Spanish and
Latin- American civilizations, societal developments).
- How to manage team projects
- Acquiring, developing know-how and knowledge in a professional and multicultural environment
- Understanding social, technological and economical challenges in Spanish-speaking countries.

Content :

Bibliography :
1. PASTOR Enrique and PROST Gisèle : "La grammaire active de l'espagnol", Le livre de poche, collection Les Langues modernes.
2. BECHERELLE, "El arte de conjugar en espanol", Hatier.
3. Larousse bilingual dictionary, Le Grand Dictionnaire de Garcia y Pelayo et Testas, Dictionary Hispano Bordas.
4. "Passez-moi l'expression en espagnol", Belin.
5. "El espanol en la prensa", Belin.

Requirements :
B1 level

Organisation :
- Reinforcing grammar / conjugation
- Reading and oral comprehension
- Writing and speaking (debates, drama).

Advice : Read in Spanish : contemporary novels, comics (Tintin, Astérix, Mafalda), magazines (Cambio 16, Epoca, Vocable and Don Balon) available at the library.
Visit the Internet pages of the Spanish and Latin-American newspapers (lavanguardia.es, elpais.es...)
Listen to Spanish National Radio programmes (RNE) on Internet.
Watch TV programmes on RTVE.es.
Read tourist guides on Spanish-speaking countries available at the library.

Evaluation :
15 mn face to face oral

Target :
3rd, 4th, 5th year

Italian	HUMF2-ITA
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : KERSUSAN Sylvia	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Level 1 Beginner :
To introduce the Italian langugae and Italian culture, to express the fundamentals in writing and orally

Level 2 Advanced Beginner:
By the end of the course, students should be able to converse and write in Italian

Level 3 Intermediate:
To enable students to develop further on themes relating to art, civilisation, literature and cinema

Content :
Oral expression and comprehension:
reading with the teacher's guidance on phonetic and grammatical corrections
reading situations in the text, viewing films and reading literary texts and press articles

Written expression and Comprehension:
completing text-based exercises with particular attention to difficulties
summarising situations in available texts and films studied in class

Bibliography :
La lingua italiana per Stranieri 1°, 2°, 3°P K.Katerinov
La prova orale 1,2,3 T.Marin
Texts taken from newspapers and Italian magasines, films by famous film directors

Requirements :
Level 1 Beginner: none
Level 2 Advanced Beginner : to have attended the Italian Beginner lessons
Level3 Intermediate: to have a good knowledge of the Italian language

Organisation :
1h30 of face-face lessons per week; 21h per semester
Personal Study: 14h
To read the photocopied texts provided

Evaluation :
S2 : Oral

Target :
Engineering students

Japanese	HUMF2-JAP
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
Targeted skills :
- to master a foreign language
- ability to communicate/progress/ work in an interntaional and intercultural context
- cultural openness
- to communicate / interact with others, work in a team
- to work autonomously

Niveau débutant (A1):
- awareness of particularities (phonetics, syntax)
- discovery of Japanese culture, traditions, customs
- learning the two systems of writing (Hiragana and Katakana)
- to be able to use spoken Japanese in everyday situations

Intermediate level (A2):
- introduction ideogrammes (60 kanji)
- reading simple texts (with Manga, etc...)
- writing simple texts
- to be able to use spoken Japanese in everyday situations

Advanced level (B1, B2):
- learning kanji (60-200)
- acquiring the four skills (written and oral comprehension, written and oral expression) for travel or study in Japan

Content :
Level 1 Beginner (A1):
- Perfecting Hiragana et Katakana - reading Manga
- Lesson 5: speaking about pastimes
- Lesson 6: using transport
- Lesson 7: shopping
- Lesson 8: expressing feelings

Level 2 Beginner (A2):
- learning 30 kanji - reading Manga
- basic Grammar
- reading and writing simple texts
- learning how to communicate in everyday situations

Intermediate level (B1, B2) :
- learning to use more than 30 kanji
- reading Manga
- acquiring the four skills (written and oral comprehension, written and oral expression)

Bibliography :
Level 1 Beginner (A1): Margot, 3A Network, to be published, Japan.
Level 2 Beginner (A2): Daichi, 1, 3A Network, 2008, Japan.
Level 3 Intermediate (B1, B2): Minna no Nihongo, I et II, 3A Network, 1998, Japan.
+ Satoru Koyama, J. Bridge, Bonjinsha, 2007, Japan.

Requirements :
Level 1: none.
Level 2: to have taken Level A1 Beginner course
Level 3: to have taken Beginner Levels A1 and A2

Organisation :
The teaching follows the TU format.

In each session there is an explanation of the structures which are then illustrated by examples and by exercises and conversation which the students participate in.

Evaluation :
S2 : Oral

Target :
Engineering students

Russian	HUMF2-RUS
Number of hours : 21.00 h	1.50 ECTS credit
TD : 21.00 h	
Reference Teacher(s) : HOLZNER-JACQUES Cecile	

Objectives :
According to level: Beginners (A1), Intermediate (A2/B1), Advanced (B1-B2). Help the students to progress autonomously.

Content :
Written and oral communication. Firstly in everyday life situations, and secondly in other fields such as professional topics.
-Films and book extracts are used as a learning aid
-Individual exercices and group work, oral presentations for intermediates
-Grammar
-Cinema, literature and civilization.

Bibliography :

Requirements :

Organisation :
Classes take place at SUPELEC (Campus de Beaulieu)

Evaluation :
Final grade (overseen by SUPELEC).

Target :

Semestre 8

Parcours Formation initiale

1	**DMA08-INFOS**		**SCIENTIFIC COMPUTING AND DISCRETE MATHEMATICS**	**7.00**
	DMA08-CHP	O	High Performance Computing	2.00
	DMA08-MERN	O	Modelling with Partial Differential Equation and Numerical Resolution	3.00
	DMA08-OND	O	Nondifferentiable Optimization, Applications in data analysis.	2.00
2	**DMA08-SN**		**COMPUTATIONAL SCIENCES**	**6.00**
	DMA08-PE	O	Design of Experiments	2.00
	DMA08-AS	O	Statistical Learning	2.00
	DMA08-OGD	O	Large-Scale Optimization	2.00
3	**DMA08-SEMP**		**SEMINAR AND PROJECT**	**3.00**
	DMA08-BE	C	Engineering Practical and Realistic Study	2.50
	DMA08-PR2	C	Research Project	2.50
	DMA08-SE	O	Business Seminar	0.50
4	**DMA08-STAGE**		**INTERNSHIP**	**8.00**
	DMA08-STAGE08	O	Internship	8.00
5	**HUM08**		**Non-scientific syllabus S8**	**6.00**
	HUM08-ANGL	O	English	2.00
	HUM08-TEJS	C	ECONOMIC, LEGAL AND SOCIAL ISSUES	1.00
	HUM08-SHES1	O	Engineer & Society - M1	1.00
	HUM08-SHES2	C	Engineer & Society - M2	1.00
	HUM08-EPS	O	Sport and Physical Education	1.00
	HUM08-IE	C	INNOVATION & ENTREPRENEURSHIP (RIE)	2.00

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

High Performance Computing	DMA08-CHP
Number of hours : 36.00 h	2.00 ECTS credit
CM : 10.00 h, TD : 6.00 h, TP : 20.00 h	
Reference Teacher(s) : PAZAT Jean-Louis	

Objectives :
The aim of this course is to provide the basic knowledge about High Performance Tools and programming techniques. We put emphasis both on using standard multicore architectures of desktop machines and on programming large clusters such at Top 500 machines.

Content :
Performance, complexity, speed-up
Overview of high performance computer architectures
Parallel Programming
Some models : map Reduce (Hadoop), multithreading (PThreads, OpenMP), introduction to the SIMD model, Message Passing (MPI).

Bibliography :
R. Chandra, R. Menon, L. Dagum, D. Kohr, D. Maydan, J. McDonald. Parallel Programming in OpenMP. Morgan Kaufmann, 2000.
T. Rauber, G. Rünger. Parallel Programming: for Multicore and Cluster Systems. 2nd edition 2013.
W. Gropp, E. Lusk, A. Skjellum. Using MPI: Portable Parallel Programming with the Message-Passing Interface. MIT Press, 1999.
W. Gropp, E. Lusk, R. Thakur. Using MPI-2. MIT Press, 1999.

Requirements :
Unix basic knowledge, C-programming knowledge.

Organisation :

Evaluation :
One written examination

Target :

Modelling with Partial Differential Equation and Numerical Resolution	DMA08-MERN
Number of hours : 42.00 h	3.00 ECTS credit
CM : 14.00 h, TD : 12.00 h, TP : 16.00 h	handout in English
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
Formation on numerical methods used in numerical simulation field industry:
- Theoretical study of Partial Differential Equations (PDE).
- Study and setting up of numerical schemes for the obtaining of approximated solutions.

Content :
1. Theoretical study of PDEs:
- Example of industrial problems and applications.
- Classification of PDEs.
- Detailed study of the transport equation (characteristic method) and the heat equation (Fourier series).
2. Numerical schemes:
- Finite Difference method: Spatial discretization, stability and Courant-Frierich-Lewy condition.
- Finite Element method: weak formulations, stability, matrix assembly, introduction to computational code FreeFem++.

Bibliography :
- A. Ern, J.L. Guermond, Theory and Practice of Finite Elements. Applied Mathematical Sciences (159), Springer-Verlag New
York, 2004.
- F. Hetch, New development in FreeFem++. J. Numer. Math. (20), 251–265, 2012, https://freefem.org/
- A. Quarteroni, F. Saleri, P. Gervasio, Calcul Scientifique. Cours, exercices corrigés et illustrations en MATLAB et Octave.
Springer, 2008.
- J. Rappaz, M. Picasso, Introduction à l'analyse numérique. Presses polytechniques et universitaires romandes, 2004.
- F. Filbet, Analyse numérique. Algorithme et étude mathématique. Dunod, 2013.

Requirements :
- Modeling with ordinary differential equations (S5, Olivier Ley).
- Numerical Methods for linear systems (S5, Camar-Eddine Mohamed).
- C language (S5, Arnaldi Bruno).
- Numerical Methods : nonlinear cases (S6, Nouveau Léo).
- Hilbertian Tools and Applications (S7, Briane Marc).

Organisation :

Evaluation :
Written exam (1/2) and project (1/2).

Target :

Nondifferentiable Optimization, Applications in data analysis.	DMA08-OND
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) : HADDOU Mounir	

Objectives :
The aim of this course is to give an introduction to non-differentiable convex optimization, to introduce several modern or
updated algorithms, recognized for their effectiveness in solving or approaching problems encountered in statistics and
data analysis. The course will be partly interactive and half of the practical work will be done in reverse mode.

Content :
- nonsmooth analysis and convexity.
- Accelerated gradient and subgradient methods.
- Stochastic and constrained gradient methods.
- Alternated directions methods.
- Nonsmooth optimization techniques.
- Augmented Lagrangien methods and ADMM.

Applications :

- Sparse inverse covariance estimation.
- Sparse principal components.
- Low-rank decomposition.
- Support Vector Machines.
- Logistic regression, …

Bibliography :
et Convex Optimization, .
S. Boyd et al, , http://cvxr.com/cvx/

J.F. Bonnans et al. Optimisation numérique. Aspects théoriques et pratiques. Springer, 1997.

J.F. Bonnans. Optimisation continue, Cours et problèmes corrigés. Dunod, 2006.

D. P. Bertsekas Convex Optimization Algorithms ISBN: 1-886529-28-0, 978-1-886529-28-1 , 2015.

Requirements :
Courses of “Introduction to mathematical softwares”, ” Continuous optimization” and “numerical Analysis” (3rd year).
Basic classical knowledge on statistics.

Organisation :

Evaluation :
One written examination and a practical examination and/or project .

Target :

Design of Experiments	DMA08-PE
Number of hours : 28.00 h	2.00 ECTS credit
CM : 10.00 h, TD : 12.00 h, TP : 6.00 h	handout in English
Reference Teacher(s) : CHAGNEAU Pierrette	

Objectives :
This course is intended to familiarize students with experimental design methodology. At the end of the course, students will have a knowledge of different possible classes of experimental designs. They should be able to design an experiment and to analyze the obtained results with appropriate statistical methods.

Content :
One-way ANOVA, Two-way ANOVA with replication
Introduction to experimental design methodology
Factorial designs
Fractional factorial designs
Response surface designs
Design for mixture experiments

Bibliography :
J.-M. Azaïs, J.-M. Bardet. Le modèle linéaire par l'exemple. Dunod, 2005.
J.J. Droesbeke, J. Fine, G. Saporta. Plans d'expériences : Applications à l'entreprise. Editions Technip, 1997.
J. Goupy, L. Creighton. Introduction aux plans d'expériences. Dunod, 3ème édition, 2006.
J. Goupy. Plans d'expériences pour surfaces de réponse. Dunod, 1999.
W. Tinsson. Plans d'expériences : constructions et analyses statistiques. Springer, 2010.

Requirements :
Algebra courses from the undergraduate program of INSA (years 1-2) or equivalent skills.
Linear regression models (DMA06-MRL)
Introduction to mathematical software (DMA05-ILM)

Organisation :

Evaluation :
One written examination of 2h

Target :

Statistical Learning	DMA08-AS
Number of hours : 36.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : GARES Valerie	

Objectives :
Objectives of this course are to make students acquainted with classical tools for statistical learning and decision-making and with modern techniques for high-dimensional data.

Content :
Discriminant analysis Decision trees
Variable selection in high-dimensional settings (penalized methods)
Non-parametric regression using kernel, splines and polynomials-basis functions Model averaging
SVM
Practical with R

Bibliography :
T. Hastie, R. Tibshirani, J. Friedman. The elements of statistical learning: data mining, inference, and prediction. Springer, 2009.
S. Tufféry. Data mining et statistique décisionnelle. Technip, 2012.

Requirements :
Courses of "Introduction to mathematical softwares", "Linear regression models" (3rd year) and "Risk analysis and scoring" (4th year).

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Large-Scale Optimization	DMA08-OGD
Number of hours : 30.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 8.00 h, TP : 10.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The objective of this course is to introduce methods appropriate to the problems of large-scale complex systems. The main ideas are based on the theory of decomposition-coordination optimization and methods such as interior points. The course will cover practical optimization applications.

Content :
Augmented Lagrangian approaches in quadratic optimization
Interior-point methods for solving linear and nonlinear problems
Sequential Quadratic Pragramming (SQP) methods
Decomposition-coordination and proximal decomposition methods
Linear and nonlinear complementarity problems
Optimization problems under equilibrium constraints.
Practice with MATLAB and/or SCILAB softwares

Bibliography :
A. Belmiloudi. Stabilization, Optimal and Robust Control. Theory and Applications in Biological and Physical Sciences, Springer-Verlag, 2008
D.P. Bertsekas. Constrained optimization and Lagrange multiplier methods, Academic Press, 1999.
L.T. Biegler et al. (Eds.) Large-Scale Optimization with Applications, Springer-Verlag, 1997.
J.-C. Culioli. Algorithmes de decomposition-coordination en optimisation stochastique. RAIRO, 1986.
M. Grötschel et al. (Eds.) Online Optimization of large Scale Systems, Springer-Verlag, 2001.
B. Jansen. Interior Point Techniques in Optimization ¿ Complementarity, Sensitivity and Algorithms.. Kluwer Academic Publishers. 1997
D.A. Wismer (Ed.), Optimization Methods for Large Scale Systems with Applications, Mac Graw-Hill, 1971.

Requirements :
Courses of "Numerical methods of linear", "Numerical methods of nonlinear" of 3rd year and "Optimization" of 4rd year.

Organisation :

Evaluation :
One written examination and a practical examination and/or project .

Target :

Engineering Practical and Realistic Study	DMA08-BE
Number of hours : 36.00 h	2.50 ECTS credit
EP : 36.00 h	
Reference Teacher(s) : LE GRUYER Yves	

Objectives :
Our main aim is to offer to an experience of realization of project in relation to industrial partners.
This experience will contribute to develop the aptitude of the students to find the relevant mathematical tools and to adapt them to deal with realistic problems. This work is done by group to reinforce the aptitudes of each student to « Team work ».

Content :
Multiple discussions with industrial and teaching supervisors.

Bibliography :
depends on the subject.

Requirements :
All courses from S5 to S7 in applied mathematics.

Organisation :
The students work is supervised by an industrial partner and a researcher from INSA (Applied department) «Mathématiques Appliquées».

Each group of students must propose an adapted solution, write a report and defend orally it’s work in front of a committee. Several meetings are planned to ensure a complete and effective follow-up.

Evaluation :
A mark is awarded by the committee and the industrial advisor after the defense. This mark corresponds to the quality of the work, the report and the oral defense.

Target :
S8 students (except “parcours recherche “).

Research Project	DMA08-PR2
Number of hours : 36.00 h	2.50 ECTS credit
PR : 36.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The objective is to propose a discovery of the profession of researcher and its professional environment in an academic or industrial context.

Content :
A project exploring one of the themes favored by the student will be proposed by a researcher from an academic/industrial laboratory in Rennes. It is adapted to the skills acquired until then by the student.
It is requested to conduct an interview with a researcher from at least three different laboratories. The project can be accompanied by any initiative of discovery of the world of research (visit of academic or industrial laboratory, participation in meetings of follow-up of research projects, process of publication of a scientific article ...)

Bibliography :
Each project is based on a specific bibliographic study.

Requirements :
36h are reserved in the timetable of the semester. Each session is an opportunity to discuss with his tutor.

Organisation :

Evaluation :
A report of not more than 25 pages which can be written in English. A 20 minutes defense in English.

Target :
3 students with strong academic results

Business Seminar	DMA08-SE
Number of hours : 23.00 h	0.50 ECTS credit
CM : 23.00 h	
Reference Teacher(s) : ARSLAN Ayse Nur, NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 4th year, the module will offer (among others) :

• Specific software training ;
• some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing…).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

Target :

Internship	DMA08-STAGE08
Number of hours : 240.00 h	8.00 ECTS credit
ES : 1.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
Each student of the Department Génie Mathématique have to carry out an internship in a company or a research laboratory (in France or in a foreign country). The minimal duration is 8 weeks and an agreement has to be signed between INSA, the company and the student.
This internship takes usually place during the 4th year (in some case during the 3rd year). It can start in May and end before September.
The objectives are to allow the student:
- to get a work experience in an industrial or business environment or/and in research;
- to improve his/her skills in communication, teamwork, creativity, integration in the professional world;
- to have a firsthand opportunity to assess his/her capacities in a job directly related to their field of studies.

Content :

Bibliography :

Requirements :

Organisation :
The internship is a full time work in the company under the responsibility of an advisor of the company. The internship is also supervised by a researcher from INSA.

Evaluation :
The achievement of the internship provides 8 ECTS credits (which count for the 4th year). The student writes a report leading to an oral defense.
Three marks are given:
- 1 mark awarded by the internship supervisor for work accomplished.
- 1 mark for the written report awarded by the INSA supervisor.
- 1 mark is awarded by a committee (including the INSA supervisor) after the defense.
The average of the marks gives a global mark couting for the 5th year.

Target :

English	HUM08-ANGL
Number of hours : 24.00 h	2.00 ECTS credit
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 :

ECONOMIC, LEGAL AND SOCIAL ISSUES	HUM08-TEJS
Number of hours : 10.00 h	1.00 ECTS credit
TD : 10.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :
This course focuses on economic, legal and social matters. Students are encouraged to develop their curiosity and their ability to analyse topics related to the general environment of a company.
Main learning outcomes:
- Understanding key concepts related to a firm’s environment
- Establishing a specific-vocabulary base
- Develop their curiosity and critical thinking

Content :
The topics covered may vary depending on the speakers and the the current events, however attention will be paid to two subjects in particular: the financial and monetary system (MSM), climate change (STIC).

Bibliography :
Provided during the course

Requirements :
None

Organisation :

Evaluation :
Continuous assessment (collective work)

Target :

Engineer & Society - M1	HUM08-SHES1
Number of hours : 14.00 h	1.00 ECTS credit
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	
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 :

INNOVATION & ENTREPRENEURSHIP (RIE)	HUM08-IE
Number of hours : 48.00 h	2.00 ECTS credit
TD : 48.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 8

Parcours interne semestre impair-externe semestre pair

1	DMA08-STAGE		INTERNSHIP	8.00
	DMA08-STAGE08	O	Internship	8.00

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

Internship	DMA08-STAGE08
Number of hours : 240.00 h	8.00 ECTS credit
ES : 1.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
Each student of the Department Génie Mathématique have to carry out an internship in a company or a research laboratory (in France or in a foreign country). The minimal duration is 8 weeks and an agreement has to be signed between INSA, the company and the student.
This internship takes usually place during the 4th year (in some case during the 3rd year). It can start in May and end before September.
The objectives are to allow the student:
- to get a work experience in an industrial or business environment or/and in research;
- to improve his/her skills in communication, teamwork, creativity, integration in the professional world;
- to have a firsthand opportunity to assess his/her capacities in a job directly related to their field of studies.

Content :

Bibliography :

Requirements :

Organisation :
The internship is a full time work in the company under the responsibility of an advisor of the company. The internship is also supervised by a researcher from INSA.

Evaluation :
The achievement of the internship provides 8 ECTS credits (which count for the 4th year). The student writes a report leading to an oral defense.
Three marks are given:
- 1 mark awarded by the internship supervisor for work accomplished.
- 1 mark for the written report awarded by the INSA supervisor.
- 1 mark is awarded by a committee (including the INSA supervisor) after the defense.
The average of the marks gives a global mark couting for the 5th year.

Target :

Semestre 8

Parcours Recherche

1	**DMA08-INFOS**		**SCIENTIFIC COMPUTING AND DISCRETE MATHEMATICS**	**7.00**
	DMA08-CHP	O	High Performance Computing	2.00
	DMA08-MERN	O	Modelling with Partial Differential Equation and Numerical Resolution	3.00
	DMA08-OND	O	Nondifferentiable Optimization, Applications in data analysis.	2.00
2	**DMA08-SN**		**COMPUTATIONAL SCIENCES**	**6.00**
	DMA08-PE	O	Design of Experiments	2.00
	DMA08-AS	O	Statistical Learning	2.00
	DMA08-OGD	O	Large-Scale Optimization	2.00
3	**DMA08-SEMP-2**		**SEMINAIRE ENTREPRISE ET PROJET**	**3.00**
	DMA08-PR2	O	Research Project	2.50
	DMA08-SE	O	Business Seminar	0.50
4	**DMA08-STAGE**		**INTERNSHIP**	**8.00**
	DMA08-STAGE08	O	Internship	8.00
5	**HUM08**		**Non-scientific syllabus S8**	**6.00**
	HUM08-ANGL	O	English	2.00
	HUM08-TEJS	C	ECONOMIC, LEGAL AND SOCIAL ISSUES	1.00
	HUM08-SHES1	O	Engineer & Society - M1	1.00
	HUM08-SHES2	C	Engineer & Society - M2	1.00
	HUM08-EPS	O	Sport and Physical Education	1.00
	HUM08-IE	C	INNOVATION & ENTREPRENEURSHIP (RIE)	2.00

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

High Performance Computing	DMA08-CHP
Number of hours : 36.00 h	2.00 ECTS credit
CM : 10.00 h, TD : 6.00 h, TP : 20.00 h	
Reference Teacher(s) : PAZAT Jean-Louis	

Objectives :
The aim of this course is to provide the basic knowledge about High Performance Tools and programming techniques. We put emphasis both on using standard multicore architectures of desktop machines and on programming large clusters such at Top 500 machines.

Content :
Performance, complexity, speed-up
Overview of high performance computer architectures
Parallel Programming
Some models : map Reduce (Hadoop), multithreading (PThreads, OpenMP), introduction to the SIMD model, Message Passing (MPI).

Bibliography :
R. Chandra, R. Menon, L. Dagum, D. Kohr, D. Maydan, J. McDonald. Parallel Programming in OpenMP. Morgan Kaufmann, 2000.
T. Rauber, G. Rünger. Parallel Programming: for Multicore and Cluster Systems. 2nd edition 2013.
W. Gropp, E. Lusk, A. Skjellum. Using MPI: Portable Parallel Programming with the Message-Passing Interface. MIT Press, 1999.
W. Gropp, E. Lusk, R. Thakur. Using MPI-2. MIT Press, 1999.

Requirements :
Unix basic knowledge, C-programming knowledge.

Organisation :

Evaluation :
One written examination

Target :

Modelling with Partial Differential Equation and Numerical Resolution	DMA08-MERN
Number of hours : 42.00 h	3.00 ECTS credit
CM : 14.00 h, TD : 12.00 h, TP : 16.00 h	handout in English
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
Formation on numerical methods used in numerical simulation field industry:
- Theoretical study of Partial Differential Equations (PDE).
- Study and setting up of numerical schemes for the obtaining of approximated solutions.

Content :
1. Theoretical study of PDEs:
- Example of industrial problems and applications.
- Classification of PDEs.
- Detailed study of the transport equation (characteristic method) and the heat equation (Fourier series).
2. Numerical schemes:
- Finite Difference method: Spatial discretization, stability and Courant-Frierich-Lewy condition.
- Finite Element method: weak formulations, stability, matrix assembly, introduction to computational code FreeFem++.

Bibliography :
- A. Ern, J.L. Guermond, Theory and Practice of Finite Elements. Applied Mathematical Sciences (159), Springer-Verlag New
York, 2004.
- F. Hetch, New development in FreeFem++. J. Numer. Math. (20), 251–265, 2012, https://freefem.org/
- A. Quarteroni, F. Saleri, P. Gervasio, Calcul Scientifique. Cours, exercices corrigés et illustrations en MATLAB et Octave.
Springer, 2008.
- J. Rappaz, M. Picasso, Introduction à l'analyse numérique. Presses polytechniques et universitaires romandes, 2004.
- F. Filbet, Analyse numérique. Algorithme et étude mathématique. Dunod, 2013.

Requirements :
- Modeling with ordinary differential equations (S5, Olivier Ley).
- Numerical Methods for linear systems (S5, Camar-Eddine Mohamed).
- C language (S5, Arnaldi Bruno).
- Numerical Methods : nonlinear cases (S6, Nouveau Léo).
- Hilbertian Tools and Applications (S7, Briane Marc).

Organisation :

Evaluation :
Written exam (1/2) and project (1/2).

Target :

Nondifferentiable Optimization, Applications in data analysis.	DMA08-OND
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) : HADDOU Mounir	

Objectives :
The aim of this course is to give an introduction to non-differentiable convex optimization, to introduce several modern or
updated algorithms, recognized for their effectiveness in solving or approaching problems encountered in statistics and
data analysis. The course will be partly interactive and half of the practical work will be done in reverse mode.

Content :
- nonsmooth analysis and convexity.
- Accelerated gradient and subgradient methods.
- Stochastic and constrained gradient methods.
- Alternated directions methods.
- Nonsmooth optimization techniques.
- Augmented Lagrangien methods and ADMM.

Applications :

- Sparse inverse covariance estimation.
- Sparse principal components.
- Low-rank decomposition.
- Support Vector Machines.
- Logistic regression, …

Bibliography :
et Convex Optimization, .
S. Boyd et al, , http://cvxr.com/cvx/

J.F. Bonnans et al. Optimisation numérique. Aspects théoriques et pratiques. Springer, 1997.

J.F. Bonnans. Optimisation continue, Cours et problèmes corrigés. Dunod, 2006.

D. P. Bertsekas Convex Optimization Algorithms ISBN: 1-886529-28-0, 978-1-886529-28-1 , 2015.

Requirements :
Courses of “Introduction to mathematical softwares”, ” Continuous optimization” and “numerical Analysis” (3rd year).
Basic classical knowledge on statistics.

Organisation :

Evaluation :
One written examination and a practical examination and/or project .

Target :

Design of Experiments	DMA08-PE
Number of hours : 28.00 h	2.00 ECTS credit
CM : 10.00 h, TD : 12.00 h, TP : 6.00 h	handout in English
Reference Teacher(s) : CHAGNEAU Pierrette	

Objectives :
This course is intended to familiarize students with experimental design methodology. At the end of the course, students will have a knowledge of different possible classes of experimental designs. They should be able to design an experiment and to analyze the obtained results with appropriate statistical methods.

Content :
One-way ANOVA, Two-way ANOVA with replication
Introduction to experimental design methodology
Factorial designs
Fractional factorial designs
Response surface designs
Design for mixture experiments

Bibliography :
J.-M. Azaïs, J.-M. Bardet. Le modèle linéaire par l'exemple. Dunod, 2005.
J.J. Droesbeke, J. Fine, G. Saporta. Plans d'expériences : Applications à l'entreprise. Editions Technip, 1997.
J. Goupy, L. Creighton. Introduction aux plans d'expériences. Dunod, 3ème édition, 2006.
J. Goupy. Plans d'expériences pour surfaces de réponse. Dunod, 1999.
W. Tinsson. Plans d'expériences : constructions et analyses statistiques. Springer, 2010.

Requirements :
Algebra courses from the undergraduate program of INSA (years 1-2) or equivalent skills.
Linear regression models (DMA06-MRL)
Introduction to mathematical software (DMA05-ILM)

Organisation :

Evaluation :
One written examination of 2h

Target :

Statistical Learning	DMA08-AS
Number of hours : 36.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 12.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : GARES Valerie	

Objectives :
Objectives of this course are to make students acquainted with classical tools for statistical learning and decision-making and with modern techniques for high-dimensional data.

Content :
Discriminant analysis Decision trees
Variable selection in high-dimensional settings (penalized methods)
Non-parametric regression using kernel, splines and polynomials-basis functions Model averaging
SVM
Practical with R

Bibliography :
T. Hastie, R. Tibshirani, J. Friedman. The elements of statistical learning: data mining, inference, and prediction. Springer, 2009.
S. Tufféry. Data mining et statistique décisionnelle. Technip, 2012.

Requirements :
Courses of "Introduction to mathematical softwares", "Linear regression models" (3rd year) and "Risk analysis and scoring" (4th year).

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Large-Scale Optimization	DMA08-OGD
Number of hours : 30.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 8.00 h, TP : 10.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The objective of this course is to introduce methods appropriate to the problems of large-scale complex systems. The main ideas are based on the theory of decomposition-coordination optimization and methods such as interior points. The course will cover practical optimization applications.

Content :
Augmented Lagrangian approaches in quadratic optimization
Interior-point methods for solving linear and nonlinear problems
Sequential Quadratic Pragramming (SQP) methods
Decomposition-coordination and proximal decomposition methods
Linear and nonlinear complementarity problems
Optimization problems under equilibrium constraints.
Practice with MATLAB and/or SCILAB softwares

Bibliography :
A. Belmiloudi. Stabilization, Optimal and Robust Control. Theory and Applications in Biological and Physical Sciences, Springer-Verlag, 2008
D.P. Bertsekas. Constrained optimization and Lagrange multiplier methods, Academic Press, 1999.
L.T. Biegler et al. (Eds.) Large-Scale Optimization with Applications, Springer-Verlag, 1997.
J.-C. Culioli. Algorithmes de decomposition-coordination en optimisation stochastique. RAIRO, 1986.
M. Grötschel et al. (Eds.) Online Optimization of large Scale Systems, Springer-Verlag, 2001.
B. Jansen. Interior Point Techniques in Optimization ¿ Complementarity, Sensitivity and Algorithms.. Kluwer Academic Publishers. 1997
D.A. Wismer (Ed.), Optimization Methods for Large Scale Systems with Applications, Mac Graw-Hill, 1971.

Requirements :
Courses of "Numerical methods of linear", "Numerical methods of nonlinear" of 3rd year and "Optimization" of 4rd year.

Organisation :

Evaluation :
One written examination and a practical examination and/or project .

Target :

Research Project	DMA08-PR2
Number of hours : 36.00 h	2.50 ECTS credit
PR : 36.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :
The objective is to propose a discovery of the profession of researcher and its professional environment in an academic or industrial context.

Content :
A project exploring one of the themes favored by the student will be proposed by a researcher from an academic/industrial laboratory in Rennes. It is adapted to the skills acquired until then by the student.
It is requested to conduct an interview with a researcher from at least three different laboratories. The project can be accompanied by any initiative of discovery of the world of research (visit of academic or industrial laboratory, participation in meetings of follow-up of research projects, process of publication of a scientific article ...)

Bibliography :
Each project is based on a specific bibliographic study.

Requirements :
36h are reserved in the timetable of the semester. Each session is an opportunity to discuss with his tutor.

Organisation :

Evaluation :
A report of not more than 25 pages which can be written in English. A 20 minutes defense in English.

Target :
3 students with strong academic results

Business Seminar	DMA08-SE
Number of hours : 23.00 h	0.50 ECTS credit
CM : 23.00 h	
Reference Teacher(s) : ARSLAN Ayse Nur, NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 4th year, the module will offer (among others) :

• Specific software training ;
• some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing…).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

Target :

Internship	DMA08-STAGE08
Number of hours : 240.00 h	8.00 ECTS credit
ES : 1.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
Each student of the Department Génie Mathématique have to carry out an internship in a company or a research laboratory (in France or in a foreign country). The minimal duration is 8 weeks and an agreement has to be signed between INSA, the company and the student.
This internship takes usually place during the 4th year (in some case during the 3rd year). It can start in May and end before September.
The objectives are to allow the student:
- to get a work experience in an industrial or business environment or/and in research;
- to improve his/her skills in communication, teamwork, creativity, integration in the professional world;
- to have a firsthand opportunity to assess his/her capacities in a job directly related to their field of studies.

Content :

Bibliography :

Requirements :

Organisation :
The internship is a full time work in the company under the responsibility of an advisor of the company. The internship is also supervised by a researcher from INSA.

Evaluation :
The achievement of the internship provides 8 ECTS credits (which count for the 4th year). The student writes a report leading to an oral defense.
Three marks are given:
- 1 mark awarded by the internship supervisor for work accomplished.
- 1 mark for the written report awarded by the INSA supervisor.
- 1 mark is awarded by a committee (including the INSA supervisor) after the defense.
The average of the marks gives a global mark couting for the 5th year.

Target :

English	HUM08-ANGL
Number of hours : 24.00 h	2.00 ECTS credit
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 :

ECONOMIC, LEGAL AND SOCIAL ISSUES	HUM08-TEJS
Number of hours : 10.00 h	1.00 ECTS credit
TD : 10.00 h	
Reference Teacher(s) : GOURRET Fanny	

Objectives :
This course focuses on economic, legal and social matters. Students are encouraged to develop their curiosity and their ability to analyse topics related to the general environment of a company.
Main learning outcomes:
- Understanding key concepts related to a firm’s environment
- Establishing a specific-vocabulary base
- Develop their curiosity and critical thinking

Content :
The topics covered may vary depending on the speakers and the the current events, however attention will be paid to two subjects in particular: the financial and monetary system (MSM), climate change (STIC).

Bibliography :
Provided during the course

Requirements :
None

Organisation :

Evaluation :
Continuous assessment (collective work)

Target :

Engineer & Society - M1	HUM08-SHES1
Number of hours : 14.00 h	1.00 ECTS credit
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	
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 :

INNOVATION & ENTREPRENEURSHIP (RIE)	HUM08-IE
Number of hours : 48.00 h	2.00 ECTS credit
TD : 48.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 9

Parcours Contrat professionnalisation

1	**DMA09-IDS-2**		**DATA AND SYSTEMS ENGINEERING**	**9.00**
	DMA09-PARCI	O	Sparsity in Signal and Image Processing	3.50
	DMA09-OI	O	Optimization under uncertainty	3.50
2	**DMA09-IR**		**RISK ENGINEERING**	**10.50**
	DMA09-AIS	O	Uncertainty and Sensitivity Analysis in Engineering	3.50
	DMA09-FMDV	O	Reliability and Survival Analysis	3.50
	DMA09-SEER	O	Rare Events Estimation and Simulation	3.50
3	**DMA09-SEMP**		**SEMINAR**	**3.50**
	DMA09-SE	C	Business Seminar	3.50
	DMA09-PR	C	Research Project	3.50
4	**HUM09-GM-PRO**		**Non-scientific syllabus S9**	**5.50**
	HUM09-ANGL-TOEIC	C	TOEIC 5th year	1.50
	HUM09-ANGL-CONV	C	English S9 Conversation	1.50
	HUM09-PM-PRO	C	Economics, Law and Business Studies (Professional management)	2.00

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

Sparsity in Signal and Image Processing	DMA09-PARCI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 24.00 h, TD : 5.00 h, TP : 11.00 h	
Reference Teacher(s) : HERZET Cedric	

Objectives :
This module provides an overview of fundamental concepts and tool relying on sparse representations in signal and image processing. Based on a “geometric” vision of the notion of sparse model, the course will describe the main sparse approximation algorithms, their complexity, and the conditions under which their performance can be guaranteed. The goal is to encompass the role of sparsity in tasks ranging from compression and coding to denoising, source separation, compressive sensing, and more generally linear inverse problems.

Content :
Reminder on harmonic analysis and Shannon/Nyquist sampling theorem General principles of sensing
Examples of inverse problems in signal and image processing Notions of sparsity and applications
Algorithms for sparse representations Convex optimization for sparse regularization
Performance guarantees of sparse regularization algorithms Compressive sensing
Sparse modeling: learning of the decomposition dictionary

Bibliography :
M. Elad. Sparse and Redundant Representations. From Theory to Applications in Signal and Image Processing. Springer, 2010.
S Mallat. A Wavelet Tour of Signal Processing (3rd edition). Academic Press, 2009.
S. Foucart & H. Rauhut, A mathematical introduction to compressive sensing. Springer. 2013.

Requirements :

Organisation :

Evaluation :
Final exam

Target :

Optimization under uncertainty	DMA09-OI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 14.00 h, TP : 12.00 h	
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course will be the opportunity to strengthen the connections between the teachings of probability and optimization of the GM specialty. Its scope is on the introduction of the fundamental concepts of the optimization under uncertainty. We will first present the different models of uncertainty that can be met and the approaches that can be used to deal with them. The rest of the course will focus on the theoretical properties of stochastic programming (minimization of an expected value) and robust optimization (minimization of a maximum value), and on
the practical methods that can solve such problems.

Content :
• Models of uncertainties; probability distributions, intervals of values, scenarios, historical data, domain of Bertsimas.
• Introduction of the existing approaches: stochastic programming, robust optimization, probabilistic constraints, stochastic dynamic programing, online optimization
• Classical examples: newspaper salesman problem, warehouse location under uncertainty, etc.
• Robust optimization: solution of simple problems with the uncertainty set of Bertsimas, mathematical programming models
• Stochastic programming: theoretical properties, solution by cutting plane generation and Monte-Carlo methods
• Implementation of solution algorithms with Julia Language
• Continuation of the S7 courses on the ethical stakes of mathematical modeling for decision aid

Bibliography :
[1] Ben-Tal, A., El Ghaoui, L., & Nemirovski, A. (2009). Robust optimization. Robust Optimization (Princeton).
[2] Birge, J. R., & Louveaux, F. (2011). Introduction to Stochastic Programming. New York, Springer.
[3] Kall, P., & Mayer, J. (2004). Stochastic Linear Programming: Models, Theory, and Computation. Springer.
[4] Shapiro, a., Dentcheva, D., & Ruszczy.ski, A. (2009). Lectures on stochastic programming: modeling and theory. SIAM Series on Optimization.

Requirements :

Organisation :
The course will follow a project-based learning approach that will help master the methods seen during the 4th year
courses on optimization and apply the methods described in class on the same given application during the whole semester.
As a homework, the students will have to produce an analysis of the ethical stakes of a real mathematical decision aid tool that they will have chosen.

Evaluation :

Target :
Fifth-year students of the Applied mathematic specialty

Uncertainty and Sensitivity Analysis in Engineering	DMA09-AIS
Number of hours : 40.00 h	3.50 ECTS credit
CM : 22.00 h, PR : 18.00 h	
Reference Teacher(s) : CHABRIDON Vincent, SUEUR Roman	

Objectives :
At the end of this module, students will be able to master the techniques for dealing with uncertainties in numerical simulation, and to implement methods for exploring numerical models and performing global sensitivity analysis.

Content :
(7 sessions):
Session #1 – Introduction: reliability and uncertainty propagation (R. Sueur)
Structural reliability
Reliability analysis for repairable systems and lifetime data analysis
Uncertainty quantification and propagation for reliability assessment
Lab: implementation with the OpenTURNS software
Sessions #2 et #3 – Metamodels for uncertainty management (R. Sueur)
Introduction to the various families of metamodels / surrogate models
Introduction and presentation of the simple Kriging
Numerical designs of computer experiments for building metamodels (space-filling designs)
Links with Gaussian processes and Bayesian interpretation
Validation of a Kriging metamodel
Lab: implementation with the OpenTURNS software
Sessions #4 et #5 – Global sensitivity analysis (V. Chabridon)
Overview and challenges
Sensitivity indices based on variance decomposition (Sobol' indices)
Screening methods dedicated to high-dimensional problems (the Morris method, HSIC indices)
Lab: implementation with the OpenTURNS software
Session #6 – Continuation/finalization of projects and openings (R. Sueur)
Finalization of numerical projects (labs)
Discussion and opening about complementary topics: calibration under uncertainty, robust optimization, links with statistical learning / machine learning
Bibliographical analysis project: in-depth study of a scientific article related to course themes
Session #7 – Final assessment (R. Sueur, V. Chabridon)
Individual presentation of the bibliographical analysis project (presentation: 20 min + 10 min Q&A)

Bibliography :
• Da Veiga, S., Gamboa, F., Iooss, B., Prieur, C. Basics and Trends in Sensitivity Analysis: Theory and Practice in R. SIAM, 2021.
• Rasmussen, C. E., Williams, C. K. I. Gaussian Processes for Machine Learning. MIT Press, 2006.

Requirements :
This course requires mastery of the module program "Intrdouction to mathematical software" and "Python and scientific Modules" (DMA-3A-1S), "Linear Regression Model" (DMA-3A-2S) et "Design of Experiments" (DMA-4A-2S).

Organisation :
• Course materials: slides
• Labs: Jupyter Notebooks based on Python and OpenTURNS (https://openturns.github.io/www/)

Evaluation :
• Oral presentation (quality of presentation and media, responses to questions)
• Lab report

Target :
• Third-year students in the Engineering curriculum / Master 2 in Applied Mathematics, students wishing to pursue their career in an industrial R&D Lab or to apply for a doctoral thesis

Reliability and Survival Analysis	DMA09-FMDV
Number of hours : 40.00 h	3.50 ECTS credit
CM : 20.00 h, TD : 10.00 h, TP : 10.00 h	
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
After this course, students will be able to deal with standard probabilistic tools for reliability and survival analysis and to select the (parametric, semiparametric and nonparametric) statistical models suitable for data. They will be able to run survival analyses with the software R and to interpret the results. The last chapter of the course will make a bridge between this course and the course “Rare events modeling”.

Content :
Various types of censoring, general context of survival analysis

Probabilistic tools of the statistical analysis of survival data

Survival function, instantaneous and cumulative hazard functions
The counting process approach. Martingales tools.

Non-parametric methods

Nelson-Aalen and Kaplan-Meier estimates
Logrank and weighted logrank tests

Cox semi-parametric regression model
Statistical inference
Validation tools : tests, residuals, influence

Joint models for survival and longitudinal processes : an introduction

Rare events modeling in presence of censoring

Applications with the software R

Bibliography :
O. Aalen, O. Borgan, H. Gjessing. Survival and event history analysis: a process point of view. Springer, 2008.
J.P. Klein, M.L. Moeschberger. Survival analysis: techniques for censored and truncated data. Springer, 2003.
T. Martinussen, T.H. Scheike. Dynamic regression models for survival data. Springer, 2006.
J. O’Quigley. Proportional hazards regression. Springer, 2008.

Requirements :
Skills from courses « Initiation to mathematical software » (DMA-3A1S), « Markov models » and « Inferential statistics » (DMA-3A2S), « Stochastic models of dynamical systems » (DMA4A1S).

Organisation :

Evaluation :
A final written examination

Target :

Rare Events Estimation and Simulation	DMA09-SEER
Number of hours : 48.00 h	3.50 ECTS credit
CM : 26.00 h, TP : 22.00 h	
Reference Teacher(s) : FURON Teddy	

Objectives :
This course introduces rare events estimation and simulation presenting methodologies and applications. Algorithms will be applied on real case studies assessing the reliability of complex systems.

Content :
Probabilities
FORM/SORM Methods (First / Second Order Reliability Method)
- Evaluation of the probability of failure and early time failure as a function of the stress demand and the resistive stress capability of a system.
Application to the assessment of the reliability of a system.

Rare Events Simulations
- 3 key algorithms: Monte-Carlo methods, Importance sampling, Importance splitting.
Application to computer security (traitor tracing), insurance (risk of bankruptcy), IT service (queuing), hypotheses testing (probability of false positive).

Statistics
Extreme Value Theory
- Distribution of the maximum, Distribution of excesses and related methods (semi-parametric approach)

Practical exercises with R, Matlab and OpenTurns

Bibliography :
J. Beirlant, Y. Goegebeur,J. Segers, J. Teugels. Statistics of Extremes, Theory and applications. Wiley, 2004.
J.A. Bucklew. Introduction to Rare Event Simulation. Springer-Verlag, 2004.
O. Ditlevsen, H.O. Madsen. Structural reliability methods. Department of mechanical engineering technical university of Denmark - Maritime engineering, 2004.
C. Robert, G. Casella. Méthodes de Monte-Carlo avec R. Springer-Verlag, 2011.
G. Rubino et B. Tuffin. Rare Event Simulation using Monte Carlo Methods. Wiley, 2009.

Requirements :
This course requires the mastering of the following modules : « Probabilities » and « Python and its scientific modules » (ARO05), « Markov models » (ARO06), « Stochastic models of dynamic systems » (ARO07).

Organisation :

Evaluation :
Written exam and computer-based test and/or project.

Target :

Business Seminar	DMA09-SE
Number of hours : 48.00 h	3.50 ECTS credit
CM : 48.00 h	
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 5th year, the module will offer (among others) :

- Specific software training ;
- some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing…).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

Target :

Research Project	DMA09-PR
Number of hours : 48.00 h	3.50 ECTS credit
PR : 48.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

TOEIC 5th year	HUM09-ANGL-TOEIC
Number of hours : 20.00 h	1.50 ECTS credit
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

English S9 Conversation	HUM09-ANGL-CONV
Number of hours : 10.00 h	1.50 ECTS credit
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 :

Economics, Law and Business Studies (Professional management)	HUM09-PM-PRO
Number of hours : 70.00 h	2.00 ECTS credit
TA : 70.00 h, TA : 70.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 9

Parcours controle optimal

1	**DMA09-IDS**		**DATA AND SYSTEMS ENGINEERING**	**10.50**
	DMA09-CO	O	Optimal Control	3.50
	DMA09-PARCI	O	Sparsity in Signal and Image Processing	3.50
	DMA09-OI	O	Optimization under uncertainty	3.50
2	**DMA09-IR-2**		**RISK ENGINEERING**	**9.00**
	DMA09-AIS	O	Uncertainty and Sensitivity Analysis in Engineering	3.50
	DMA09-FMDV	O	Reliability and Survival Analysis	3.50
3	**DMA09-SEMP**		**SEMINAR**	**3.50**
	DMA09-SE	C	Business Seminar	3.50
	DMA09-PR	C	Research Project	3.50
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 MANAGEMENT	2.00
	HUM09-PM-B	C	Economics, Law and Business Studies B (Human Resources 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 AND ETHICS FOR ENGINEERS	2.00
	HUM09-PM-E	C	Economics, Law and Business Studies E (INTERNATIONAL DEVELOPPEMENT & STRATEGIES)	2.00
	HUM09-PM-F	C	Economics, Law and Business Studies F (sustainable development)	2.00
	EII09-EVST	C	Internship evaluation	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	Internship evaluation	1.00
	INF09-STGDATING	C	Internship Dating	1.00
	GCU09-SPEC-GPC	C	Management of construction project	1.00
	GCU09-SPEC-GPD	C	BIM Project Management	1.00
	INF09-ETHIQUE	C	Formation éthique de l'ingénieur	1.00
	HUM09-PM-PRO	C	Economics, Law and Business Studies (Professional management)	2.00
	DET10-SPEC PRO	C	Expérience en entreprise	2.00

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

Optimal Control	DMA09-CO
Number of hours : 48.00 h	3.50 ECTS credit
CM : 16.00 h, TD : 16.00 h, TP : 16.00 h	
Reference Teacher(s) : HADDOU Mounir	

Objectives :
Our overall goal is to provide an understanding of the main results in optimal control and how they can be used in various applications. We will introduce and investigate key basic optimal control concepts and extend to some advanced algorithms and techniques. We will focus on both modelization and solution techniques.

Content :
Modelling principles of a control problem.
Controllability , observability and Stabilization .
Optimality principles .
HJB equations , LQR control .
Direct and indirect methods .
Practical examples and exercises using MATLAB & / or Scilab and AMPL .

Bibliography :
M. Bergounioux. Optimisation et contrôle des systèmes linéaires. Dunod, 2001.
A. Locatelli. Optimal control, an introduction. Birkhauser, 2000.
E. Trélat. Contrôle optimal : théorie et applications. Vuibert, 2005.
T. Weber. Optimal control theory. The MIT press 2011.

Requirements :
Course assumes a good working knowledge of linear algebra and differential equations. New material will be covered in depth in the class, but a strong background will be necessary. Course material and homework also assume a good working knowledge of MATLAB and AMPL. (AROM-3A1S, AROM-3A2S, AROM-4A1S and AROM-4A2S).

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Sparsity in Signal and Image Processing	DMA09-PARCI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 24.00 h, TD : 5.00 h, TP : 11.00 h	
Reference Teacher(s) : HERZET Cedric	

Objectives :
This module provides an overview of fundamental concepts and tool relying on sparse representations in signal and image processing. Based on a “geometric” vision of the notion of sparse model, the course will describe the main sparse approximation algorithms, their complexity, and the conditions under which their performance can be guaranteed. The goal is to encompass the role of sparsity in tasks ranging from compression and coding to denoising, source separation, compressive sensing, and more generally linear inverse problems.

Content :
Reminder on harmonic analysis and Shannon/Nyquist sampling theorem General principles of sensing
Examples of inverse problems in signal and image processing Notions of sparsity and applications
Algorithms for sparse representations Convex optimization for sparse regularization
Performance guarantees of sparse regularization algorithms Compressive sensing
Sparse modeling: learning of the decomposition dictionary

Bibliography :
M. Elad. Sparse and Redundant Representations. From Theory to Applications in Signal and Image Processing. Springer, 2010.
S Mallat. A Wavelet Tour of Signal Processing (3rd edition). Academic Press, 2009.
S. Foucart & H. Rauhut, A mathematical introduction to compressive sensing. Springer. 2013.

Requirements :

Organisation :

Evaluation :
Final exam

Target :

Optimization under uncertainty	DMA09-OI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 14.00 h, TP : 12.00 h	
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course will be the opportunity to strengthen the connections between the teachings of probability and optimization of the GM specialty. Its scope is on the introduction of the fundamental concepts of the optimization under uncertainty. We will first present the different models of uncertainty that can be met and the approaches that can be used to deal with them. The rest of the course will focus on the theoretical properties of stochastic programming (minimization of an expected value) and robust optimization (minimization of a maximum value), and on
the practical methods that can solve such problems.

Content :
• Models of uncertainties; probability distributions, intervals of values, scenarios, historical data, domain of Bertsimas.
• Introduction of the existing approaches: stochastic programming, robust optimization, probabilistic constraints, stochastic dynamic programing, online optimization
• Classical examples: newspaper salesman problem, warehouse location under uncertainty, etc.
• Robust optimization: solution of simple problems with the uncertainty set of Bertsimas, mathematical programming models
• Stochastic programming: theoretical properties, solution by cutting plane generation and Monte-Carlo methods
• Implementation of solution algorithms with Julia Language
• Continuation of the S7 courses on the ethical stakes of mathematical modeling for decision aid

Bibliography :
[1] Ben-Tal, A., El Ghaoui, L., & Nemirovski, A. (2009). Robust optimization. Robust Optimization (Princeton).
[2] Birge, J. R., & Louveaux, F. (2011). Introduction to Stochastic Programming. New York, Springer.
[3] Kall, P., & Mayer, J. (2004). Stochastic Linear Programming: Models, Theory, and Computation. Springer.
[4] Shapiro, a., Dentcheva, D., & Ruszczy.ski, A. (2009). Lectures on stochastic programming: modeling and theory. SIAM Series on Optimization.

Requirements :

Organisation :
The course will follow a project-based learning approach that will help master the methods seen during the 4th year
courses on optimization and apply the methods described in class on the same given application during the whole semester.
As a homework, the students will have to produce an analysis of the ethical stakes of a real mathematical decision aid tool that they will have chosen.

Evaluation :

Target :
Fifth-year students of the Applied mathematic specialty

Uncertainty and Sensitivity Analysis in Engineering	DMA09-AIS
Number of hours : 40.00 h	3.50 ECTS credit
CM : 22.00 h, PR : 18.00 h	
Reference Teacher(s) : CHABRIDON Vincent, SUEUR Roman	

Objectives :
At the end of this module, students will be able to master the techniques for dealing with uncertainties in numerical simulation, and to implement methods for exploring numerical models and performing global sensitivity analysis.

Content :
(7 sessions):
Session #1 – Introduction: reliability and uncertainty propagation (R. Sueur)
Structural reliability
Reliability analysis for repairable systems and lifetime data analysis
Uncertainty quantification and propagation for reliability assessment
Lab: implementation with the OpenTURNS software
Sessions #2 et #3 – Metamodels for uncertainty management (R. Sueur)
Introduction to the various families of metamodels / surrogate models
Introduction and presentation of the simple Kriging
Numerical designs of computer experiments for building metamodels (space-filling designs)
Links with Gaussian processes and Bayesian interpretation
Validation of a Kriging metamodel
Lab: implementation with the OpenTURNS software
Sessions #4 et #5 – Global sensitivity analysis (V. Chabridon)
Overview and challenges
Sensitivity indices based on variance decomposition (Sobol' indices)
Screening methods dedicated to high-dimensional problems (the Morris method, HSIC indices)
Lab: implementation with the OpenTURNS software
Session #6 – Continuation/finalization of projects and openings (R. Sueur)
Finalization of numerical projects (labs)
Discussion and opening about complementary topics: calibration under uncertainty, robust optimization, links with statistical learning / machine learning
Bibliographical analysis project: in-depth study of a scientific article related to course themes
Session #7 – Final assessment (R. Sueur, V. Chabridon)
Individual presentation of the bibliographical analysis project (presentation: 20 min + 10 min Q&A)

Bibliography :
• Da Veiga, S., Gamboa, F., Iooss, B., Prieur, C. Basics and Trends in Sensitivity Analysis: Theory and Practice in R. SIAM, 2021.
• Rasmussen, C. E., Williams, C. K. I. Gaussian Processes for Machine Learning. MIT Press, 2006.

Requirements :
This course requires mastery of the module program "Intrdouction to mathematical software" and "Python and scientific Modules" (DMA-3A-1S), "Linear Regression Model" (DMA-3A-2S) et "Design of Experiments" (DMA-4A-2S).

Organisation :
• Course materials: slides
• Labs: Jupyter Notebooks based on Python and OpenTURNS (https://openturns.github.io/www/)

Evaluation :
• Oral presentation (quality of presentation and media, responses to questions)
• Lab report

Target :
• Third-year students in the Engineering curriculum / Master 2 in Applied Mathematics, students wishing to pursue their career in an industrial R&D Lab or to apply for a doctoral thesis

Reliability and Survival Analysis	DMA09-FMDV
Number of hours : 40.00 h	3.50 ECTS credit
CM : 20.00 h, TD : 10.00 h, TP : 10.00 h	
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
After this course, students will be able to deal with standard probabilistic tools for reliability and survival analysis and to select the (parametric, semiparametric and nonparametric) statistical models suitable for data. They will be able to run survival analyses with the software R and to interpret the results. The last chapter of the course will make a bridge between this course and the course “Rare events modeling”.

Content :
Various types of censoring, general context of survival analysis

Probabilistic tools of the statistical analysis of survival data

Survival function, instantaneous and cumulative hazard functions
The counting process approach. Martingales tools.

Non-parametric methods

Nelson-Aalen and Kaplan-Meier estimates
Logrank and weighted logrank tests

Cox semi-parametric regression model
Statistical inference
Validation tools : tests, residuals, influence

Joint models for survival and longitudinal processes : an introduction

Rare events modeling in presence of censoring

Applications with the software R

Bibliography :
O. Aalen, O. Borgan, H. Gjessing. Survival and event history analysis: a process point of view. Springer, 2008.
J.P. Klein, M.L. Moeschberger. Survival analysis: techniques for censored and truncated data. Springer, 2003.
T. Martinussen, T.H. Scheike. Dynamic regression models for survival data. Springer, 2006.
J. O’Quigley. Proportional hazards regression. Springer, 2008.

Requirements :
Skills from courses « Initiation to mathematical software » (DMA-3A1S), « Markov models » and « Inferential statistics » (DMA-3A2S), « Stochastic models of dynamical systems » (DMA4A1S).

Organisation :

Evaluation :
A final written examination

Target :

Business Seminar	DMA09-SE
Number of hours : 48.00 h	3.50 ECTS credit
CM : 48.00 h	
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 5th year, the module will offer (among others) :

- Specific software training ;
- some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing…).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

Target :

Research Project	DMA09-PR
Number of hours : 48.00 h	3.50 ECTS credit
PR : 48.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

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	
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	
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 MANAGEMENT	HUM09-PM-A
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) :	

Objectives :
The Management Course shoudl enable students:
to engage with «management-oriented» themes d'aborder des thèmes « orientés métiers » relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses one course from the list of suggested courses.

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

to understand and know how to use the specialised vocabulary of management
to recognise the main issues in a chosen management theme
to practise teamwork: taking decisions collectively and be able to deliver within set deadlines

Lean Management (28h)
To master the theoretical concepts and practices of Lean and Six Sigma
To develop your capacity to manage and lead value-creating projects
To understand the issues of associated with a culture of continuous progress and, by extension, its implementation within an organisation

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
«Lean Management» Course Programme
Lean Management (28h)

Lean Management is a structured management method. It is increasingly becoming an approach to improve the performance of companies through improved process efficiency.

Applied to company managament, « Lean Management » offers a range of methods to work towards operational excellence.
Associated with the «Six Sigma» methodology which is designed to improve quality, Lean offers an approach that ensures that all customer expectations in terms of quality, deadlines and costs are taken into account.
Programme
The content of this course develops and deepens understanding of certain notions seen in the core curriculum for 3rd Year (IMO).

Introduction to improvement
DMAIC Project
Organising and Leading a team
specific Lean tools
specific Six Sigma tools
field-oriented Lean and Six Sigma tools
feedback from industry and industrial applications

Students registered in this module will be able to participate in the Hackathon of quality and operational excellence organized in December in Nantes. This event will bring together for a whole day teams made up of 4 to 6 students from several educational institutions from Bac + 2 to Master 2 level, supervised by professionals in operational excellence, QHSE management, continuous improvement ...
Together, the students will have to take up the challenge of responding to a real business problem and proposing a relevant action plan. At the end of the day, each team will pitch their final work. The best presentation will be rewarded with a vote from the public and the jury of experts.
Legal Knowledge (6h)

sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers.

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

Target :

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

Objectives :
Objectives of Management Courses
The Management Course shoudl enable students:
to engage with «management-oriented» themes relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses a course from a list of suggested options:

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

1. to understand and know how to use the specialised vocabulary of management
2. to recognise the main issues in a chosen management theme
3. to practise teamwork: taking decisions collectively and be able to deliver within set deadlines
Human Resources Management (20h)
This module therefore specifically aims to:

make future engineers aware of individual and collective management
identify the expectations associated with the manager's mission
equip students with the tools and techniques suited to the manager's mission

Labour Law (8h)
To make future engineers aware of the right to work by giving them key aspects of comprehension in this area which has been rendered more complex due to the diversity of its origins, the multiplication of reforms and frequent changes in jursiprudence.

To enable future engineers therefore to access the labour market with a concise overview of their rights and obligations within a company
Legal Knowledge (6h)
• To acquire a general knowledge of the law
• To understand the organisation and main principles of the legal environment

Content :
«Human Resources Management» Course Programme
Human Resources Management (20h)

Confronted with numerous and ever rapid changes, it is imperative for companies to adapt in order to ensure their sustainability band development. In this context, man management is capital. Leaders must know how to lead,develop and organise the skills of their teams that are necessary to meet objectives and at the same time create commitment in ways that nurture energies sustainably
Programme
the essentials of management
communication and motivatioon
knowing how to set objectives
leadership and team leadership
developing teamwork skills
managing complexity
supporting change

Labour Law (8h)
background to Labour law
the work contract : study of some essential clauses (workplace, salaries, work hours, non-competitive clause
some elements on the different types of work contract termination

Legal Knowledge (6h)
• sources of law, the hierarchy of rules, notion of jurisprudence;

• jurisdictions;
• types of law practioners;
• the contract;
• civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class.

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

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, 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 AND ETHICS FOR ENGINEERS	HUM09-PM-D
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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 :
- The fundamentals of management
- Ethics and business practices (international and corporate frameworks and regulations, impact on project management and decision processes)
- Reflexion on personal motivations related to social and environmental impact of innovation and business, personal values vs professional goals)
Transversal approach by industry sector case studies

Bibliography :
Given during the course

Requirements :
NONE

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 DEVELOPPEMENT & STRATEGIES)	HUM09-PM-E
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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

Bibliography :
Given during the course

Requirements :
None

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 F (sustainable development)	HUM09-PM-F
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :
Sustainable Development (28h)
Sustainable development is a major societal issue that challenges all stakeholders, including training and research institutions. The INSA group has taken up this theme and actively engages with the ways and means of “training engineers to a very high technical level… |but who are also] aware of today's global challenges & capable of helping their companies to make their own energy and ecological transition ”(Inter-INSA Energy-Climate Challenges Working Group in engineer training).

INSA Rennes has committed to the SDSR (Sustainable Developmet and Social Responsibility) accreditation process. The Engineering students enrolled in Course F will be able to contribute concretely to this process by presenting projects that meet the requirements of this standard, in collaboration with the COPIL-DD (Sustainable Development Piloting Committee) and the CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development).

Objectives
To deepen your knowledge of SDS issues and be able to raise awareness of them;
To understand the SD standards and the stages of the accreditation process;
To build a team project that serves the accreditation of INSA Rennes ;
To know how to convince others of your project's relevance and to assess its feasibility (technical and economic)

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
Programme
Presentation of COPIL-DD (Sustainable Development Piloting Committee), CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development) and SD-SR accreditation
Conferences on SD: environmental impacts of digital technology , biodiversity and gardens, SSS (Social et Solidarity Space), etc.
Training on the «Fresco for the Climate» tool

Legal Knowledge (6h)
Programme
sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

As part of this module, the student engineers:
- will attend conferences on SD themes
- will be trained on how to use the «Fresco for the Climate» tool

- will work in pluridisciplinary teams to develop a project that is eligible for SD-SR accreditation and can be implemented on campus.

Personal study time will be provided for within the schedule in order to allow students to advance with the team projects

Evaluation :
Continuous assessment (collective work)

Target :

Internship evaluation	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, 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	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Internship evaluation	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 :

Internship Dating	INF09-STGDATING
Number of hours : 24.00 h	1.00 ECTS credit
CONF : 24.00 h	
Reference Teacher(s) : BLOUIN Arnaud	

Objectives :
The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :
The "stage dating" allows students to have several short interviews of 10mn with different companies.

Conferences are done by industrial contributors, on different subjects like:
- data management, data science, big data
- introduction to the profession of IT architect

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :
A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :
Validation on the presence of the student

Target :

Management of construction project	GCU09-SPEC-GPC
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :
Presenting the different actors involved in project of construction, the operational organisation of the project, the different requirements to be fulfilled, the different phases to be achieved in a project, and the management techniques and tools to be used for this purpose.

Content :
Part 1
The industrial process and fulfillment of missions
Project actors (Project Owner, Project manager, Execution Company, Controller…): Structures, Responsibilities, Expertise, Means.
The project: Structure, organization, and evolution.
Strategies of project management: organization, supervision, modifications, coordination, subcontracting, delivery
Quality assurance and audits
Management of crises and conflicts

Part 2
Actors of technical management of a project: Project Director, Project Supervisor, Programming Engineer, Project Engineer, Specialty Leader…)
Management of technical documents
Management of works
Management of modifications
Management de delays (study, logistics, execution, delivery…
Operational techniques for cost control
Multi-component programming of projects (time, human resources, logistics, cost, risk…).

Online organization of projects and co-contracting

Bibliography :

Requirements :

Organisation :
Plenary lectures supplemented by case studies to illustrate the presented concept of project management. A challenge is organised for applying skills in real-like situations.

Evaluation :
The evaluation concerns the presented project during the challenge.

Target :
5GCU

BIM Project Management	GCU09-SPEC-GPD
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :
BIM technology is a process that involves the creation and use of an intelligent and configurable 3D model to make better decisions about a project and communicate them. This will involve designing, visualizing, simulating, collaborating and managing more easily throughout the project lifecycle. This course aims to introduce you to BIM technology in building project management.

Content :
Introduction to BIM

The digital technology in the construction industry
The main national and international users
Technical terms of the BIM
The digitization of trades
Technological watch
The implementation of a BIM approach

Interoperability

The challenges of openBIM
The IFC
The BCF
The Facility management

Modeling by BIM approach

Modeling a project by tender mission
Structural modeling
The point clouds
Introduction to Dynamo
Content creation
Architectural modeling

Network modeling

Communicating in a BIM approach
PC and digital DOE
Collaborative platforms
Digital communication tools
Virtual reality and augmented reality
4D simulation

Quality control in BIM approach

Automated and iterative control
Steering and refereeing a synthesis
The point clouds
The digital synthesis model

BIM approach methods

The site installation plan
3D phasing
The layout of facades
The banches cycle
The establishment of security element
The operating mode
BCF in different applications
Interference detection in Revit

Interference detection in Solibri Model Checker
Taking into account the specificities of the trades
Consideration of transitional phases of construction site or maintenance phases

Bibliography :
• De la maquette numérique au BIM, Eyrolles
BIM et architecture, DUNOD
Le BIM appliqué à la gestion du projet de construction: Outils, méthodes et flux de travaux, David McCool et Brad Hardin

Requirements :
Revit

Organisation :
8 hours of lectures and 8 hours of tutorials
Copies of handouts

Evaluation :
Mini-Project

Target :
5GCU

Formation éthique de l'ingénieur	INF09-ETHIQUE
Number of hours : 16.00 h	1.00 ECTS credit
CM : 12.00 h, TD : 4.00 h	
Reference Teacher(s) : CELLIER-BELLINA Peggy	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Economics, Law and Business Studies (Professional management)	HUM09-PM-PRO
Number of hours : 70.00 h	2.00 ECTS credit
TA : 70.00 h, TA : 70.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Expérience en entreprise	DET10-SPEC PRO
Number of hours : 30.00 h	2.00 ECTS credit
PR : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 9

Parcours FISP

1	**DMA09-IDS-2**		**DATA AND SYSTEMS ENGINEERING**	**9.00**
	DMA09-PARCI	O	Sparsity in Signal and Image Processing	3.50
	DMA09-OI	O	Optimization under uncertainty	3.50
2	**DMA09-IR**		**RISK ENGINEERING**	**10.50**
	DMA09-AIS	O	Uncertainty and Sensitivity Analysis in Engineering	3.50
	DMA09-FMDV	O	Reliability and Survival Analysis	3.50
	DMA09-SEER	O	Rare Events Estimation and Simulation	3.50
3	**DMA09-SEMP**		**SEMINAR**	**3.50**
	DMA09-SE	C	Business Seminar	3.50
	DMA09-PR	C	Research Project	3.50
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 MANAGEMENT	2.00
	HUM09-PM-B	C	Economics, Law and Business Studies B (Human Resources 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 AND ETHICS FOR ENGINEERS	2.00
	HUM09-PM-E	C	Economics, Law and Business Studies E (INTERNATIONAL DEVELOPPEMENT & STRATEGIES)	2.00
	HUM09-PM-F	C	Economics, Law and Business Studies F (sustainable development)	2.00
	EII09-EVST	C	Internship evaluation	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	Internship evaluation	1.00
	INF09-STGDATING	C	Internship Dating	1.00
	GCU09-SPEC-GPC	C	Management of construction project	1.00
	GCU09-SPEC-GPD	C	BIM Project Management	1.00
	INF09-ETHIQUE	C	Formation éthique de l'ingénieur	1.00
	HUM09-PM-PRO	C	Economics, Law and Business Studies (Professional management)	2.00
	DET10-SPEC PRO	C	Expérience en entreprise	2.00

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

Sparsity in Signal and Image Processing	DMA09-PARCI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 24.00 h, TD : 5.00 h, TP : 11.00 h	
Reference Teacher(s) : HERZET Cedric	

Objectives :
This module provides an overview of fundamental concepts and tool relying on sparse representations in signal and image processing. Based on a “geometric” vision of the notion of sparse model, the course will describe the main sparse approximation algorithms, their complexity, and the conditions under which their performance can be guaranteed. The goal is to encompass the role of sparsity in tasks ranging from compression and coding to denoising, source separation, compressive sensing, and more generally linear inverse problems.

Content :
Reminder on harmonic analysis and Shannon/Nyquist sampling theorem General principles of sensing
Examples of inverse problems in signal and image processing Notions of sparsity and applications
Algorithms for sparse representations Convex optimization for sparse regularization
Performance guarantees of sparse regularization algorithms Compressive sensing
Sparse modeling: learning of the decomposition dictionary

Bibliography :
M. Elad. Sparse and Redundant Representations. From Theory to Applications in Signal and Image Processing. Springer, 2010.
S Mallat. A Wavelet Tour of Signal Processing (3rd edition). Academic Press, 2009.
S. Foucart & H. Rauhut, A mathematical introduction to compressive sensing. Springer. 2013.

Requirements :

Organisation :

Evaluation :
Final exam

Target :

Optimization under uncertainty	DMA09-OI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 14.00 h, TP : 12.00 h	
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course will be the opportunity to strengthen the connections between the teachings of probability and optimization of the GM specialty. Its scope is on the introduction of the fundamental concepts of the optimization under uncertainty. We will first present the different models of uncertainty that can be met and the approaches that can be used to deal with them. The rest of the course will focus on the theoretical properties of stochastic programming (minimization of an expected value) and robust optimization (minimization of a maximum value), and on
the practical methods that can solve such problems.

Content :
• Models of uncertainties; probability distributions, intervals of values, scenarios, historical data, domain of Bertsimas.
• Introduction of the existing approaches: stochastic programming, robust optimization, probabilistic constraints, stochastic dynamic programing, online optimization
• Classical examples: newspaper salesman problem, warehouse location under uncertainty, etc.
• Robust optimization: solution of simple problems with the uncertainty set of Bertsimas, mathematical programming models
• Stochastic programming: theoretical properties, solution by cutting plane generation and Monte-Carlo methods
• Implementation of solution algorithms with Julia Language
• Continuation of the S7 courses on the ethical stakes of mathematical modeling for decision aid

Bibliography :
[1] Ben-Tal, A., El Ghaoui, L., & Nemirovski, A. (2009). Robust optimization. Robust Optimization (Princeton).
[2] Birge, J. R., & Louveaux, F. (2011). Introduction to Stochastic Programming. New York, Springer.
[3] Kall, P., & Mayer, J. (2004). Stochastic Linear Programming: Models, Theory, and Computation. Springer.
[4] Shapiro, a., Dentcheva, D., & Ruszczy.ski, A. (2009). Lectures on stochastic programming: modeling and theory. SIAM Series on Optimization.

Requirements :

Organisation :
The course will follow a project-based learning approach that will help master the methods seen during the 4th year
courses on optimization and apply the methods described in class on the same given application during the whole semester.
As a homework, the students will have to produce an analysis of the ethical stakes of a real mathematical decision aid tool that they will have chosen.

Evaluation :

Target :
Fifth-year students of the Applied mathematic specialty

Uncertainty and Sensitivity Analysis in Engineering	DMA09-AIS
Number of hours : 40.00 h	3.50 ECTS credit
CM : 22.00 h, PR : 18.00 h	
Reference Teacher(s) : CHABRIDON Vincent, SUEUR Roman	

Objectives :
At the end of this module, students will be able to master the techniques for dealing with uncertainties in numerical simulation, and to implement methods for exploring numerical models and performing global sensitivity analysis.

Content :
(7 sessions):
Session #1 – Introduction: reliability and uncertainty propagation (R. Sueur)
Structural reliability
Reliability analysis for repairable systems and lifetime data analysis
Uncertainty quantification and propagation for reliability assessment
Lab: implementation with the OpenTURNS software
Sessions #2 et #3 – Metamodels for uncertainty management (R. Sueur)
Introduction to the various families of metamodels / surrogate models
Introduction and presentation of the simple Kriging
Numerical designs of computer experiments for building metamodels (space-filling designs)
Links with Gaussian processes and Bayesian interpretation
Validation of a Kriging metamodel
Lab: implementation with the OpenTURNS software
Sessions #4 et #5 – Global sensitivity analysis (V. Chabridon)
Overview and challenges
Sensitivity indices based on variance decomposition (Sobol' indices)
Screening methods dedicated to high-dimensional problems (the Morris method, HSIC indices)
Lab: implementation with the OpenTURNS software
Session #6 – Continuation/finalization of projects and openings (R. Sueur)
Finalization of numerical projects (labs)
Discussion and opening about complementary topics: calibration under uncertainty, robust optimization, links with statistical learning / machine learning
Bibliographical analysis project: in-depth study of a scientific article related to course themes
Session #7 – Final assessment (R. Sueur, V. Chabridon)
Individual presentation of the bibliographical analysis project (presentation: 20 min + 10 min Q&A)

Bibliography :
• Da Veiga, S., Gamboa, F., Iooss, B., Prieur, C. Basics and Trends in Sensitivity Analysis: Theory and Practice in R. SIAM, 2021.
• Rasmussen, C. E., Williams, C. K. I. Gaussian Processes for Machine Learning. MIT Press, 2006.

Requirements :
This course requires mastery of the module program "Intrdouction to mathematical software" and "Python and scientific Modules" (DMA-3A-1S), "Linear Regression Model" (DMA-3A-2S) et "Design of Experiments" (DMA-4A-2S).

Organisation :
• Course materials: slides
• Labs: Jupyter Notebooks based on Python and OpenTURNS (https://openturns.github.io/www/)

Evaluation :
• Oral presentation (quality of presentation and media, responses to questions)
• Lab report

Target :
• Third-year students in the Engineering curriculum / Master 2 in Applied Mathematics, students wishing to pursue their career in an industrial R&D Lab or to apply for a doctoral thesis

Reliability and Survival Analysis	DMA09-FMDV
Number of hours : 40.00 h	3.50 ECTS credit
CM : 20.00 h, TD : 10.00 h, TP : 10.00 h	
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
After this course, students will be able to deal with standard probabilistic tools for reliability and survival analysis and to select the (parametric, semiparametric and nonparametric) statistical models suitable for data. They will be able to run survival analyses with the software R and to interpret the results. The last chapter of the course will make a bridge between this course and the course “Rare events modeling”.

Content :
Various types of censoring, general context of survival analysis

Probabilistic tools of the statistical analysis of survival data

Survival function, instantaneous and cumulative hazard functions
The counting process approach. Martingales tools.

Non-parametric methods

Nelson-Aalen and Kaplan-Meier estimates
Logrank and weighted logrank tests

Cox semi-parametric regression model
Statistical inference
Validation tools : tests, residuals, influence

Joint models for survival and longitudinal processes : an introduction

Rare events modeling in presence of censoring

Applications with the software R

Bibliography :
O. Aalen, O. Borgan, H. Gjessing. Survival and event history analysis: a process point of view. Springer, 2008.
J.P. Klein, M.L. Moeschberger. Survival analysis: techniques for censored and truncated data. Springer, 2003.
T. Martinussen, T.H. Scheike. Dynamic regression models for survival data. Springer, 2006.
J. O’Quigley. Proportional hazards regression. Springer, 2008.

Requirements :
Skills from courses « Initiation to mathematical software » (DMA-3A1S), « Markov models » and « Inferential statistics » (DMA-3A2S), « Stochastic models of dynamical systems » (DMA4A1S).

Organisation :

Evaluation :
A final written examination

Target :

Rare Events Estimation and Simulation	DMA09-SEER
Number of hours : 48.00 h	3.50 ECTS credit
CM : 26.00 h, TP : 22.00 h	
Reference Teacher(s) : FURON Teddy	

Objectives :
This course introduces rare events estimation and simulation presenting methodologies and applications. Algorithms will be applied on real case studies assessing the reliability of complex systems.

Content :
Probabilities
FORM/SORM Methods (First / Second Order Reliability Method)
- Evaluation of the probability of failure and early time failure as a function of the stress demand and the resistive stress capability of a system.
Application to the assessment of the reliability of a system.

Rare Events Simulations
- 3 key algorithms: Monte-Carlo methods, Importance sampling, Importance splitting.
Application to computer security (traitor tracing), insurance (risk of bankruptcy), IT service (queuing), hypotheses testing (probability of false positive).

Statistics
Extreme Value Theory
- Distribution of the maximum, Distribution of excesses and related methods (semi-parametric approach)

Practical exercises with R, Matlab and OpenTurns

Bibliography :
J. Beirlant, Y. Goegebeur,J. Segers, J. Teugels. Statistics of Extremes, Theory and applications. Wiley, 2004.
J.A. Bucklew. Introduction to Rare Event Simulation. Springer-Verlag, 2004.
O. Ditlevsen, H.O. Madsen. Structural reliability methods. Department of mechanical engineering technical university of Denmark - Maritime engineering, 2004.
C. Robert, G. Casella. Méthodes de Monte-Carlo avec R. Springer-Verlag, 2011.
G. Rubino et B. Tuffin. Rare Event Simulation using Monte Carlo Methods. Wiley, 2009.

Requirements :
This course requires the mastering of the following modules : « Probabilities » and « Python and its scientific modules » (ARO05), « Markov models » (ARO06), « Stochastic models of dynamic systems » (ARO07).

Organisation :

Evaluation :
Written exam and computer-based test and/or project.

Target :

Business Seminar	DMA09-SE
Number of hours : 48.00 h	3.50 ECTS credit
CM : 48.00 h	
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 5th year, the module will offer (among others) :

- Specific software training ;
- some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing…).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

Target :

Research Project	DMA09-PR
Number of hours : 48.00 h	3.50 ECTS credit
PR : 48.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

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	
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	
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 MANAGEMENT	HUM09-PM-A
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) :	

Objectives :
The Management Course shoudl enable students:
to engage with «management-oriented» themes d'aborder des thèmes « orientés métiers » relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses one course from the list of suggested courses.

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

to understand and know how to use the specialised vocabulary of management
to recognise the main issues in a chosen management theme
to practise teamwork: taking decisions collectively and be able to deliver within set deadlines

Lean Management (28h)
To master the theoretical concepts and practices of Lean and Six Sigma
To develop your capacity to manage and lead value-creating projects
To understand the issues of associated with a culture of continuous progress and, by extension, its implementation within an organisation

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
«Lean Management» Course Programme
Lean Management (28h)

Lean Management is a structured management method. It is increasingly becoming an approach to improve the performance of companies through improved process efficiency.

Applied to company managament, « Lean Management » offers a range of methods to work towards operational excellence.
Associated with the «Six Sigma» methodology which is designed to improve quality, Lean offers an approach that ensures that all customer expectations in terms of quality, deadlines and costs are taken into account.
Programme
The content of this course develops and deepens understanding of certain notions seen in the core curriculum for 3rd Year (IMO).

Introduction to improvement
DMAIC Project
Organising and Leading a team
specific Lean tools
specific Six Sigma tools
field-oriented Lean and Six Sigma tools
feedback from industry and industrial applications

Students registered in this module will be able to participate in the Hackathon of quality and operational excellence organized in December in Nantes. This event will bring together for a whole day teams made up of 4 to 6 students from several educational institutions from Bac + 2 to Master 2 level, supervised by professionals in operational excellence, QHSE management, continuous improvement ...
Together, the students will have to take up the challenge of responding to a real business problem and proposing a relevant action plan. At the end of the day, each team will pitch their final work. The best presentation will be rewarded with a vote from the public and the jury of experts.
Legal Knowledge (6h)

sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers.

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

Target :

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

Objectives :
Objectives of Management Courses
The Management Course shoudl enable students:
to engage with «management-oriented» themes relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses a course from a list of suggested options:

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

1. to understand and know how to use the specialised vocabulary of management
2. to recognise the main issues in a chosen management theme
3. to practise teamwork: taking decisions collectively and be able to deliver within set deadlines
Human Resources Management (20h)
This module therefore specifically aims to:

make future engineers aware of individual and collective management
identify the expectations associated with the manager's mission
equip students with the tools and techniques suited to the manager's mission

Labour Law (8h)
To make future engineers aware of the right to work by giving them key aspects of comprehension in this area which has been rendered more complex due to the diversity of its origins, the multiplication of reforms and frequent changes in jursiprudence.

To enable future engineers therefore to access the labour market with a concise overview of their rights and obligations within a company
Legal Knowledge (6h)
• To acquire a general knowledge of the law
• To understand the organisation and main principles of the legal environment

Content :
«Human Resources Management» Course Programme
Human Resources Management (20h)

Confronted with numerous and ever rapid changes, it is imperative for companies to adapt in order to ensure their sustainability band development. In this context, man management is capital. Leaders must know how to lead,develop and organise the skills of their teams that are necessary to meet objectives and at the same time create commitment in ways that nurture energies sustainably
Programme
the essentials of management
communication and motivatioon
knowing how to set objectives
leadership and team leadership
developing teamwork skills
managing complexity
supporting change

Labour Law (8h)
background to Labour law
the work contract : study of some essential clauses (workplace, salaries, work hours, non-competitive clause
some elements on the different types of work contract termination

Legal Knowledge (6h)
• sources of law, the hierarchy of rules, notion of jurisprudence;

• jurisdictions;
• types of law practioners;
• the contract;
• civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class.

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

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, 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 AND ETHICS FOR ENGINEERS	HUM09-PM-D
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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 :
- The fundamentals of management
- Ethics and business practices (international and corporate frameworks and regulations, impact on project management and decision processes)
- Reflexion on personal motivations related to social and environmental impact of innovation and business, personal values vs professional goals)
Transversal approach by industry sector case studies

Bibliography :
Given during the course

Requirements :
NONE

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 DEVELOPPEMENT & STRATEGIES)	HUM09-PM-E
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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

Bibliography :
Given during the course

Requirements :
None

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 F (sustainable development)	HUM09-PM-F
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :
Sustainable Development (28h)
Sustainable development is a major societal issue that challenges all stakeholders, including training and research institutions. The INSA group has taken up this theme and actively engages with the ways and means of “training engineers to a very high technical level… |but who are also] aware of today's global challenges & capable of helping their companies to make their own energy and ecological transition ”(Inter-INSA Energy-Climate Challenges Working Group in engineer training).

INSA Rennes has committed to the SDSR (Sustainable Developmet and Social Responsibility) accreditation process. The Engineering students enrolled in Course F will be able to contribute concretely to this process by presenting projects that meet the requirements of this standard, in collaboration with the COPIL-DD (Sustainable Development Piloting Committee) and the CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development).

Objectives
To deepen your knowledge of SDS issues and be able to raise awareness of them;
To understand the SD standards and the stages of the accreditation process;
To build a team project that serves the accreditation of INSA Rennes ;
To know how to convince others of your project's relevance and to assess its feasibility (technical and economic)

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
Programme
Presentation of COPIL-DD (Sustainable Development Piloting Committee), CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development) and SD-SR accreditation
Conferences on SD: environmental impacts of digital technology , biodiversity and gardens, SSS (Social et Solidarity Space), etc.
Training on the «Fresco for the Climate» tool

Legal Knowledge (6h)
Programme
sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

As part of this module, the student engineers:
- will attend conferences on SD themes
- will be trained on how to use the «Fresco for the Climate» tool

- will work in pluridisciplinary teams to develop a project that is eligible for SD-SR accreditation and can be implemented on campus.

Personal study time will be provided for within the schedule in order to allow students to advance with the team projects

Evaluation :
Continuous assessment (collective work)

Target :

Internship evaluation	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, 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	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Internship evaluation	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 :

Internship Dating	INF09-STGDATING
Number of hours : 24.00 h	1.00 ECTS credit
CONF : 24.00 h	
Reference Teacher(s) : BLOUIN Arnaud	

Objectives :
The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :
The "stage dating" allows students to have several short interviews of 10mn with different companies.

Conferences are done by industrial contributors, on different subjects like:
- data management, data science, big data
- introduction to the profession of IT architect

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :
A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :
Validation on the presence of the student

Target :

Management of construction project	GCU09-SPEC-GPC
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :
Presenting the different actors involved in project of construction, the operational organisation of the project, the different requirements to be fulfilled, the different phases to be achieved in a project, and the management techniques and tools to be used for this purpose.

Content :
Part 1
The industrial process and fulfillment of missions
Project actors (Project Owner, Project manager, Execution Company, Controller…): Structures, Responsibilities, Expertise, Means.
The project: Structure, organization, and evolution.
Strategies of project management: organization, supervision, modifications, coordination, subcontracting, delivery
Quality assurance and audits
Management of crises and conflicts

Part 2
Actors of technical management of a project: Project Director, Project Supervisor, Programming Engineer, Project Engineer, Specialty Leader…)
Management of technical documents
Management of works
Management of modifications
Management de delays (study, logistics, execution, delivery…
Operational techniques for cost control
Multi-component programming of projects (time, human resources, logistics, cost, risk…).

Online organization of projects and co-contracting

Bibliography :

Requirements :

Organisation :
Plenary lectures supplemented by case studies to illustrate the presented concept of project management. A challenge is organised for applying skills in real-like situations.

Evaluation :
The evaluation concerns the presented project during the challenge.

Target :
5GCU

BIM Project Management	GCU09-SPEC-GPD
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :
BIM technology is a process that involves the creation and use of an intelligent and configurable 3D model to make better decisions about a project and communicate them. This will involve designing, visualizing, simulating, collaborating and managing more easily throughout the project lifecycle. This course aims to introduce you to BIM technology in building project management.

Content :
Introduction to BIM

The digital technology in the construction industry
The main national and international users
Technical terms of the BIM
The digitization of trades
Technological watch
The implementation of a BIM approach

Interoperability

The challenges of openBIM
The IFC
The BCF
The Facility management

Modeling by BIM approach

Modeling a project by tender mission
Structural modeling
The point clouds
Introduction to Dynamo
Content creation
Architectural modeling

Network modeling

Communicating in a BIM approach
PC and digital DOE
Collaborative platforms
Digital communication tools
Virtual reality and augmented reality
4D simulation

Quality control in BIM approach

Automated and iterative control
Steering and refereeing a synthesis
The point clouds
The digital synthesis model

BIM approach methods

The site installation plan
3D phasing
The layout of facades
The banches cycle
The establishment of security element
The operating mode
BCF in different applications
Interference detection in Revit

Interference detection in Solibri Model Checker
Taking into account the specificities of the trades
Consideration of transitional phases of construction site or maintenance phases

Bibliography :
• De la maquette numérique au BIM, Eyrolles
BIM et architecture, DUNOD
Le BIM appliqué à la gestion du projet de construction: Outils, méthodes et flux de travaux, David McCool et Brad Hardin

Requirements :
Revit

Organisation :
8 hours of lectures and 8 hours of tutorials
Copies of handouts

Evaluation :
Mini-Project

Target :
5GCU

Formation éthique de l'ingénieur	INF09-ETHIQUE
Number of hours : 16.00 h	1.00 ECTS credit
CM : 12.00 h, TD : 4.00 h	
Reference Teacher(s) : CELLIER-BELLINA Peggy	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Economics, Law and Business Studies (Professional management)	HUM09-PM-PRO
Number of hours : 70.00 h	2.00 ECTS credit
TA : 70.00 h, TA : 70.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Expérience en entreprise	DET10-SPEC PRO
Number of hours : 30.00 h	2.00 ECTS credit
PR : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 9

Parcours Formation initiale

1	**DMA09-IDS**		**DATA AND SYSTEMS ENGINEERING**	**10.50**
	DMA09-CO	O	Optimal Control	3.50
	DMA09-PARCI	O	Sparsity in Signal and Image Processing	3.50
	DMA09-OI	O	Optimization under uncertainty	3.50
2	**DMA09-IR**		**RISK ENGINEERING**	**10.50**
	DMA09-AIS	O	Uncertainty and Sensitivity Analysis in Engineering	3.50
	DMA09-FMDV	O	Reliability and Survival Analysis	3.50
	DMA09-SEER	O	Rare Events Estimation and Simulation	3.50
3	**DMA09-SEMP**		**SEMINAR**	**3.50**
	DMA09-SE	C	Business Seminar	3.50
	DMA09-PR	C	Research Project	3.50
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 MANAGEMENT	2.00
	HUM09-PM-B	C	Economics, Law and Business Studies B (Human Resources 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 AND ETHICS FOR ENGINEERS	2.00
	HUM09-PM-E	C	Economics, Law and Business Studies E (INTERNATIONAL DEVELOPPEMENT & STRATEGIES)	2.00
	HUM09-PM-F	C	Economics, Law and Business Studies F (sustainable development)	2.00
	EII09-EVST	C	Internship evaluation	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	Internship evaluation	1.00
	INF09-STGDATING	C	Internship Dating	1.00
	GCU09-SPEC-GPC	C	Management of construction project	1.00
	GCU09-SPEC-GPD	C	BIM Project Management	1.00
	INF09-ETHIQUE	C	Formation éthique de l'ingénieur	1.00
	HUM09-PM-PRO	C	Economics, Law and Business Studies (Professional management)	2.00
	DET10-SPEC PRO	C	Expérience en entreprise	2.00

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

Optimal Control	DMA09-CO
Number of hours : 48.00 h	3.50 ECTS credit
CM : 16.00 h, TD : 16.00 h, TP : 16.00 h	
Reference Teacher(s) : HADDOU Mounir	

Objectives :
Our overall goal is to provide an understanding of the main results in optimal control and how they can be used in various applications. We will introduce and investigate key basic optimal control concepts and extend to some advanced algorithms and techniques. We will focus on both modelization and solution techniques.

Content :
Modelling principles of a control problem.
Controllability , observability and Stabilization .
Optimality principles .
HJB equations , LQR control .
Direct and indirect methods .
Practical examples and exercises using MATLAB & / or Scilab and AMPL .

Bibliography :
M. Bergounioux. Optimisation et contrôle des systèmes linéaires. Dunod, 2001.
A. Locatelli. Optimal control, an introduction. Birkhauser, 2000.
E. Trélat. Contrôle optimal : théorie et applications. Vuibert, 2005.
T. Weber. Optimal control theory. The MIT press 2011.

Requirements :
Course assumes a good working knowledge of linear algebra and differential equations. New material will be covered in depth in the class, but a strong background will be necessary. Course material and homework also assume a good working knowledge of MATLAB and AMPL. (AROM-3A1S, AROM-3A2S, AROM-4A1S and AROM-4A2S).

Organisation :

Evaluation :
One written examination (2/3) and a practical examination and/or project (1/3).

Target :

Sparsity in Signal and Image Processing	DMA09-PARCI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 24.00 h, TD : 5.00 h, TP : 11.00 h	
Reference Teacher(s) : HERZET Cedric	

Objectives :
This module provides an overview of fundamental concepts and tool relying on sparse representations in signal and image processing. Based on a “geometric” vision of the notion of sparse model, the course will describe the main sparse approximation algorithms, their complexity, and the conditions under which their performance can be guaranteed. The goal is to encompass the role of sparsity in tasks ranging from compression and coding to denoising, source separation, compressive sensing, and more generally linear inverse problems.

Content :
Reminder on harmonic analysis and Shannon/Nyquist sampling theorem General principles of sensing
Examples of inverse problems in signal and image processing Notions of sparsity and applications
Algorithms for sparse representations Convex optimization for sparse regularization
Performance guarantees of sparse regularization algorithms Compressive sensing
Sparse modeling: learning of the decomposition dictionary

Bibliography :
M. Elad. Sparse and Redundant Representations. From Theory to Applications in Signal and Image Processing. Springer, 2010.
S Mallat. A Wavelet Tour of Signal Processing (3rd edition). Academic Press, 2009.
S. Foucart & H. Rauhut, A mathematical introduction to compressive sensing. Springer. 2013.

Requirements :

Organisation :

Evaluation :
Final exam

Target :

Optimization under uncertainty	DMA09-OI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 14.00 h, TP : 12.00 h	
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course will be the opportunity to strengthen the connections between the teachings of probability and optimization of the GM specialty. Its scope is on the introduction of the fundamental concepts of the optimization under uncertainty. We will first present the different models of uncertainty that can be met and the approaches that can be used to deal with them. The rest of the course will focus on the theoretical properties of stochastic programming (minimization of an expected value) and robust optimization (minimization of a maximum value), and on
the practical methods that can solve such problems.

Content :
• Models of uncertainties; probability distributions, intervals of values, scenarios, historical data, domain of Bertsimas.
• Introduction of the existing approaches: stochastic programming, robust optimization, probabilistic constraints, stochastic dynamic programing, online optimization
• Classical examples: newspaper salesman problem, warehouse location under uncertainty, etc.
• Robust optimization: solution of simple problems with the uncertainty set of Bertsimas, mathematical programming models
• Stochastic programming: theoretical properties, solution by cutting plane generation and Monte-Carlo methods
• Implementation of solution algorithms with Julia Language
• Continuation of the S7 courses on the ethical stakes of mathematical modeling for decision aid

Bibliography :
[1] Ben-Tal, A., El Ghaoui, L., & Nemirovski, A. (2009). Robust optimization. Robust Optimization (Princeton).
[2] Birge, J. R., & Louveaux, F. (2011). Introduction to Stochastic Programming. New York, Springer.
[3] Kall, P., & Mayer, J. (2004). Stochastic Linear Programming: Models, Theory, and Computation. Springer.
[4] Shapiro, a., Dentcheva, D., & Ruszczy.ski, A. (2009). Lectures on stochastic programming: modeling and theory. SIAM Series on Optimization.

Requirements :

Organisation :
The course will follow a project-based learning approach that will help master the methods seen during the 4th year
courses on optimization and apply the methods described in class on the same given application during the whole semester.
As a homework, the students will have to produce an analysis of the ethical stakes of a real mathematical decision aid tool that they will have chosen.

Evaluation :

Target :
Fifth-year students of the Applied mathematic specialty

Uncertainty and Sensitivity Analysis in Engineering	DMA09-AIS
Number of hours : 40.00 h	3.50 ECTS credit
CM : 22.00 h, PR : 18.00 h	
Reference Teacher(s) : CHABRIDON Vincent, SUEUR Roman	

Objectives :
At the end of this module, students will be able to master the techniques for dealing with uncertainties in numerical simulation, and to implement methods for exploring numerical models and performing global sensitivity analysis.

Content :
(7 sessions):
Session #1 – Introduction: reliability and uncertainty propagation (R. Sueur)
Structural reliability
Reliability analysis for repairable systems and lifetime data analysis
Uncertainty quantification and propagation for reliability assessment
Lab: implementation with the OpenTURNS software
Sessions #2 et #3 – Metamodels for uncertainty management (R. Sueur)
Introduction to the various families of metamodels / surrogate models
Introduction and presentation of the simple Kriging
Numerical designs of computer experiments for building metamodels (space-filling designs)
Links with Gaussian processes and Bayesian interpretation
Validation of a Kriging metamodel
Lab: implementation with the OpenTURNS software
Sessions #4 et #5 – Global sensitivity analysis (V. Chabridon)
Overview and challenges
Sensitivity indices based on variance decomposition (Sobol' indices)
Screening methods dedicated to high-dimensional problems (the Morris method, HSIC indices)
Lab: implementation with the OpenTURNS software
Session #6 – Continuation/finalization of projects and openings (R. Sueur)
Finalization of numerical projects (labs)
Discussion and opening about complementary topics: calibration under uncertainty, robust optimization, links with statistical learning / machine learning
Bibliographical analysis project: in-depth study of a scientific article related to course themes
Session #7 – Final assessment (R. Sueur, V. Chabridon)
Individual presentation of the bibliographical analysis project (presentation: 20 min + 10 min Q&A)

Bibliography :
• Da Veiga, S., Gamboa, F., Iooss, B., Prieur, C. Basics and Trends in Sensitivity Analysis: Theory and Practice in R. SIAM, 2021.
• Rasmussen, C. E., Williams, C. K. I. Gaussian Processes for Machine Learning. MIT Press, 2006.

Requirements :
This course requires mastery of the module program "Intrdouction to mathematical software" and "Python and scientific Modules" (DMA-3A-1S), "Linear Regression Model" (DMA-3A-2S) et "Design of Experiments" (DMA-4A-2S).

Organisation :
• Course materials: slides
• Labs: Jupyter Notebooks based on Python and OpenTURNS (https://openturns.github.io/www/)

Evaluation :
• Oral presentation (quality of presentation and media, responses to questions)
• Lab report

Target :
• Third-year students in the Engineering curriculum / Master 2 in Applied Mathematics, students wishing to pursue their career in an industrial R&D Lab or to apply for a doctoral thesis

Reliability and Survival Analysis	DMA09-FMDV
Number of hours : 40.00 h	3.50 ECTS credit
CM : 20.00 h, TD : 10.00 h, TP : 10.00 h	
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
After this course, students will be able to deal with standard probabilistic tools for reliability and survival analysis and to select the (parametric, semiparametric and nonparametric) statistical models suitable for data. They will be able to run survival analyses with the software R and to interpret the results. The last chapter of the course will make a bridge between this course and the course “Rare events modeling”.

Content :
Various types of censoring, general context of survival analysis

Probabilistic tools of the statistical analysis of survival data

Survival function, instantaneous and cumulative hazard functions
The counting process approach. Martingales tools.

Non-parametric methods

Nelson-Aalen and Kaplan-Meier estimates
Logrank and weighted logrank tests

Cox semi-parametric regression model
Statistical inference
Validation tools : tests, residuals, influence

Joint models for survival and longitudinal processes : an introduction

Rare events modeling in presence of censoring

Applications with the software R

Bibliography :
O. Aalen, O. Borgan, H. Gjessing. Survival and event history analysis: a process point of view. Springer, 2008.
J.P. Klein, M.L. Moeschberger. Survival analysis: techniques for censored and truncated data. Springer, 2003.
T. Martinussen, T.H. Scheike. Dynamic regression models for survival data. Springer, 2006.
J. O’Quigley. Proportional hazards regression. Springer, 2008.

Requirements :
Skills from courses « Initiation to mathematical software » (DMA-3A1S), « Markov models » and « Inferential statistics » (DMA-3A2S), « Stochastic models of dynamical systems » (DMA4A1S).

Organisation :

Evaluation :
A final written examination

Target :

Rare Events Estimation and Simulation	DMA09-SEER
Number of hours : 48.00 h	3.50 ECTS credit
CM : 26.00 h, TP : 22.00 h	
Reference Teacher(s) : FURON Teddy	

Objectives :
This course introduces rare events estimation and simulation presenting methodologies and applications. Algorithms will be applied on real case studies assessing the reliability of complex systems.

Content :
Probabilities
FORM/SORM Methods (First / Second Order Reliability Method)
- Evaluation of the probability of failure and early time failure as a function of the stress demand and the resistive stress capability of a system.
Application to the assessment of the reliability of a system.

Rare Events Simulations
- 3 key algorithms: Monte-Carlo methods, Importance sampling, Importance splitting.
Application to computer security (traitor tracing), insurance (risk of bankruptcy), IT service (queuing), hypotheses testing (probability of false positive).

Statistics
Extreme Value Theory
- Distribution of the maximum, Distribution of excesses and related methods (semi-parametric approach)

Practical exercises with R, Matlab and OpenTurns

Bibliography :
J. Beirlant, Y. Goegebeur,J. Segers, J. Teugels. Statistics of Extremes, Theory and applications. Wiley, 2004.
J.A. Bucklew. Introduction to Rare Event Simulation. Springer-Verlag, 2004.
O. Ditlevsen, H.O. Madsen. Structural reliability methods. Department of mechanical engineering technical university of Denmark - Maritime engineering, 2004.
C. Robert, G. Casella. Méthodes de Monte-Carlo avec R. Springer-Verlag, 2011.
G. Rubino et B. Tuffin. Rare Event Simulation using Monte Carlo Methods. Wiley, 2009.

Requirements :
This course requires the mastering of the following modules : « Probabilities » and « Python and its scientific modules » (ARO05), « Markov models » (ARO06), « Stochastic models of dynamic systems » (ARO07).

Organisation :

Evaluation :
Written exam and computer-based test and/or project.

Target :

Business Seminar	DMA09-SE
Number of hours : 48.00 h	3.50 ECTS credit
CM : 48.00 h	
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 5th year, the module will offer (among others) :

- Specific software training ;
- some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing…).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

Target :

Research Project	DMA09-PR
Number of hours : 48.00 h	3.50 ECTS credit
PR : 48.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

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	
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	
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 MANAGEMENT	HUM09-PM-A
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) :	

Objectives :
The Management Course shoudl enable students:
to engage with «management-oriented» themes d'aborder des thèmes « orientés métiers » relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses one course from the list of suggested courses.

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

to understand and know how to use the specialised vocabulary of management
to recognise the main issues in a chosen management theme
to practise teamwork: taking decisions collectively and be able to deliver within set deadlines

Lean Management (28h)
To master the theoretical concepts and practices of Lean and Six Sigma
To develop your capacity to manage and lead value-creating projects
To understand the issues of associated with a culture of continuous progress and, by extension, its implementation within an organisation

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
«Lean Management» Course Programme
Lean Management (28h)

Lean Management is a structured management method. It is increasingly becoming an approach to improve the performance of companies through improved process efficiency.

Applied to company managament, « Lean Management » offers a range of methods to work towards operational excellence.
Associated with the «Six Sigma» methodology which is designed to improve quality, Lean offers an approach that ensures that all customer expectations in terms of quality, deadlines and costs are taken into account.
Programme
The content of this course develops and deepens understanding of certain notions seen in the core curriculum for 3rd Year (IMO).

Introduction to improvement
DMAIC Project
Organising and Leading a team
specific Lean tools
specific Six Sigma tools
field-oriented Lean and Six Sigma tools
feedback from industry and industrial applications

Students registered in this module will be able to participate in the Hackathon of quality and operational excellence organized in December in Nantes. This event will bring together for a whole day teams made up of 4 to 6 students from several educational institutions from Bac + 2 to Master 2 level, supervised by professionals in operational excellence, QHSE management, continuous improvement ...
Together, the students will have to take up the challenge of responding to a real business problem and proposing a relevant action plan. At the end of the day, each team will pitch their final work. The best presentation will be rewarded with a vote from the public and the jury of experts.
Legal Knowledge (6h)

sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers.

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

Target :

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

Objectives :
Objectives of Management Courses
The Management Course shoudl enable students:
to engage with «management-oriented» themes relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses a course from a list of suggested options:

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

1. to understand and know how to use the specialised vocabulary of management
2. to recognise the main issues in a chosen management theme
3. to practise teamwork: taking decisions collectively and be able to deliver within set deadlines
Human Resources Management (20h)
This module therefore specifically aims to:

make future engineers aware of individual and collective management
identify the expectations associated with the manager's mission
equip students with the tools and techniques suited to the manager's mission

Labour Law (8h)
To make future engineers aware of the right to work by giving them key aspects of comprehension in this area which has been rendered more complex due to the diversity of its origins, the multiplication of reforms and frequent changes in jursiprudence.

To enable future engineers therefore to access the labour market with a concise overview of their rights and obligations within a company
Legal Knowledge (6h)
• To acquire a general knowledge of the law
• To understand the organisation and main principles of the legal environment

Content :
«Human Resources Management» Course Programme
Human Resources Management (20h)

Confronted with numerous and ever rapid changes, it is imperative for companies to adapt in order to ensure their sustainability band development. In this context, man management is capital. Leaders must know how to lead,develop and organise the skills of their teams that are necessary to meet objectives and at the same time create commitment in ways that nurture energies sustainably
Programme
the essentials of management
communication and motivatioon
knowing how to set objectives
leadership and team leadership
developing teamwork skills
managing complexity
supporting change

Labour Law (8h)
background to Labour law
the work contract : study of some essential clauses (workplace, salaries, work hours, non-competitive clause
some elements on the different types of work contract termination

Legal Knowledge (6h)
• sources of law, the hierarchy of rules, notion of jurisprudence;

• jurisdictions;
• types of law practioners;
• the contract;
• civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class.

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

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, 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 AND ETHICS FOR ENGINEERS	HUM09-PM-D
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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 :
- The fundamentals of management
- Ethics and business practices (international and corporate frameworks and regulations, impact on project management and decision processes)
- Reflexion on personal motivations related to social and environmental impact of innovation and business, personal values vs professional goals)
Transversal approach by industry sector case studies

Bibliography :
Given during the course

Requirements :
NONE

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 DEVELOPPEMENT & STRATEGIES)	HUM09-PM-E
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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

Bibliography :
Given during the course

Requirements :
None

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 F (sustainable development)	HUM09-PM-F
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :
Sustainable Development (28h)
Sustainable development is a major societal issue that challenges all stakeholders, including training and research institutions. The INSA group has taken up this theme and actively engages with the ways and means of “training engineers to a very high technical level… |but who are also] aware of today's global challenges & capable of helping their companies to make their own energy and ecological transition ”(Inter-INSA Energy-Climate Challenges Working Group in engineer training).

INSA Rennes has committed to the SDSR (Sustainable Developmet and Social Responsibility) accreditation process. The Engineering students enrolled in Course F will be able to contribute concretely to this process by presenting projects that meet the requirements of this standard, in collaboration with the COPIL-DD (Sustainable Development Piloting Committee) and the CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development).

Objectives
To deepen your knowledge of SDS issues and be able to raise awareness of them;
To understand the SD standards and the stages of the accreditation process;
To build a team project that serves the accreditation of INSA Rennes ;
To know how to convince others of your project's relevance and to assess its feasibility (technical and economic)

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
Programme
Presentation of COPIL-DD (Sustainable Development Piloting Committee), CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development) and SD-SR accreditation
Conferences on SD: environmental impacts of digital technology , biodiversity and gardens, SSS (Social et Solidarity Space), etc.
Training on the «Fresco for the Climate» tool

Legal Knowledge (6h)
Programme
sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

As part of this module, the student engineers:
- will attend conferences on SD themes
- will be trained on how to use the «Fresco for the Climate» tool

- will work in pluridisciplinary teams to develop a project that is eligible for SD-SR accreditation and can be implemented on campus.

Personal study time will be provided for within the schedule in order to allow students to advance with the team projects

Evaluation :
Continuous assessment (collective work)

Target :

Internship evaluation	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, 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	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Internship evaluation	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 :

Internship Dating	INF09-STGDATING
Number of hours : 24.00 h	1.00 ECTS credit
CONF : 24.00 h	
Reference Teacher(s) : BLOUIN Arnaud	

Objectives :
The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :
The "stage dating" allows students to have several short interviews of 10mn with different companies.

Conferences are done by industrial contributors, on different subjects like:
- data management, data science, big data
- introduction to the profession of IT architect

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :
A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :
Validation on the presence of the student

Target :

Management of construction project	GCU09-SPEC-GPC
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :
Presenting the different actors involved in project of construction, the operational organisation of the project, the different requirements to be fulfilled, the different phases to be achieved in a project, and the management techniques and tools to be used for this purpose.

Content :
Part 1
The industrial process and fulfillment of missions
Project actors (Project Owner, Project manager, Execution Company, Controller…): Structures, Responsibilities, Expertise, Means.
The project: Structure, organization, and evolution.
Strategies of project management: organization, supervision, modifications, coordination, subcontracting, delivery
Quality assurance and audits
Management of crises and conflicts

Part 2
Actors of technical management of a project: Project Director, Project Supervisor, Programming Engineer, Project Engineer, Specialty Leader…)
Management of technical documents
Management of works
Management of modifications
Management de delays (study, logistics, execution, delivery…
Operational techniques for cost control
Multi-component programming of projects (time, human resources, logistics, cost, risk…).

Online organization of projects and co-contracting

Bibliography :

Requirements :

Organisation :
Plenary lectures supplemented by case studies to illustrate the presented concept of project management. A challenge is organised for applying skills in real-like situations.

Evaluation :
The evaluation concerns the presented project during the challenge.

Target :
5GCU

BIM Project Management	GCU09-SPEC-GPD
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :
BIM technology is a process that involves the creation and use of an intelligent and configurable 3D model to make better decisions about a project and communicate them. This will involve designing, visualizing, simulating, collaborating and managing more easily throughout the project lifecycle. This course aims to introduce you to BIM technology in building project management.

Content :
Introduction to BIM

The digital technology in the construction industry
The main national and international users
Technical terms of the BIM
The digitization of trades
Technological watch
The implementation of a BIM approach

Interoperability

The challenges of openBIM
The IFC
The BCF
The Facility management

Modeling by BIM approach

Modeling a project by tender mission
Structural modeling
The point clouds
Introduction to Dynamo
Content creation
Architectural modeling

Network modeling

Communicating in a BIM approach
PC and digital DOE
Collaborative platforms
Digital communication tools
Virtual reality and augmented reality
4D simulation

Quality control in BIM approach

Automated and iterative control
Steering and refereeing a synthesis
The point clouds
The digital synthesis model

BIM approach methods

The site installation plan
3D phasing
The layout of facades
The banches cycle
The establishment of security element
The operating mode
BCF in different applications
Interference detection in Revit

Interference detection in Solibri Model Checker
Taking into account the specificities of the trades
Consideration of transitional phases of construction site or maintenance phases

Bibliography :
• De la maquette numérique au BIM, Eyrolles
BIM et architecture, DUNOD
Le BIM appliqué à la gestion du projet de construction: Outils, méthodes et flux de travaux, David McCool et Brad Hardin

Requirements :
Revit

Organisation :
8 hours of lectures and 8 hours of tutorials
Copies of handouts

Evaluation :
Mini-Project

Target :
5GCU

Formation éthique de l'ingénieur	INF09-ETHIQUE
Number of hours : 16.00 h	1.00 ECTS credit
CM : 12.00 h, TD : 4.00 h	
Reference Teacher(s) : CELLIER-BELLINA Peggy	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Economics, Law and Business Studies (Professional management)	HUM09-PM-PRO
Number of hours : 70.00 h	2.00 ECTS credit
TA : 70.00 h, TA : 70.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Expérience en entreprise	DET10-SPEC PRO
Number of hours : 30.00 h	2.00 ECTS credit
PR : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 9

Parcours IGR-MAE

1	**DMA09-IDS-2**		**DATA AND SYSTEMS ENGINEERING**	**9.00**
	DMA09-PARCI	O	Sparsity in Signal and Image Processing	3.50
	DMA09-OI	O	Optimization under uncertainty	3.50
2	**DMA09-IR-MAE**		**INGENIERIE DU RISQUE**	**9.00**
	DMA09-FMDV	O	Reliability and Survival Analysis	3.50
	DMA09-SEER	O	Rare Events Estimation and Simulation	3.50
3	**HUM09 MAE DMA**		**Non-scientific syllabus S9**	**3.50**
	HUM09-ANGL-CONV	C	English S9 Conversation	1.50
	HUM09-ANGL-TOEIC	C	TOEIC 5th year	1.50

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

Sparsity in Signal and Image Processing	DMA09-PARCI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 24.00 h, TD : 5.00 h, TP : 11.00 h	
Reference Teacher(s) : HERZET Cedric	

Objectives :
This module provides an overview of fundamental concepts and tool relying on sparse representations in signal and image processing. Based on a “geometric” vision of the notion of sparse model, the course will describe the main sparse approximation algorithms, their complexity, and the conditions under which their performance can be guaranteed. The goal is to encompass the role of sparsity in tasks ranging from compression and coding to denoising, source separation, compressive sensing, and more generally linear inverse problems.

Content :
Reminder on harmonic analysis and Shannon/Nyquist sampling theorem General principles of sensing
Examples of inverse problems in signal and image processing Notions of sparsity and applications
Algorithms for sparse representations Convex optimization for sparse regularization
Performance guarantees of sparse regularization algorithms Compressive sensing
Sparse modeling: learning of the decomposition dictionary

Bibliography :
M. Elad. Sparse and Redundant Representations. From Theory to Applications in Signal and Image Processing. Springer, 2010.
S Mallat. A Wavelet Tour of Signal Processing (3rd edition). Academic Press, 2009.
S. Foucart & H. Rauhut, A mathematical introduction to compressive sensing. Springer. 2013.

Requirements :

Organisation :

Evaluation :
Final exam

Target :

Optimization under uncertainty	DMA09-OI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 14.00 h, TP : 12.00 h	
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course will be the opportunity to strengthen the connections between the teachings of probability and optimization of the GM specialty. Its scope is on the introduction of the fundamental concepts of the optimization under uncertainty. We will first present the different models of uncertainty that can be met and the approaches that can be used to deal with them. The rest of the course will focus on the theoretical properties of stochastic programming (minimization of an expected value) and robust optimization (minimization of a maximum value), and on
the practical methods that can solve such problems.

Content :
• Models of uncertainties; probability distributions, intervals of values, scenarios, historical data, domain of Bertsimas.
• Introduction of the existing approaches: stochastic programming, robust optimization, probabilistic constraints, stochastic dynamic programing, online optimization
• Classical examples: newspaper salesman problem, warehouse location under uncertainty, etc.
• Robust optimization: solution of simple problems with the uncertainty set of Bertsimas, mathematical programming models
• Stochastic programming: theoretical properties, solution by cutting plane generation and Monte-Carlo methods
• Implementation of solution algorithms with Julia Language
• Continuation of the S7 courses on the ethical stakes of mathematical modeling for decision aid

Bibliography :
[1] Ben-Tal, A., El Ghaoui, L., & Nemirovski, A. (2009). Robust optimization. Robust Optimization (Princeton).
[2] Birge, J. R., & Louveaux, F. (2011). Introduction to Stochastic Programming. New York, Springer.
[3] Kall, P., & Mayer, J. (2004). Stochastic Linear Programming: Models, Theory, and Computation. Springer.
[4] Shapiro, a., Dentcheva, D., & Ruszczy.ski, A. (2009). Lectures on stochastic programming: modeling and theory. SIAM Series on Optimization.

Requirements :

Organisation :
The course will follow a project-based learning approach that will help master the methods seen during the 4th year
courses on optimization and apply the methods described in class on the same given application during the whole semester.
As a homework, the students will have to produce an analysis of the ethical stakes of a real mathematical decision aid tool that they will have chosen.

Evaluation :

Target :
Fifth-year students of the Applied mathematic specialty

Reliability and Survival Analysis	DMA09-FMDV
Number of hours : 40.00 h	3.50 ECTS credit
CM : 20.00 h, TD : 10.00 h, TP : 10.00 h	
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
After this course, students will be able to deal with standard probabilistic tools for reliability and survival analysis and to select the (parametric, semiparametric and nonparametric) statistical models suitable for data. They will be able to run survival analyses with the software R and to interpret the results. The last chapter of the course will make a bridge between this course and the course “Rare events modeling”.

Content :
Various types of censoring, general context of survival analysis

Probabilistic tools of the statistical analysis of survival data

Survival function, instantaneous and cumulative hazard functions
The counting process approach. Martingales tools.

Non-parametric methods

Nelson-Aalen and Kaplan-Meier estimates
Logrank and weighted logrank tests

Cox semi-parametric regression model
Statistical inference
Validation tools : tests, residuals, influence

Joint models for survival and longitudinal processes : an introduction

Rare events modeling in presence of censoring

Applications with the software R

Bibliography :
O. Aalen, O. Borgan, H. Gjessing. Survival and event history analysis: a process point of view. Springer, 2008.
J.P. Klein, M.L. Moeschberger. Survival analysis: techniques for censored and truncated data. Springer, 2003.
T. Martinussen, T.H. Scheike. Dynamic regression models for survival data. Springer, 2006.
J. O’Quigley. Proportional hazards regression. Springer, 2008.

Requirements :
Skills from courses « Initiation to mathematical software » (DMA-3A1S), « Markov models » and « Inferential statistics » (DMA-3A2S), « Stochastic models of dynamical systems » (DMA4A1S).

Organisation :

Evaluation :
A final written examination

Target :

Rare Events Estimation and Simulation	DMA09-SEER
Number of hours : 48.00 h	3.50 ECTS credit
CM : 26.00 h, TP : 22.00 h	
Reference Teacher(s) : FURON Teddy	

Objectives :
This course introduces rare events estimation and simulation presenting methodologies and applications. Algorithms will be applied on real case studies assessing the reliability of complex systems.

Content :
Probabilities
FORM/SORM Methods (First / Second Order Reliability Method)
- Evaluation of the probability of failure and early time failure as a function of the stress demand and the resistive stress capability of a system.
Application to the assessment of the reliability of a system.

Rare Events Simulations
- 3 key algorithms: Monte-Carlo methods, Importance sampling, Importance splitting.
Application to computer security (traitor tracing), insurance (risk of bankruptcy), IT service (queuing), hypotheses testing (probability of false positive).

Statistics
Extreme Value Theory
- Distribution of the maximum, Distribution of excesses and related methods (semi-parametric approach)

Practical exercises with R, Matlab and OpenTurns

Bibliography :
J. Beirlant, Y. Goegebeur,J. Segers, J. Teugels. Statistics of Extremes, Theory and applications. Wiley, 2004.
J.A. Bucklew. Introduction to Rare Event Simulation. Springer-Verlag, 2004.
O. Ditlevsen, H.O. Madsen. Structural reliability methods. Department of mechanical engineering technical university of Denmark - Maritime engineering, 2004.
C. Robert, G. Casella. Méthodes de Monte-Carlo avec R. Springer-Verlag, 2011.
G. Rubino et B. Tuffin. Rare Event Simulation using Monte Carlo Methods. Wiley, 2009.

Requirements :
This course requires the mastering of the following modules : « Probabilities » and « Python and its scientific modules » (ARO05), « Markov models » (ARO06), « Stochastic models of dynamic systems » (ARO07).

Organisation :

Evaluation :
Written exam and computer-based test and/or project.

Target :

English S9 Conversation	HUM09-ANGL-CONV
Number of hours : 10.00 h	1.50 ECTS credit
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	
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

Semestre 9

Parcours Recherche

1	**DMA09-IDS-PR-2**		**DATA AND SYSTEMS ENGINEERING**	**8.00**
	DMA09-PARCI-PR	O	Sparsity in Signal and Image Processing	4.00
	DMA09-OI-PR	O	Optimization under uncertainty	4.00
2	**DMA09-IR-2-PR**		**RISK ENGINEERING**	**12.00**
	DMA09-AIS-PR	O	Uncertainty and Sensitivity Analysis in Engineering	4.00
	DMA09-FMDV-PR	O	Reliability and Survival Analysis	4.00
	DMA09-SEER-PR	O	Rare Events Estimation and Simulation	4.00
3	**DMA09-PR**		**Research Project**	**4.50**
	DMA09-PR	O	Research Project	3.50
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 MANAGEMENT	2.00
	HUM09-PM-B	C	Economics, Law and Business Studies B (Human Resources 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 AND ETHICS FOR ENGINEERS	2.00
	HUM09-PM-E	C	Economics, Law and Business Studies E (INTERNATIONAL DEVELOPPEMENT & STRATEGIES)	2.00
	HUM09-PM-F	C	Economics, Law and Business Studies F (sustainable development)	2.00
	EII09-EVST	C	Internship evaluation	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	Internship evaluation	1.00
	INF09-STGDATING	C	Internship Dating	1.00
	GCU09-SPEC-GPC	C	Management of construction project	1.00
	GCU09-SPEC-GPD	C	BIM Project Management	1.00
	INF09-ETHIQUE	C	Formation éthique de l'ingénieur	1.00
	HUM09-PM-PRO	C	Economics, Law and Business Studies (Professional management)	2.00
	DET10-SPEC PRO	C	Expérience en entreprise	2.00

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

Sparsity in Signal and Image Processing	DMA09-PARCI-PR
Number of hours : 50.00 h	4.00 ECTS credit
CM : 26.00 h, TD : 12.00 h, TP : 12.00 h	
Reference Teacher(s) : HERZET Cedric	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Optimization under uncertainty	DMA09-OI-PR
Number of hours : 40.00 h	4.00 ECTS credit
CM : 14.00 h, TD : 14.00 h, TP : 12.00 h	
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course will be the opportunity to strengthen the connections between the teachings of probability and optimization of the GM specialty. Its scope is on the introduction of the fundamental concepts of the optimization under uncertainty. We will first present the different models of uncertainty that can be met and the approaches that can be used to deal with them. The rest of the course will focus on the theoretical properties of stochastic programming (minimization of an expected value) and robust optimization (minimization of a maximum value), and on
the practical methods that can solve such problems. The labs will allow the implementation of some of these methods.

Content :
• Models of uncertainties; probability distributions, intervals of values, scenarios, historical data, domain of Bertsimas.
• Introduction of the existing approaches: stochastic programming, robust optimization, probabilistic constraints, stochastic dynamic programing, online optimization
• Classical examples: newspaper salesman problem, warehouse location under uncertainty, etc.
• Robust optimization: solution of simple problems with the uncertainty set of Bertsimas, mathematical programming models
• Stochastic programming: theoretical properties, solution by cutting plane generation and Monte-Carlo methods
• Implementation of solution algorithms with Julia Language

Bibliography :
[1] Ben-Tal, A., El Ghaoui, L., & Nemirovski, A. (2009). Robust optimization. Robust Optimization (Princeton).
[2] Birge, J. R., & Louveaux, F. (2011). Introduction to Stochastic Programming. New York, Springer.
[3] Kall, P., & Mayer, J. (2004). Stochastic Linear Programming: Models, Theory, and Computation. Springer.
[4] Shapiro, a., Dentcheva, D., & Ruszczy.ski, A. (2009). Lectures on stochastic programming: modeling and theory. SIAM Series on Optimization.

Requirements :
• Third and fourth year courses of optimization: Continuous optimization, Discrete optimization and Operational research
• Second and third year courses of probability, and the third-year course on Markovian models
• Advanced skills in programming with Julia Language

Organisation :

Evaluation :
Project (50 %) and Exam (50 %)

Target :
Fifth-year students of the MA specialty

Uncertainty and Sensitivity Analysis in Engineering	DMA09-AIS-PR
Number of hours : 48.00 h	4.00 ECTS credit
CM : 18.00 h, PR : 30.00 h	
Reference Teacher(s) : SUEUR Roman	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Reliability and Survival Analysis	DMA09-FMDV-PR
Number of hours : 48.00 h	4.00 ECTS credit
CM : 20.00 h, TD : 10.00 h, TP : 18.00 h	
Reference Teacher(s) : DUPUY Jean-Francois, GARES Valerie	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Rare Events Estimation and Simulation	DMA09-SEER-PR
Number of hours : 48.00 h	4.00 ECTS credit
CM : 26.00 h, TD : 22.00 h	
Reference Teacher(s) : FURON Teddy	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Research Project	DMA09-PR
Number of hours : 48.00 h	3.50 ECTS credit
PR : 48.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

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	
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	
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 MANAGEMENT	HUM09-PM-A
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) :	

Objectives :
The Management Course shoudl enable students:
to engage with «management-oriented» themes d'aborder des thèmes « orientés métiers » relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses one course from the list of suggested courses.

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

to understand and know how to use the specialised vocabulary of management
to recognise the main issues in a chosen management theme
to practise teamwork: taking decisions collectively and be able to deliver within set deadlines

Lean Management (28h)
To master the theoretical concepts and practices of Lean and Six Sigma
To develop your capacity to manage and lead value-creating projects
To understand the issues of associated with a culture of continuous progress and, by extension, its implementation within an organisation

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
«Lean Management» Course Programme
Lean Management (28h)

Lean Management is a structured management method. It is increasingly becoming an approach to improve the performance of companies through improved process efficiency.

Applied to company managament, « Lean Management » offers a range of methods to work towards operational excellence.
Associated with the «Six Sigma» methodology which is designed to improve quality, Lean offers an approach that ensures that all customer expectations in terms of quality, deadlines and costs are taken into account.
Programme
The content of this course develops and deepens understanding of certain notions seen in the core curriculum for 3rd Year (IMO).

Introduction to improvement
DMAIC Project
Organising and Leading a team
specific Lean tools
specific Six Sigma tools
field-oriented Lean and Six Sigma tools
feedback from industry and industrial applications

Students registered in this module will be able to participate in the Hackathon of quality and operational excellence organized in December in Nantes. This event will bring together for a whole day teams made up of 4 to 6 students from several educational institutions from Bac + 2 to Master 2 level, supervised by professionals in operational excellence, QHSE management, continuous improvement ...
Together, the students will have to take up the challenge of responding to a real business problem and proposing a relevant action plan. At the end of the day, each team will pitch their final work. The best presentation will be rewarded with a vote from the public and the jury of experts.
Legal Knowledge (6h)

sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers.

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

Target :

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

Objectives :
Objectives of Management Courses
The Management Course shoudl enable students:
to engage with «management-oriented» themes relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses a course from a list of suggested options:

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

1. to understand and know how to use the specialised vocabulary of management
2. to recognise the main issues in a chosen management theme
3. to practise teamwork: taking decisions collectively and be able to deliver within set deadlines
Human Resources Management (20h)
This module therefore specifically aims to:

make future engineers aware of individual and collective management
identify the expectations associated with the manager's mission
equip students with the tools and techniques suited to the manager's mission

Labour Law (8h)
To make future engineers aware of the right to work by giving them key aspects of comprehension in this area which has been rendered more complex due to the diversity of its origins, the multiplication of reforms and frequent changes in jursiprudence.

To enable future engineers therefore to access the labour market with a concise overview of their rights and obligations within a company
Legal Knowledge (6h)
• To acquire a general knowledge of the law
• To understand the organisation and main principles of the legal environment

Content :
«Human Resources Management» Course Programme
Human Resources Management (20h)

Confronted with numerous and ever rapid changes, it is imperative for companies to adapt in order to ensure their sustainability band development. In this context, man management is capital. Leaders must know how to lead,develop and organise the skills of their teams that are necessary to meet objectives and at the same time create commitment in ways that nurture energies sustainably
Programme
the essentials of management
communication and motivatioon
knowing how to set objectives
leadership and team leadership
developing teamwork skills
managing complexity
supporting change

Labour Law (8h)
background to Labour law
the work contract : study of some essential clauses (workplace, salaries, work hours, non-competitive clause
some elements on the different types of work contract termination

Legal Knowledge (6h)
• sources of law, the hierarchy of rules, notion of jurisprudence;

• jurisdictions;
• types of law practioners;
• the contract;
• civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class.

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

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, 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 AND ETHICS FOR ENGINEERS	HUM09-PM-D
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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 :
- The fundamentals of management
- Ethics and business practices (international and corporate frameworks and regulations, impact on project management and decision processes)
- Reflexion on personal motivations related to social and environmental impact of innovation and business, personal values vs professional goals)
Transversal approach by industry sector case studies

Bibliography :
Given during the course

Requirements :
NONE

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 DEVELOPPEMENT & STRATEGIES)	HUM09-PM-E
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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

Bibliography :
Given during the course

Requirements :
None

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 F (sustainable development)	HUM09-PM-F
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :
Sustainable Development (28h)
Sustainable development is a major societal issue that challenges all stakeholders, including training and research institutions. The INSA group has taken up this theme and actively engages with the ways and means of “training engineers to a very high technical level… |but who are also] aware of today's global challenges & capable of helping their companies to make their own energy and ecological transition ”(Inter-INSA Energy-Climate Challenges Working Group in engineer training).

INSA Rennes has committed to the SDSR (Sustainable Developmet and Social Responsibility) accreditation process. The Engineering students enrolled in Course F will be able to contribute concretely to this process by presenting projects that meet the requirements of this standard, in collaboration with the COPIL-DD (Sustainable Development Piloting Committee) and the CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development).

Objectives
To deepen your knowledge of SDS issues and be able to raise awareness of them;
To understand the SD standards and the stages of the accreditation process;
To build a team project that serves the accreditation of INSA Rennes ;
To know how to convince others of your project's relevance and to assess its feasibility (technical and economic)

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
Programme
Presentation of COPIL-DD (Sustainable Development Piloting Committee), CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development) and SD-SR accreditation
Conferences on SD: environmental impacts of digital technology , biodiversity and gardens, SSS (Social et Solidarity Space), etc.
Training on the «Fresco for the Climate» tool

Legal Knowledge (6h)
Programme
sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

As part of this module, the student engineers:
- will attend conferences on SD themes
- will be trained on how to use the «Fresco for the Climate» tool

- will work in pluridisciplinary teams to develop a project that is eligible for SD-SR accreditation and can be implemented on campus.

Personal study time will be provided for within the schedule in order to allow students to advance with the team projects

Evaluation :
Continuous assessment (collective work)

Target :

Internship evaluation	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, 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	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Internship evaluation	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 :

Internship Dating	INF09-STGDATING
Number of hours : 24.00 h	1.00 ECTS credit
CONF : 24.00 h	
Reference Teacher(s) : BLOUIN Arnaud	

Objectives :
The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :
The "stage dating" allows students to have several short interviews of 10mn with different companies.

Conferences are done by industrial contributors, on different subjects like:
- data management, data science, big data
- introduction to the profession of IT architect

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :
A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :
Validation on the presence of the student

Target :

Management of construction project	GCU09-SPEC-GPC
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :
Presenting the different actors involved in project of construction, the operational organisation of the project, the different requirements to be fulfilled, the different phases to be achieved in a project, and the management techniques and tools to be used for this purpose.

Content :
Part 1
The industrial process and fulfillment of missions
Project actors (Project Owner, Project manager, Execution Company, Controller…): Structures, Responsibilities, Expertise, Means.
The project: Structure, organization, and evolution.
Strategies of project management: organization, supervision, modifications, coordination, subcontracting, delivery
Quality assurance and audits
Management of crises and conflicts

Part 2
Actors of technical management of a project: Project Director, Project Supervisor, Programming Engineer, Project Engineer, Specialty Leader…)
Management of technical documents
Management of works
Management of modifications
Management de delays (study, logistics, execution, delivery…
Operational techniques for cost control
Multi-component programming of projects (time, human resources, logistics, cost, risk…).

Online organization of projects and co-contracting

Bibliography :

Requirements :

Organisation :
Plenary lectures supplemented by case studies to illustrate the presented concept of project management. A challenge is organised for applying skills in real-like situations.

Evaluation :
The evaluation concerns the presented project during the challenge.

Target :
5GCU

BIM Project Management	GCU09-SPEC-GPD
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :
BIM technology is a process that involves the creation and use of an intelligent and configurable 3D model to make better decisions about a project and communicate them. This will involve designing, visualizing, simulating, collaborating and managing more easily throughout the project lifecycle. This course aims to introduce you to BIM technology in building project management.

Content :
Introduction to BIM

The digital technology in the construction industry
The main national and international users
Technical terms of the BIM
The digitization of trades
Technological watch
The implementation of a BIM approach

Interoperability

The challenges of openBIM
The IFC
The BCF
The Facility management

Modeling by BIM approach

Modeling a project by tender mission
Structural modeling
The point clouds
Introduction to Dynamo
Content creation
Architectural modeling

Network modeling

Communicating in a BIM approach
PC and digital DOE
Collaborative platforms
Digital communication tools
Virtual reality and augmented reality
4D simulation

Quality control in BIM approach

Automated and iterative control
Steering and refereeing a synthesis
The point clouds
The digital synthesis model

BIM approach methods

The site installation plan
3D phasing
The layout of facades
The banches cycle
The establishment of security element
The operating mode
BCF in different applications
Interference detection in Revit

Interference detection in Solibri Model Checker
Taking into account the specificities of the trades
Consideration of transitional phases of construction site or maintenance phases

Bibliography :
• De la maquette numérique au BIM, Eyrolles
BIM et architecture, DUNOD
Le BIM appliqué à la gestion du projet de construction: Outils, méthodes et flux de travaux, David McCool et Brad Hardin

Requirements :
Revit

Organisation :
8 hours of lectures and 8 hours of tutorials
Copies of handouts

Evaluation :
Mini-Project

Target :
5GCU

Formation éthique de l'ingénieur	INF09-ETHIQUE
Number of hours : 16.00 h	1.00 ECTS credit
CM : 12.00 h, TD : 4.00 h	
Reference Teacher(s) : CELLIER-BELLINA Peggy	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Economics, Law and Business Studies (Professional management)	HUM09-PM-PRO
Number of hours : 70.00 h	2.00 ECTS credit
TA : 70.00 h, TA : 70.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Expérience en entreprise	DET10-SPEC PRO
Number of hours : 30.00 h	2.00 ECTS credit
PR : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

INSA RENNES - Mathématiques appliquées (MA) : 2023/2024

Semestre 9

Parcours SEER

1	**DMA09-IDS-2**		**DATA AND SYSTEMS ENGINEERING**	**9.00**
	DMA09-PARCI	O	Sparsity in Signal and Image Processing	3.50
	DMA09-OI	O	Optimization under uncertainty	3.50
2	**DMA09-IR**		**RISK ENGINEERING**	**10.50**
	DMA09-AIS	O	Uncertainty and Sensitivity Analysis in Engineering	3.50
	DMA09-FMDV	O	Reliability and Survival Analysis	3.50
	DMA09-SEER	O	Rare Events Estimation and Simulation	3.50
3	**DMA09-SEMP**		**SEMINAR**	**3.50**
	DMA09-SE	C	Business Seminar	3.50
	DMA09-PR	C	Research Project	3.50
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 MANAGEMENT	2.00
	HUM09-PM-B	C	Economics, Law and Business Studies B (Human Resources 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 AND ETHICS FOR ENGINEERS	2.00
	HUM09-PM-E	C	Economics, Law and Business Studies E (INTERNATIONAL DEVELOPPEMENT & STRATEGIES)	2.00
	HUM09-PM-F	C	Economics, Law and Business Studies F (sustainable development)	2.00
	EII09-EVST	C	Internship evaluation	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	Internship evaluation	1.00
	INF09-STGDATING	C	Internship Dating	1.00
	GCU09-SPEC-GPC	C	Management of construction project	1.00
	GCU09-SPEC-GPD	C	BIM Project Management	1.00
	INF09-ETHIQUE	C	Formation éthique de l'ingénieur	1.00
	HUM09-PM-PRO	C	Economics, Law and Business Studies (Professional management)	2.00
	DET10-SPEC PRO	C	Expérience en entreprise	2.00

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

Sparsity in Signal and Image Processing	DMA09-PARCI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 24.00 h, TD : 5.00 h, TP : 11.00 h	
Reference Teacher(s) : HERZET Cedric	

Objectives :
This module provides an overview of fundamental concepts and tool relying on sparse representations in signal and image processing. Based on a “geometric” vision of the notion of sparse model, the course will describe the main sparse approximation algorithms, their complexity, and the conditions under which their performance can be guaranteed. The goal is to encompass the role of sparsity in tasks ranging from compression and coding to denoising, source separation, compressive sensing, and more generally linear inverse problems.

Content :
Reminder on harmonic analysis and Shannon/Nyquist sampling theorem General principles of sensing
Examples of inverse problems in signal and image processing Notions of sparsity and applications
Algorithms for sparse representations Convex optimization for sparse regularization
Performance guarantees of sparse regularization algorithms Compressive sensing
Sparse modeling: learning of the decomposition dictionary

Bibliography :
M. Elad. Sparse and Redundant Representations. From Theory to Applications in Signal and Image Processing. Springer, 2010.
S Mallat. A Wavelet Tour of Signal Processing (3rd edition). Academic Press, 2009.
S. Foucart & H. Rauhut, A mathematical introduction to compressive sensing. Springer. 2013.

Requirements :

Organisation :

Evaluation :
Final exam

Target :

Optimization under uncertainty	DMA09-OI
Number of hours : 40.00 h	3.50 ECTS credit
CM : 14.00 h, TD : 14.00 h, TP : 12.00 h	
Reference Teacher(s) : OMER Jeremy	

Objectives :
This course will be the opportunity to strengthen the connections between the teachings of probability and optimization of the GM specialty. Its scope is on the introduction of the fundamental concepts of the optimization under uncertainty. We will first present the different models of uncertainty that can be met and the approaches that can be used to deal with them. The rest of the course will focus on the theoretical properties of stochastic programming (minimization of an expected value) and robust optimization (minimization of a maximum value), and on
the practical methods that can solve such problems.

Content :
• Models of uncertainties; probability distributions, intervals of values, scenarios, historical data, domain of Bertsimas.
• Introduction of the existing approaches: stochastic programming, robust optimization, probabilistic constraints, stochastic dynamic programing, online optimization
• Classical examples: newspaper salesman problem, warehouse location under uncertainty, etc.
• Robust optimization: solution of simple problems with the uncertainty set of Bertsimas, mathematical programming models
• Stochastic programming: theoretical properties, solution by cutting plane generation and Monte-Carlo methods
• Implementation of solution algorithms with Julia Language
• Continuation of the S7 courses on the ethical stakes of mathematical modeling for decision aid

Bibliography :
[1] Ben-Tal, A., El Ghaoui, L., & Nemirovski, A. (2009). Robust optimization. Robust Optimization (Princeton).
[2] Birge, J. R., & Louveaux, F. (2011). Introduction to Stochastic Programming. New York, Springer.
[3] Kall, P., & Mayer, J. (2004). Stochastic Linear Programming: Models, Theory, and Computation. Springer.
[4] Shapiro, a., Dentcheva, D., & Ruszczy.ski, A. (2009). Lectures on stochastic programming: modeling and theory. SIAM Series on Optimization.

Requirements :

Organisation :
The course will follow a project-based learning approach that will help master the methods seen during the 4th year
courses on optimization and apply the methods described in class on the same given application during the whole semester.
As a homework, the students will have to produce an analysis of the ethical stakes of a real mathematical decision aid tool that they will have chosen.

Evaluation :

Target :
Fifth-year students of the Applied mathematic specialty

Uncertainty and Sensitivity Analysis in Engineering	DMA09-AIS
Number of hours : 40.00 h	3.50 ECTS credit
CM : 22.00 h, PR : 18.00 h	
Reference Teacher(s) : CHABRIDON Vincent, SUEUR Roman	

Objectives :
At the end of this module, students will be able to master the techniques for dealing with uncertainties in numerical simulation, and to implement methods for exploring numerical models and performing global sensitivity analysis.

Content :
(7 sessions):
Session #1 – Introduction: reliability and uncertainty propagation (R. Sueur)
Structural reliability
Reliability analysis for repairable systems and lifetime data analysis
Uncertainty quantification and propagation for reliability assessment
Lab: implementation with the OpenTURNS software
Sessions #2 et #3 – Metamodels for uncertainty management (R. Sueur)
Introduction to the various families of metamodels / surrogate models
Introduction and presentation of the simple Kriging
Numerical designs of computer experiments for building metamodels (space-filling designs)
Links with Gaussian processes and Bayesian interpretation
Validation of a Kriging metamodel
Lab: implementation with the OpenTURNS software
Sessions #4 et #5 – Global sensitivity analysis (V. Chabridon)
Overview and challenges
Sensitivity indices based on variance decomposition (Sobol' indices)
Screening methods dedicated to high-dimensional problems (the Morris method, HSIC indices)
Lab: implementation with the OpenTURNS software
Session #6 – Continuation/finalization of projects and openings (R. Sueur)
Finalization of numerical projects (labs)
Discussion and opening about complementary topics: calibration under uncertainty, robust optimization, links with statistical learning / machine learning
Bibliographical analysis project: in-depth study of a scientific article related to course themes
Session #7 – Final assessment (R. Sueur, V. Chabridon)
Individual presentation of the bibliographical analysis project (presentation: 20 min + 10 min Q&A)

Bibliography :
• Da Veiga, S., Gamboa, F., Iooss, B., Prieur, C. Basics and Trends in Sensitivity Analysis: Theory and Practice in R. SIAM, 2021.
• Rasmussen, C. E., Williams, C. K. I. Gaussian Processes for Machine Learning. MIT Press, 2006.

Requirements :
This course requires mastery of the module program "Intrdouction to mathematical software" and "Python and scientific Modules" (DMA-3A-1S), "Linear Regression Model" (DMA-3A-2S) et "Design of Experiments" (DMA-4A-2S).

Organisation :
• Course materials: slides
• Labs: Jupyter Notebooks based on Python and OpenTURNS (https://openturns.github.io/www/)

Evaluation :
• Oral presentation (quality of presentation and media, responses to questions)
• Lab report

Target :
• Third-year students in the Engineering curriculum / Master 2 in Applied Mathematics, students wishing to pursue their career in an industrial R&D Lab or to apply for a doctoral thesis

Reliability and Survival Analysis	DMA09-FMDV
Number of hours : 40.00 h	3.50 ECTS credit
CM : 20.00 h, TD : 10.00 h, TP : 10.00 h	
Reference Teacher(s) : DUPUY Jean-Francois	

Objectives :
After this course, students will be able to deal with standard probabilistic tools for reliability and survival analysis and to select the (parametric, semiparametric and nonparametric) statistical models suitable for data. They will be able to run survival analyses with the software R and to interpret the results. The last chapter of the course will make a bridge between this course and the course “Rare events modeling”.

Content :
Various types of censoring, general context of survival analysis

Probabilistic tools of the statistical analysis of survival data

Survival function, instantaneous and cumulative hazard functions
The counting process approach. Martingales tools.

Non-parametric methods

Nelson-Aalen and Kaplan-Meier estimates
Logrank and weighted logrank tests

Cox semi-parametric regression model
Statistical inference
Validation tools : tests, residuals, influence

Joint models for survival and longitudinal processes : an introduction

Rare events modeling in presence of censoring

Applications with the software R

Bibliography :
O. Aalen, O. Borgan, H. Gjessing. Survival and event history analysis: a process point of view. Springer, 2008.
J.P. Klein, M.L. Moeschberger. Survival analysis: techniques for censored and truncated data. Springer, 2003.
T. Martinussen, T.H. Scheike. Dynamic regression models for survival data. Springer, 2006.
J. O’Quigley. Proportional hazards regression. Springer, 2008.

Requirements :
Skills from courses « Initiation to mathematical software » (DMA-3A1S), « Markov models » and « Inferential statistics » (DMA-3A2S), « Stochastic models of dynamical systems » (DMA4A1S).

Organisation :

Evaluation :
A final written examination

Target :

Rare Events Estimation and Simulation	DMA09-SEER
Number of hours : 48.00 h	3.50 ECTS credit
CM : 26.00 h, TP : 22.00 h	
Reference Teacher(s) : FURON Teddy	

Objectives :
This course introduces rare events estimation and simulation presenting methodologies and applications. Algorithms will be applied on real case studies assessing the reliability of complex systems.

Content :
Probabilities
FORM/SORM Methods (First / Second Order Reliability Method)
- Evaluation of the probability of failure and early time failure as a function of the stress demand and the resistive stress capability of a system.
Application to the assessment of the reliability of a system.

Rare Events Simulations
- 3 key algorithms: Monte-Carlo methods, Importance sampling, Importance splitting.
Application to computer security (traitor tracing), insurance (risk of bankruptcy), IT service (queuing), hypotheses testing (probability of false positive).

Statistics
Extreme Value Theory
- Distribution of the maximum, Distribution of excesses and related methods (semi-parametric approach)

Practical exercises with R, Matlab and OpenTurns

Bibliography :
J. Beirlant, Y. Goegebeur,J. Segers, J. Teugels. Statistics of Extremes, Theory and applications. Wiley, 2004.
J.A. Bucklew. Introduction to Rare Event Simulation. Springer-Verlag, 2004.
O. Ditlevsen, H.O. Madsen. Structural reliability methods. Department of mechanical engineering technical university of Denmark - Maritime engineering, 2004.
C. Robert, G. Casella. Méthodes de Monte-Carlo avec R. Springer-Verlag, 2011.
G. Rubino et B. Tuffin. Rare Event Simulation using Monte Carlo Methods. Wiley, 2009.

Requirements :
This course requires the mastering of the following modules : « Probabilities » and « Python and its scientific modules » (ARO05), « Markov models » (ARO06), « Stochastic models of dynamic systems » (ARO07).

Organisation :

Evaluation :
Written exam and computer-based test and/or project.

Target :

Business Seminar	DMA09-SE
Number of hours : 48.00 h	3.50 ECTS credit
CM : 48.00 h	
Reference Teacher(s) : NOUVEAU Leo	

Objectives :
This module is an open forum for stakeholders of the business world. It covers all semesters of the engineering curriculum and aims at providing the students a broad-spectrum engineering culture. This module will constitute a unique opportunity for students to discover the different career profiles of mathematical engineering. Through this module, the students will also acquire some useful technical, managerial and juridical skills and a solid operational expertise. Finally, this module will help the students raising their awareness to the challenges of sustainable development and to the societal aspects of their future profession of engineer.

Content :
In the 5th year, the module will offer (among others) :

- Specific software training ;
- some awareness to specific technical issues related to the profession of mathematical engineer (such as scoring, pricing…).

Bibliography :

Requirements :

Organisation :

Evaluation :
The assessment is based on some report delivery.

Target :

Research Project	DMA09-PR
Number of hours : 48.00 h	3.50 ECTS credit
PR : 48.00 h	
Reference Teacher(s) : BELMILOUDI Abdelaziz	

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	
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	
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 MANAGEMENT	HUM09-PM-A
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) :	

Objectives :
The Management Course shoudl enable students:
to engage with «management-oriented» themes d'aborder des thèmes « orientés métiers » relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses one course from the list of suggested courses.

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

to understand and know how to use the specialised vocabulary of management
to recognise the main issues in a chosen management theme
to practise teamwork: taking decisions collectively and be able to deliver within set deadlines

Lean Management (28h)
To master the theoretical concepts and practices of Lean and Six Sigma
To develop your capacity to manage and lead value-creating projects
To understand the issues of associated with a culture of continuous progress and, by extension, its implementation within an organisation

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
«Lean Management» Course Programme
Lean Management (28h)

Lean Management is a structured management method. It is increasingly becoming an approach to improve the performance of companies through improved process efficiency.

Applied to company managament, « Lean Management » offers a range of methods to work towards operational excellence.
Associated with the «Six Sigma» methodology which is designed to improve quality, Lean offers an approach that ensures that all customer expectations in terms of quality, deadlines and costs are taken into account.
Programme
The content of this course develops and deepens understanding of certain notions seen in the core curriculum for 3rd Year (IMO).

Introduction to improvement
DMAIC Project
Organising and Leading a team
specific Lean tools
specific Six Sigma tools
field-oriented Lean and Six Sigma tools
feedback from industry and industrial applications

Students registered in this module will be able to participate in the Hackathon of quality and operational excellence organized in December in Nantes. This event will bring together for a whole day teams made up of 4 to 6 students from several educational institutions from Bac + 2 to Master 2 level, supervised by professionals in operational excellence, QHSE management, continuous improvement ...
Together, the students will have to take up the challenge of responding to a real business problem and proposing a relevant action plan. At the end of the day, each team will pitch their final work. The best presentation will be rewarded with a vote from the public and the jury of experts.
Legal Knowledge (6h)

sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers.

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

Target :

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

Objectives :
Objectives of Management Courses
The Management Course shoudl enable students:
to engage with «management-oriented» themes relative to management,
to personnalise their programme by choosing modules «à la carte», in accordance with their interests and professional projects.

Each student chooses a course from a list of suggested options:

Beyond the specific skills that are the focus of each course, the learning outcomes can be identifed as follows:

1. to understand and know how to use the specialised vocabulary of management
2. to recognise the main issues in a chosen management theme
3. to practise teamwork: taking decisions collectively and be able to deliver within set deadlines
Human Resources Management (20h)
This module therefore specifically aims to:

make future engineers aware of individual and collective management
identify the expectations associated with the manager's mission
equip students with the tools and techniques suited to the manager's mission

Labour Law (8h)
To make future engineers aware of the right to work by giving them key aspects of comprehension in this area which has been rendered more complex due to the diversity of its origins, the multiplication of reforms and frequent changes in jursiprudence.

To enable future engineers therefore to access the labour market with a concise overview of their rights and obligations within a company
Legal Knowledge (6h)
• To acquire a general knowledge of the law
• To understand the organisation and main principles of the legal environment

Content :
«Human Resources Management» Course Programme
Human Resources Management (20h)

Confronted with numerous and ever rapid changes, it is imperative for companies to adapt in order to ensure their sustainability band development. In this context, man management is capital. Leaders must know how to lead,develop and organise the skills of their teams that are necessary to meet objectives and at the same time create commitment in ways that nurture energies sustainably
Programme
the essentials of management
communication and motivatioon
knowing how to set objectives
leadership and team leadership
developing teamwork skills
managing complexity
supporting change

Labour Law (8h)
background to Labour law
the work contract : study of some essential clauses (workplace, salaries, work hours, non-competitive clause
some elements on the different types of work contract termination

Legal Knowledge (6h)
• sources of law, the hierarchy of rules, notion of jurisprudence;

• jurisdictions;
• types of law practioners;
• the contract;
• civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class.

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

Evaluation :
Continuous Assessment: teamwork with oral and/or written assignment

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, 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 AND ETHICS FOR ENGINEERS	HUM09-PM-D
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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 :
- The fundamentals of management
- Ethics and business practices (international and corporate frameworks and regulations, impact on project management and decision processes)
- Reflexion on personal motivations related to social and environmental impact of innovation and business, personal values vs professional goals)
Transversal approach by industry sector case studies

Bibliography :
Given during the course

Requirements :
NONE

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 DEVELOPPEMENT & STRATEGIES)	HUM09-PM-E
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 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

Bibliography :
Given during the course

Requirements :
None

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 F (sustainable development)	HUM09-PM-F
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :
Sustainable Development (28h)
Sustainable development is a major societal issue that challenges all stakeholders, including training and research institutions. The INSA group has taken up this theme and actively engages with the ways and means of “training engineers to a very high technical level… |but who are also] aware of today's global challenges & capable of helping their companies to make their own energy and ecological transition ”(Inter-INSA Energy-Climate Challenges Working Group in engineer training).

INSA Rennes has committed to the SDSR (Sustainable Developmet and Social Responsibility) accreditation process. The Engineering students enrolled in Course F will be able to contribute concretely to this process by presenting projects that meet the requirements of this standard, in collaboration with the COPIL-DD (Sustainable Development Piloting Committee) and the CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development).

Objectives
To deepen your knowledge of SDS issues and be able to raise awareness of them;
To understand the SD standards and the stages of the accreditation process;
To build a team project that serves the accreditation of INSA Rennes ;
To know how to convince others of your project's relevance and to assess its feasibility (technical and economic)

Legal Knowledge (6h)
Objectives
To acquire a general knowledge of the law
To understand the organisation and main principles of the legal environment

Content :
Programme
Presentation of COPIL-DD (Sustainable Development Piloting Committee), CRIC-DD (Rennes Inter-Campus Collective for Sustainable Development) and SD-SR accreditation
Conferences on SD: environmental impacts of digital technology , biodiversity and gardens, SSS (Social et Solidarity Space), etc.
Training on the «Fresco for the Climate» tool

Legal Knowledge (6h)
Programme
sources of law, the hierarchy of rules, notion of jurisprudence;
jurisdictions;
types of law practioners;
the contract;
civil and criminal liability in a company

Bibliography :
A specific bibliography on the themes developed is suggested to students in class

Requirements :
Eco-Management Modules in S7 and S8

Organisation :
The different Management courses bring together students from the various speciality Departments. Eacg course includes the participation of external speakers (industry professionals, lawyers or consultants). Interactive pedagogy and project work are favoured, with students working in teams on projects that are defined in collaboration with the speakers

As part of this module, the student engineers:
- will attend conferences on SD themes
- will be trained on how to use the «Fresco for the Climate» tool

- will work in pluridisciplinary teams to develop a project that is eligible for SD-SR accreditation and can be implemented on campus.

Personal study time will be provided for within the schedule in order to allow students to advance with the team projects

Evaluation :
Continuous assessment (collective work)

Target :

Internship evaluation	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, 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	
Reference Teacher(s) : BOUGUENNEC Christelle	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Internship evaluation	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 :

Internship Dating	INF09-STGDATING
Number of hours : 24.00 h	1.00 ECTS credit
CONF : 24.00 h	
Reference Teacher(s) : BLOUIN Arnaud	

Objectives :
The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :
The "stage dating" allows students to have several short interviews of 10mn with different companies.

Conferences are done by industrial contributors, on different subjects like:
- data management, data science, big data
- introduction to the profession of IT architect

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :
A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :
Validation on the presence of the student

Target :

Management of construction project	GCU09-SPEC-GPC
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :
Presenting the different actors involved in project of construction, the operational organisation of the project, the different requirements to be fulfilled, the different phases to be achieved in a project, and the management techniques and tools to be used for this purpose.

Content :
Part 1
The industrial process and fulfillment of missions
Project actors (Project Owner, Project manager, Execution Company, Controller…): Structures, Responsibilities, Expertise, Means.
The project: Structure, organization, and evolution.
Strategies of project management: organization, supervision, modifications, coordination, subcontracting, delivery
Quality assurance and audits
Management of crises and conflicts

Part 2
Actors of technical management of a project: Project Director, Project Supervisor, Programming Engineer, Project Engineer, Specialty Leader…)
Management of technical documents
Management of works
Management of modifications
Management de delays (study, logistics, execution, delivery…
Operational techniques for cost control
Multi-component programming of projects (time, human resources, logistics, cost, risk…).

Online organization of projects and co-contracting

Bibliography :

Requirements :

Organisation :
Plenary lectures supplemented by case studies to illustrate the presented concept of project management. A challenge is organised for applying skills in real-like situations.

Evaluation :
The evaluation concerns the presented project during the challenge.

Target :
5GCU

BIM Project Management	GCU09-SPEC-GPD
Number of hours : 18.00 h	1.00 ECTS credit
CM : 18.00 h	
Reference Teacher(s) : NGUYEN Quang Huy	

Objectives :
BIM technology is a process that involves the creation and use of an intelligent and configurable 3D model to make better decisions about a project and communicate them. This will involve designing, visualizing, simulating, collaborating and managing more easily throughout the project lifecycle. This course aims to introduce you to BIM technology in building project management.

Content :
Introduction to BIM

The digital technology in the construction industry
The main national and international users
Technical terms of the BIM
The digitization of trades
Technological watch
The implementation of a BIM approach

Interoperability

The challenges of openBIM
The IFC
The BCF
The Facility management

Modeling by BIM approach

Modeling a project by tender mission
Structural modeling
The point clouds
Introduction to Dynamo
Content creation
Architectural modeling

Network modeling

Communicating in a BIM approach
PC and digital DOE
Collaborative platforms
Digital communication tools
Virtual reality and augmented reality
4D simulation

Quality control in BIM approach

Automated and iterative control
Steering and refereeing a synthesis
The point clouds
The digital synthesis model

BIM approach methods

The site installation plan
3D phasing
The layout of facades
The banches cycle
The establishment of security element
The operating mode
BCF in different applications
Interference detection in Revit

Interference detection in Solibri Model Checker
Taking into account the specificities of the trades
Consideration of transitional phases of construction site or maintenance phases

Bibliography :
• De la maquette numérique au BIM, Eyrolles
BIM et architecture, DUNOD
Le BIM appliqué à la gestion du projet de construction: Outils, méthodes et flux de travaux, David McCool et Brad Hardin

Requirements :
Revit

Organisation :
8 hours of lectures and 8 hours of tutorials
Copies of handouts

Evaluation :
Mini-Project

Target :
5GCU

Formation éthique de l'ingénieur	INF09-ETHIQUE
Number of hours : 16.00 h	1.00 ECTS credit
CM : 12.00 h, TD : 4.00 h	
Reference Teacher(s) : CELLIER-BELLINA Peggy	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Economics, Law and Business Studies (Professional management)	HUM09-PM-PRO
Number of hours : 70.00 h	2.00 ECTS credit
TA : 70.00 h, TA : 70.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Expérience en entreprise	DET10-SPEC PRO
Number of hours : 30.00 h	2.00 ECTS credit
PR : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 10

Parcours Contrat professionnalisation

1	DMA10-PFE		FINAL YEAR PROJECT	30.00
	DMA10-PFE	O	End of Studies Project	30.00

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

End of Studies Project	DMA10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ES : 4.00 h, ST : 346.00 h, ST : 346.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The 2nd semester of the 5th year of studies is completely devoted to the End of Studies Project (ESP). The ESP is a work-experience placement to enable the student to acquire practical experience in a professional environment and to apply the theoretical knowledge of his studies at the GM department. It aims to develop his teamwork, communication and observation skills, and to improve his capacity to integrate a business environment. For this reason, it is recommended that the work placement takes place in a private company. The ESP needs an agreement (junior engineer level) between the host and INSA.

Content :
- Duration: 16 to 24 weeks.
- Period: from the beginning of February to the end of September.
- Host: Industrial or business company, research laboratory in France or abroad. It is strongly advised that the subject is closely related to the topics of the GM department.
- Administrative formalities: All placements are subject to an agreement between the INSA and the host. For further information, please contact the work placement office of the INSA (service des stages). Before all, the subject of the project has to be accepted by the reference teacher of ESP at GM department.

Bibliography :

Requirements :

Organisation :
The student has to learn to manage some situation in a real professional environment and to meet the needs of the employer or advisor. He has to show autonomy and take initiatives. It is important that his work proves his ability to apply the theoretical knowledge of the department GM.

Evaluation :
- A short written mid-term report must be sent to the INSA advisor.
- A written report must be handed in time in upon completion of the placement.
- Oral presentation of the report.

The final mark is obtained from:
- the amount and quality of work according the host manager of the student;
- the quality of the writing report according to the INSA advisor;
- the quality of the defence of the internship in front of an examining board.

Target :
Electronics and Computer Science Engineer (A-level +5).

Semestre 10

Parcours controle optimal

1	DMA10-PFE		FINAL YEAR PROJECT	30.00
	DMA10-PFE	O	End of Studies Project	30.00

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

End of Studies Project	DMA10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ES : 4.00 h, ST : 346.00 h, ST : 346.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The 2nd semester of the 5th year of studies is completely devoted to the End of Studies Project (ESP). The ESP is a work-experience placement to enable the student to acquire practical experience in a professional environment and to apply the theoretical knowledge of his studies at the GM department. It aims to develop his teamwork, communication and observation skills, and to improve his capacity to integrate a business environment. For this reason, it is recommended that the work placement takes place in a private company. The ESP needs an agreement (junior engineer level) between the host and INSA.

Content :
- Duration: 16 to 24 weeks.
- Period: from the beginning of February to the end of September.
- Host: Industrial or business company, research laboratory in France or abroad. It is strongly advised that the subject is closely related to the topics of the GM department.
- Administrative formalities: All placements are subject to an agreement between the INSA and the host. For further information, please contact the work placement office of the INSA (service des stages). Before all, the subject of the project has to be accepted by the reference teacher of ESP at GM department.

Bibliography :

Requirements :

Organisation :
The student has to learn to manage some situation in a real professional environment and to meet the needs of the employer or advisor. He has to show autonomy and take initiatives. It is important that his work proves his ability to apply the theoretical knowledge of the department GM.

Evaluation :
- A short written mid-term report must be sent to the INSA advisor.
- A written report must be handed in time in upon completion of the placement.
- Oral presentation of the report.

The final mark is obtained from:
- the amount and quality of work according the host manager of the student;
- the quality of the writing report according to the INSA advisor;
- the quality of the defence of the internship in front of an examining board.

Target :
Electronics and Computer Science Engineer (A-level +5).

Semestre 10

Parcours externe semestre impair-interne semestre pair

1	DMA10-PFE		FINAL YEAR PROJECT	30.00
	DMA10-PFE	O	End of Studies Project	30.00

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

End of Studies Project	DMA10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ES : 4.00 h, ST : 346.00 h, ST : 346.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The 2nd semester of the 5th year of studies is completely devoted to the End of Studies Project (ESP). The ESP is a work-experience placement to enable the student to acquire practical experience in a professional environment and to apply the theoretical knowledge of his studies at the GM department. It aims to develop his teamwork, communication and observation skills, and to improve his capacity to integrate a business environment. For this reason, it is recommended that the work placement takes place in a private company. The ESP needs an agreement (junior engineer level) between the host and INSA.

Content :
- Duration: 16 to 24 weeks.
- Period: from the beginning of February to the end of September.
- Host: Industrial or business company, research laboratory in France or abroad. It is strongly advised that the subject is closely related to the topics of the GM department.
- Administrative formalities: All placements are subject to an agreement between the INSA and the host. For further information, please contact the work placement office of the INSA (service des stages). Before all, the subject of the project has to be accepted by the reference teacher of ESP at GM department.

Bibliography :

Requirements :

Organisation :
The student has to learn to manage some situation in a real professional environment and to meet the needs of the employer or advisor. He has to show autonomy and take initiatives. It is important that his work proves his ability to apply the theoretical knowledge of the department GM.

Evaluation :
- A short written mid-term report must be sent to the INSA advisor.
- A written report must be handed in time in upon completion of the placement.
- Oral presentation of the report.

The final mark is obtained from:
- the amount and quality of work according the host manager of the student;
- the quality of the writing report according to the INSA advisor;
- the quality of the defence of the internship in front of an examining board.

Target :
Electronics and Computer Science Engineer (A-level +5).

Semestre 10

Parcours FISP

1	DMA10-PFE		FINAL YEAR PROJECT	30.00
	DMA10-PFE	O	End of Studies Project	30.00

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

End of Studies Project	DMA10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ES : 4.00 h, ST : 346.00 h, ST : 346.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The 2nd semester of the 5th year of studies is completely devoted to the End of Studies Project (ESP). The ESP is a work-experience placement to enable the student to acquire practical experience in a professional environment and to apply the theoretical knowledge of his studies at the GM department. It aims to develop his teamwork, communication and observation skills, and to improve his capacity to integrate a business environment. For this reason, it is recommended that the work placement takes place in a private company. The ESP needs an agreement (junior engineer level) between the host and INSA.

Content :
- Duration: 16 to 24 weeks.
- Period: from the beginning of February to the end of September.
- Host: Industrial or business company, research laboratory in France or abroad. It is strongly advised that the subject is closely related to the topics of the GM department.
- Administrative formalities: All placements are subject to an agreement between the INSA and the host. For further information, please contact the work placement office of the INSA (service des stages). Before all, the subject of the project has to be accepted by the reference teacher of ESP at GM department.

Bibliography :

Requirements :

Organisation :
The student has to learn to manage some situation in a real professional environment and to meet the needs of the employer or advisor. He has to show autonomy and take initiatives. It is important that his work proves his ability to apply the theoretical knowledge of the department GM.

Evaluation :
- A short written mid-term report must be sent to the INSA advisor.
- A written report must be handed in time in upon completion of the placement.
- Oral presentation of the report.

The final mark is obtained from:
- the amount and quality of work according the host manager of the student;
- the quality of the writing report according to the INSA advisor;
- the quality of the defence of the internship in front of an examining board.

Target :
Electronics and Computer Science Engineer (A-level +5).

Semestre 10

Parcours Formation initiale

1	DMA10-PFE		FINAL YEAR PROJECT	30.00
	DMA10-PFE	O	End of Studies Project	30.00

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

End of Studies Project	DMA10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ES : 4.00 h, ST : 346.00 h, ST : 346.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The 2nd semester of the 5th year of studies is completely devoted to the End of Studies Project (ESP). The ESP is a work-experience placement to enable the student to acquire practical experience in a professional environment and to apply the theoretical knowledge of his studies at the GM department. It aims to develop his teamwork, communication and observation skills, and to improve his capacity to integrate a business environment. For this reason, it is recommended that the work placement takes place in a private company. The ESP needs an agreement (junior engineer level) between the host and INSA.

Content :
- Duration: 16 to 24 weeks.
- Period: from the beginning of February to the end of September.
- Host: Industrial or business company, research laboratory in France or abroad. It is strongly advised that the subject is closely related to the topics of the GM department.
- Administrative formalities: All placements are subject to an agreement between the INSA and the host. For further information, please contact the work placement office of the INSA (service des stages). Before all, the subject of the project has to be accepted by the reference teacher of ESP at GM department.

Bibliography :

Requirements :

Organisation :
The student has to learn to manage some situation in a real professional environment and to meet the needs of the employer or advisor. He has to show autonomy and take initiatives. It is important that his work proves his ability to apply the theoretical knowledge of the department GM.

Evaluation :
- A short written mid-term report must be sent to the INSA advisor.
- A written report must be handed in time in upon completion of the placement.
- Oral presentation of the report.

The final mark is obtained from:
- the amount and quality of work according the host manager of the student;
- the quality of the writing report according to the INSA advisor;
- the quality of the defence of the internship in front of an examining board.

Target :
Electronics and Computer Science Engineer (A-level +5).

Semestre 10

Parcours IGR-MAE

1	DMA10-PFE		FINAL YEAR PROJECT	30.00
	DMA10-PFE	O	End of Studies Project	30.00

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

End of Studies Project	DMA10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ES : 4.00 h, ST : 346.00 h, ST : 346.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The 2nd semester of the 5th year of studies is completely devoted to the End of Studies Project (ESP). The ESP is a work-experience placement to enable the student to acquire practical experience in a professional environment and to apply the theoretical knowledge of his studies at the GM department. It aims to develop his teamwork, communication and observation skills, and to improve his capacity to integrate a business environment. For this reason, it is recommended that the work placement takes place in a private company. The ESP needs an agreement (junior engineer level) between the host and INSA.

Content :
- Duration: 16 to 24 weeks.
- Period: from the beginning of February to the end of September.
- Host: Industrial or business company, research laboratory in France or abroad. It is strongly advised that the subject is closely related to the topics of the GM department.
- Administrative formalities: All placements are subject to an agreement between the INSA and the host. For further information, please contact the work placement office of the INSA (service des stages). Before all, the subject of the project has to be accepted by the reference teacher of ESP at GM department.

Bibliography :

Requirements :

Organisation :
The student has to learn to manage some situation in a real professional environment and to meet the needs of the employer or advisor. He has to show autonomy and take initiatives. It is important that his work proves his ability to apply the theoretical knowledge of the department GM.

Evaluation :
- A short written mid-term report must be sent to the INSA advisor.
- A written report must be handed in time in upon completion of the placement.
- Oral presentation of the report.

The final mark is obtained from:
- the amount and quality of work according the host manager of the student;
- the quality of the writing report according to the INSA advisor;
- the quality of the defence of the internship in front of an examining board.

Target :
Electronics and Computer Science Engineer (A-level +5).

Semestre 10

Parcours Recherche

1	DMA10-PFE		FINAL YEAR PROJECT	30.00
	DMA10-PFE	O	End of Studies Project	30.00

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

End of Studies Project	DMA10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ES : 4.00 h, ST : 346.00 h, ST : 346.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The 2nd semester of the 5th year of studies is completely devoted to the End of Studies Project (ESP). The ESP is a work-experience placement to enable the student to acquire practical experience in a professional environment and to apply the theoretical knowledge of his studies at the GM department. It aims to develop his teamwork, communication and observation skills, and to improve his capacity to integrate a business environment. For this reason, it is recommended that the work placement takes place in a private company. The ESP needs an agreement (junior engineer level) between the host and INSA.

Content :
- Duration: 16 to 24 weeks.
- Period: from the beginning of February to the end of September.
- Host: Industrial or business company, research laboratory in France or abroad. It is strongly advised that the subject is closely related to the topics of the GM department.
- Administrative formalities: All placements are subject to an agreement between the INSA and the host. For further information, please contact the work placement office of the INSA (service des stages). Before all, the subject of the project has to be accepted by the reference teacher of ESP at GM department.

Bibliography :

Requirements :

Organisation :
The student has to learn to manage some situation in a real professional environment and to meet the needs of the employer or advisor. He has to show autonomy and take initiatives. It is important that his work proves his ability to apply the theoretical knowledge of the department GM.

Evaluation :
- A short written mid-term report must be sent to the INSA advisor.
- A written report must be handed in time in upon completion of the placement.
- Oral presentation of the report.

The final mark is obtained from:
- the amount and quality of work according the host manager of the student;
- the quality of the writing report according to the INSA advisor;
- the quality of the defence of the internship in front of an examining board.

Target :
Electronics and Computer Science Engineer (A-level +5).

Semestre 10

Parcours SEER

1	DMA10-PFE		FINAL YEAR PROJECT	30.00
	DMA10-PFE	O	End of Studies Project	30.00

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

End of Studies Project	DMA10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ES : 4.00 h, ST : 346.00 h, ST : 346.00 h	
Reference Teacher(s) : LEY Olivier	

Objectives :
The 2nd semester of the 5th year of studies is completely devoted to the End of Studies Project (ESP). The ESP is a work-experience placement to enable the student to acquire practical experience in a professional environment and to apply the theoretical knowledge of his studies at the GM department. It aims to develop his teamwork, communication and observation skills, and to improve his capacity to integrate a business environment. For this reason, it is recommended that the work placement takes place in a private company. The ESP needs an agreement (junior engineer level) between the host and INSA.

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Target :
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