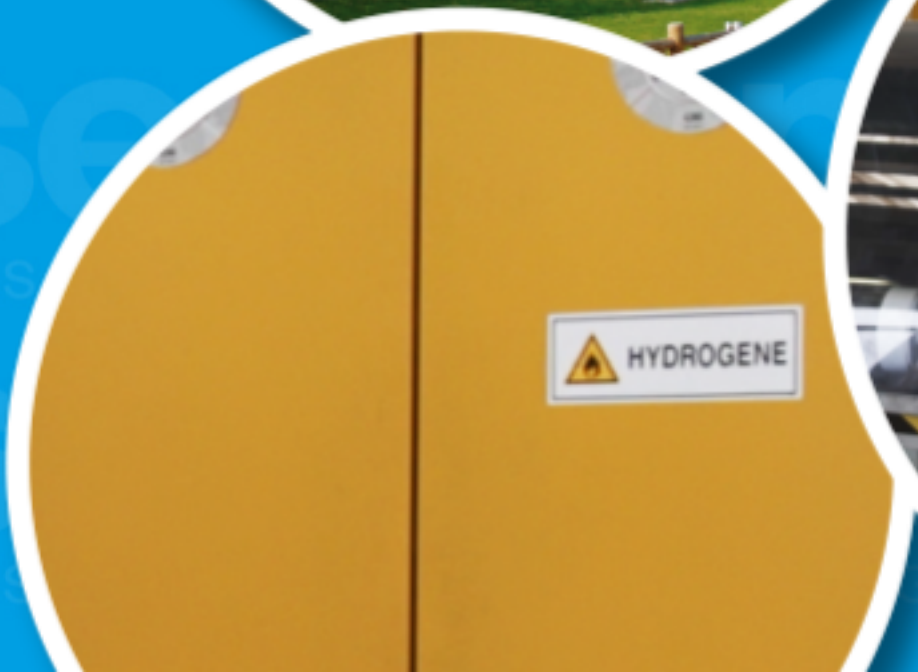
SYLLABUS

SHORT SYLLABUS ENERGY ENGINEERING

LORRAINE INP Ensem

ÉCOLE D'INGÉNIEURS CRÉÉE EN 1900



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PROGRAM DESCRIPTION
ENSEM

The challenges of the energy transition by 2050 lead to many technological breakthroughs in the fields of production, optimal distribution and rational use of energy and renewables (energy efficiency and consumption optimization, massive electrification, control and management of energy systems, cogeneration and energy recovery processes, new and renewable energies, etc.).

The first three semesters of training take place in a common core curriculum. Scientific curriculum combining mechanical engineering, electrical engineering and information sciences is supplemented by general training (modern languages, communication, managerial sciences, system engineering). An introduction to the professional world is guaranteed by internships in companies and multiple industrial interventions.

From the second half of the second year, the training is organised in the form of skill blocks around energy networks, energy conversion, electrical machines, energetics, control monitoring and safety of energy systems, numerical modelling & simulation and mechanical engineering. A selection of these blocks makes it possible to customize the training paths according to the students' professional projects: transport and mobility, industrial energetics, energy networks, etc.

International experience is encouraged through numerous opportunities for academic exchanges and internships abroad. All of this makes it possible to acquire solid scientific and technical knowledge recognized by industrialists, a precise understanding of the challenges in the field of energy and the soft skills that are essential to engineering professions.

550 engineering students

150 graduates each year

8000 graduates to date

6000 active alumni

52 professors

200 researchers or students

18000 m² teaching and research facilities

+than 60 partnerships with international Universities

Semester 5 courses

CM = Lecture TD = Tutorial TP = Lab work Barre UE = Pass Grade

Course ref	Course name	CM	TD	TP	Hours	Coeff.	ECTS	Barre UE	More info
5KSPLN02	**ENSEM ENERGY DEGREE Semester 5**								
5KUPLN08	**EU Mathematical Tools 1**								
5KEPLN81	Mathematics for engineering	14	16	0	**30**	3	**5**	10	
5KEPLN82	Numerical analysis 1	8	6	6	**20**	2			
5KUPLN02	**EU Foundations of Mechanics**								
5KEPLN21	Continuum Mechanics	20	10	0	**30**	2,5	**5**	10	
5KEPLN22	Thermodynamics	16	14	0	**30**	2,5			
5KUPLN09	**EU Electricity 1**								
5KEPLN91	Electrotechnics	14	10	6	**30**	2,5	**5**	10	
5KEPLN92	Tools for electricity and electronics	12	10	8	**30**	2,5			
5KUPLN10	**EU Sciences de l'Information & Info 1**								
5KEPLN0A	Signal and system modeling	9	4	10	**23**	2	**5**	10	
5KEPLN0B	DES modeling	4	3	0	**7**	0,5			
5KEPLN0C	Algorithms and programming	7	5	18	**30**	2,5			
5KUPLN11	**EU Languages 1**								
5KEPLN1A	English	0	24	0	**24**	2,5	**5**	10	
5KEPLN1B	Foreign Language 2	0	24	0	**24**	2,5			
5KEPLN1C	Validation of French language level	0	1	0	**1**	Quitus			
5KUPLN12	**EU General Education**								
5KEPLN2A	Management	14	0	0	**14**	1,5	**5**	10	
5KEPLN2E	Electrical accreditation-work safety	8	0	0	**8**	Quitus			
5KEPLN2B	Communication	0	16	0	**16**	1,5			
5KEPLN2C	Project management	4	16	0	**20**	2			
5KEPLN2D	1st year project	0	0	30	**30**	Quitus			
				TOTAL	**367**		**30**		

Semester 6 courses

CM = Lecture TD = Tutorial TP = Lab work Barre UE = Pass Grade

Course ref	Course name	CM	TD	TP	Hours	Coeff.	ECTS	Barre UE	More info
6KSPLN02	**ENSEM ENERGY DEGREE Semester 6**								
6KUPLN09	**EU Mathematical Tools 2**								
6KUPLN91	Probabilities and statistics	18	16	0	**30**	2	**5**	10	
6KUPLN92	Optimization and graphs	16	14	0	**20**	1,5			
6KUPLN93	Numerical analysis 2	8	6	6	**20**	1,5			
6KUPLN02	**EU Applied Mechanics**								
6KEPLN21	Mechanics for engineering	14	8	8	**30**	2,5	**5**	10	
6KEPLN22	Fluid Mechanics and Applications	12	10	8	**30**	2,5			
6KUPLN10	**EU Electricity 2**								
6KEPLN0A	Electrical machines	13	8	9	**30**	2,5	**5**	10	
6KEPLN0B	Power electronics	13	8	9	**30**	2,5			
6KUPLN11	**EU Information Science 2**								
6KEPLN1A	Automatic control - System control and dynamics	14	7	9	**30**	2,5	**5**	10	
6KEPLN1B	Object-oriented Algorithms and programming	7	5	18	**30**	2,5			
6KUPLN12	**EU Languages 2**								
6KEPLN2A	English	0	24	0	**24**	2,5	**5**	10	
6KEPLN2B	Foreign Language 2	0	24	0	**24**	2,5			
6KEPLN2C	Validation of French language level	0	1	0	**1**	Quitus			
6KUPLN13	**EU General Education 2**								
6KEPLN3A	Business Management	12	6	0	**18**	2	**5**	12	
6KEPLN3B	Innovation and entrepreneurship	0	12	0	**12**	Quitus			
6KEPLN3E	Electrical accreditation-work safety	0	0	0,5	**0.5**	Quitus			
6KEPLN3C	Communication	2	10	0	**12**	1			
6KEPLN3D	1st year project	0	0	20	**20**	2			
6KUPLN08	**EU Industrial internship**								
6KEPLN81	Industrial internship	1 month				–	Quitus		
					TOTAL	**371,5**		**30**	

Semester 7 courses

CM = Lecture TD = Tutorial TP = Lab work Barre UE = Pass Grade

Course ref	Course name	CM	TD	TP	Hours	Coeff.	ECTS	Barre UE	More info
7KS2AN05	**ENSEM ENERGY DEGREE Semester 7**								
7KUNRJ01	**EU Mathematical Tools 3**								
7KENRJ10	Distributions	9	6	0	**15**	1,5	**3**	10	⊕
7KENRJ11	PDE	9	6	0	**15**	1,5			
7KUNRJ02	**EU Energy conversion**								
7KENRJ20	Electromechanical conversion of energy	8	4	12	**24**	2	**5**	10	⊕
7KENRJ21	Energy conversion chain	6	0	20	**26**	2			
7KENRJ22	Materials for engineering	8	12	0	**20**	1			
7KUNRJ03	**EU Mechanics**								
7KENRJ31	Foundation in heat transfers	8	12	10	**30**	2,5	**5**	10	⊕
7KENRJ32	Rotating machines	18	8	4	**30**	2,5			
7KUNRJ04	**EU Electrical engineering**								
7KENRJ40	Power electronics	16	6	8	**30**	2,5	**5**	10	⊕
7KENRJ41	Electrical machines	10	8	12	**30**	2,5			
7KUNRJ05	**EU Information Science 3**								
7KENRJ50	Signal Processing	18	8	4	**30**	2,5	**5**	10	⊕
7KENRJ50	Sensor Networks	10	5	15	**30**	2,5			
7KUNRJ06	**EU General Education 3**								
7KENRJ60	Conferences: scientific culture in energy	20	0	0	**20**	Quitus	**7**	10	⊕
7KENRJ61	Professional communication	8	2	0	**10**	1			
7KENRJ62	Account management	10	10	0	**20**	2			
7KENRJ63	English	0	24	0	**24**	2			
7KENRJ64	2nd foreign language	0	24	0	**24**	2			
				TOTAL	**378**		**30**		

Semester 8 courses

CM = Lecture TD = Tutorial TP = Lab work Barre UE = Pass Grade

Course ref	Course name	CM	TD	TP	Hours	Coeff.	ECTS	Barre UE	More info
8KPNAN01	**Semester 8**								
X	B01 : 4 electives to choose among 8				**80**		**6**	10	
X	B02 : 4 electives to choose among 8				**80**		**6**	10	
X	B03 : 4 electives to choose among 8				**80**		**6**	10	
X	B04 : 4 electives to choose among 8				**80**		**6**	10	
8KUNRJ10	**EU General education 4**								
8KENRJ1A	English	0	24	0	**24**	2	**6**	10	
8KENRJ1B	2nd foreign language	0	24	0	**26**	2			
8KENRJ1C	Marketing strategy and business simulation	6	24	0	**30**	2			
					TOTAL	**398**		**30**	

EU General Education 4

English

Dynamic presentations.
In this module the focus is on oral skills and communication techniques (technical impact, report building, signposting, effective use of slides). Students will have to present an innovative project for which they would need funding.

2nd foreign language

Development of transferable skills in daily and professional life.
Work on different exercises to prepare the language certifications in listening comprehension, reading comprehension, grammar and vocabulary and oral expression. Preparation for public speaking.

Business Strategy and Business Simulation

The business management simulation is a module for applying the notions learned in management, marketing, finance and goods production. Based on group work, this business game offers an effective way to concretely apprehend the interweaving of commercial, financial and human decisions and the company's relationship with its environment. It gives everyone the opportunity to test their ability to react to the vagaries of the economic situation, to the blows of the competition, based on imperfect information and in a limited time.omprehension, grammar and vocabulary and oral expression. Preparation for public speaking.

Semester 8 electives (choose 4)

Note that these combinaisons are not compatible in terms of schedule : B1/B8 , B2/B5, B3/B6

CM = Lecture TD = Tutorial TP = Lab work Barre UE = Pass Grade

Course ref	Elective name	CM	TD	TP	Hours	Coeff.	ECTS	Barre UE	More info
8KS2AN06	Semester 8								
B1 8KUNRJ01	**Networks, sources and storage elements**								
	Electrical networks modeling	8	4	4	**16**	1,2	**6**		
	Renewable energy integration	10	2	4	**16**	1,2			
	Static and dynamic characteristics of energy storage sources and elements	18	0	0	**18**	1,2			
	Heat networks	6	4	4	**14**	1,2			
	Case study	0	4	12	**16**	1,2			
					TOTAL	**80**			
B2 8KUNRJ02	**Electrical machine drive control and dynamic modeling**								
	Electric motorization and generation systems: modeling and implementation	20	12	8	**40**	3	**6**		
	Electrical machines connected to the network: failures and transient regimes	16	8	16	**40**	3			
					TOTAL	**80**			
B3 8KUNRJ03	**Thermal and fluid conversion in energy systems**								
	Thermodynamics of energy systems	10	20	10	**40**	3	**6**		
	Fluid energy conversion: modeling and dimensioning	14	10	16	**40**	3			
					TOTAL	**80**			
B4 8KUNRJ04	**Advanced power electronics for stationary and embedded applications**								
	Current and emerging Power Structures	20	8	12	**40**	3	**6**		
	Digital integration	16	0	24	**40**	3			
					TOTAL	**80**			
B5 8KUNRJ05	**Fluid and thermal couplings for energy systems**								
	Transfer intensification and multiphysics couplings	28	22	0	**50**	3,75	**6**		
	Coupling case studies	0	0	30	**30**	2,25			
					TOTAL	**80**			
B6 8KUNRJ06	**Control, monitoring, dependability**								
	Digital control	10	10	0	**20**	1,5	**6**		
	Stability and stabilization of systems	10	10	0	**20**	1,5			
	Discrete Event Systems	8	4	8	**20**	1,5			
	Dependability	10	4	6	**20**	1,5			
					TOTAL	**80**			

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Course ref	Elective name	CM	TD	TP	Hours	Coeff.	ECTS	Barre UE	More info
8KS2AN06	**Semester 8**								
B7 8KUNRJ07	**Modeling and numerical simulation (choose 1 core module + 2 modules a&b) = 80H**								
	Module 1 : Numerical simulation methods (core module)	14	0	6	**20**	1,5	**6**		
	Module 2a : Finite element modeling and simulation of magnetic devices	6	0	24	**30**	2,25			
	Module 2b : Finite element method in low frequency electromagnetism	12	6	12	**30**	2,25			
	Module 3a : Finite volumes and finite elements applied to Mechanics (Matlab/FlexPDE)	6	0	24	**30**	2,25			
	Module 3b1 : Finite element analysis of machines & structures (Abaqus)	6	0	24	**30**	2,25			
	Module 3b2 : Numerical tools for fluid and thermal mechanics (Fluent/Comsol)	6	0	24	**30**	2,25			
	Module 4a : Dynamic models & Coupled multiphysics systems (co-modeling)	0	0	30	**30**	2,25			
	Module 4b : From co-modeling to co-simulation	0	0	30	**30**	2,25			
	Module 5a : Simulation applied to the control of continuous systems	10	0	20	**30**	2,25			
	Module 5b : Numerical simulation of DES	12	6	12	**30**	2,25			
				TOTAL	**80**				
B8 8KUNRJ08	**Ecodesign for energy and mobility**								
	Computer Aided Design (CAD)	4	0	16	**20**	1,5	**6**		
	Eco-design: materials, costs and life cycle	14	6	0	**20**	1,5			
	Innovative technologies and processes	10	2	8	**20**	1,5			
	Case studies in dimensioning	2	0	18	**20**	1,5			
				TOTAL	**80**				

Semester 9 courses

CM = Lecture TD = Tutorial TP = Lab work Barre UE = Pass Grade

Course	Elective name	CM	TD	TP	Hours	Coeff.	ECTS	Barre UE	More info
XXXXXXXX	Energie Semester 9								
B1	B01 Elective (4 to choose among 18,)				60		20	10	
B2	B02 Elective (4 to choose among 18)				60			10	
B3	B03 Elective (4 to choose among 18)				60			10	
B4	B04 Elective (4 to choose among 18)				60			10	
9KUFGN06	EU General training 5								
9KXANG06	English	0	30	0	30	2,5	5	10	
	Profesional development seminar	10	20	0	30	2,5			
	Research in Energy	20	0	0	20	Quitus			
9KUFGN15	EU Projects								
9KEFGN51	final year project	0	0	60	60	3	5	12	
9KEFGN52	Cross-disciplinary design office	0	0	30	30	2			
					TOTAL 410		30		

EU General Education 5

English

This course consists of 2 modules with a professional focus: Interacting Professionally and Scientific communication.
The objective is to provide students with skills in business and scientific English.
Students who have not yet validated the B2 level will be able to follow a «B2 support» module designed to help them obtain a minimum score of 785 on the TOEIC test..

Professional developement seminar

During one week the students will be prepared for their search for an engineering internship. They will follow different workshops (definition of the professional project, digital identity, advice for writing CVs and cover letters, etc.)
They will meet HR people from different companies, alumni and participate in job interview simulations.

EU projects

End of studies project

The objective of this end-of-study project is to allow students to implement the knowledge acquired during their training at Ensem and to apply it to a concrete engineering research and development problem.
The subject is proposed by a professor or a company and the students will work individually or in groups depending on the subject and the work required to meet the specifications of the study.
The students will thus develop their reasoning and adaptation faculties, in order to immerse themselves in a company during the engineering internship that will follow at the end of semester 9.

Cross-disciplinary design office

Group project that allows to put into practice in the form of a design office the skills and knowledge developed during the modules taught.
The students will be able to apply them on the experimental platforms (Urbanloop, Internet of Energies, ,Energetics etc..)
They will also acquire transferable skills in project management, teamwork and independent research.

Course ref	Course name	Hours	More info
XXXXXXXX	**Energie**	**240h**	
	Semester 9 : 4 courses to choose among 18		
B9	Diagnostic, risk analysis, monitoring	**60h**	
B10	Data Analysis, Machine Learning and AI		
B11	Mesurement, inverse problems and identification		
B12	Transmission, distribution and security in communication networks		
B13	Autonomous and embedded electrical networks		
B14	Electrical machines		
B15	High-availability electromechanical conversion		
B16	Electrical components in their environment		
B17	Electrical storage systems		
B18	Digital twin: Power Hardware in the Loop (P-HIL)		
B19	Energy network management		
B20	High speed flows, energy conversion by combustion		
B21	Experimental methods for transfer characterization		
B22	Interfacial transfers for efficient industrial processes		
B23	Transfer intensifications		
B24	Mechanical quality and reliability		
B25	Material durability and service life		
B26	Mechanical structure optimization		

Semester 10 courses

6-month internship

The objective of the final-year year internship is to prepare the students' integration into the working world; this 6-month internship is an essential means to confront the knowledge acquired during the university course with the know-how of the companies. Indeed, this practical training is truly an opportunity for students, immersed in an industrial environment, to acquire a corporate culture and to demonstrate that they have the human, technical and scientific skills necessary to assume their future role as engineers.

LORRAINE INP Ensem

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