Ecole Nationale Supérieure en Génie
des Technologies Industrielles

COURSE CATALOGUE

Third Year (M2, Sem. 9 and 10)

2023 - 2024

GENERAL CHRONOLOGY
Speciality Energetics and Process Engineering

Year	Semester	Months	Courses / Training			
3rd Year (Master II)	S10	Sept. Aug. Jul. Jun. May Apr.	Industrial Training 30 ECTS		MAE Training	Professionnal Contracts
	S9	Mar. Feb. Jan. Dec. Nov. Oct.	Common Courses EN : SB or TEDDI ; Proc : PE or CPAO 30 ECTS	Mobilité académique	Master in Management (MAE)	
		Sept. Aug. Jul. Jun.	Industrial or Research Training			
2nd Year (Master I)	S8	May Apr. Mar. Feb. Jan.	Common and Specialized Courses Energetics or Process Engineering 30 ECTS	Mobilité académique		
	S7	Dec. Nov. Oct. Sept.	Common and Specialized Courses Energetics or Process Engineering 30 ECTS			
		Aug. Jul. Jun.	Short Training			
1st Year (Bachelor)	S6	May Apr. Mar. Feb. Jan.	Common and Specialized Courses Energetics or Process Engineering 30 ECTS			
	S5	Dec. Nov. Oct. Sept.	Common Courses 30 ECTS			

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CPGE BUT L3

UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR | COLLÈGE STEE SCIENCES ET TECHNOLOGIES POUR L'ÉNERGIE ET L'ENVIRONNEMENT

ENSGTI ÉCOLE D'INGÉNIEURS

Bordeaux INP AQUITAINE

GENERAL CHRONOLOGY
Speciality Electrical Engineering and Computer Science

3rd Year (Master II)	S10	Aug. Jul. Jun. May Apr. Mar.	26 weeks in the company	
3rd Year (Master II)	S9	Feb. Jan. Dec. Nov. Oct.	15 weeks in academic center 11 weeks in the company 30 ECTS	Academic Mobility
		Sept. Aug. Jul. Jun.	12 weeks in the company	
2nd Year (Master I)	S8	May Apr. Mar. Feb. Jan.	14 weeks in academic center 8 weeks in the company 30 ECTS	Academic Mobility
2nd Year (Master I)	S7	Dec. Nov. Oct. Sept.	10 weeks in academic center 8 weeks in the company 30 ECTS	
		Aug. Jul. Jun.	12 weeks in the company	
1st Year (Bachelor)	S6	May Apr. Mar. Feb. Jan.	14 weeks in academic center 8 weeks in the company 30 ECTS	
1st Year (Bachelor)	S5	Dec. Nov. Oct. Sept.	11 weeks in academic center 7 weeks in the company 30 ECTS	

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BUT L3 BTS

NOMENCLATURE

UE : Teaching unit
EC : Constituent Element

CM : Lectures
TD : Tutorials
TP : Practical work
Proj. : Project
TA : Autonomous work

TC : Common Course

EN : Speciality « Energy »
GP : Speciality « Process Engineering »
GEII : Speciality « Electrical Engineering and Computer Science»

EN SB : Speciality « Energy » - Pathways (3A) « Smart Building »
EN TEDDI : Speciality « Energy » - Pathways (3A) « Transition Énergétique et Développement Durable dans l'Industrie »

GP PE : Speciality « Process Engineering » – Pathways (3A) « Procédés pour l'Environnement »
GP CPAO : Speciality « Process Engineering » – Pathways (3A) « Conception des Procédés assistée par Ordinateur »

GEII HT : Speciality « Electrical Engineering and Computer Science» – Pathways (3A) « Haute Tension »

NOMENCLATURE FOR ASSESSMENT PROCEDURES

Nature_1 (Modality_1) x Weighting_factor_1 + Nature_2 (Modality_2) x Weighting_factor_2 + …

Assessment nature

CC: Continuous Assessment

Proj: Project

Sta: Work placement

TP: Practical Examination

CoE: Reading Comprehension (languages)

CoO: Listening Comprehension (languages)

ExE: Writing (languages)

ExO: Speaking (languages)

IntO: Oral Interaction (languages)

Cert: Certificate of competency in languages

EvaC: Skills assessment

Assessment modalities

EE: Written examination (by default, if no information provided)

EO: Oral examination

EM: Engine examination

ES: Surprise written examination

PA: Active participation

Sout: Oral defense

Rap: Written report

Prog: Computer program

Tr: Work (within the framework of a work placement, a project or practical work)

D: File

CR: Report (within the framework of practical work)

LA: Reading articles

sd: no document is allowed (by default, if no information provided)

da: documents are allowed (da: further details on the authorized documents)

st: no smart object is allowed (mobile phones, smartwatches...) (by default, if no information provided)

ta: smart objects are allowed

sc: no calculator is allowed (by default, if no information provided) ca: calculators are allowed

Operators

x/y: x or y

max(x, y): Maximum in several assessments

moyenne(x): Average of several assessments of the same kind and coefficient

Examples

CC (EE, 2h)

A 2-hour written examination, no document allowed, no calculator allowed.

CC (EM, 2h, da:tutoriels) x 1/2 + CC (EE, 2h) x 1/2

A 2-hour engine examination, tutorials are allowed, coefficient 1/2 and a 2-hour written examination, no document allowed, no calculator allowed, coefficient 1/2

CC (ES, 15mn) x 1/10 + CC (EE, 2h, da:tous, ca) x 9/10

A 15-minute surprise examination, no document allowed, no calculator allowed, coefficient 1/10 and a 2-hour written examination, all documents allowed, calculator allowed, coefficient 9/10.

TP(EO, 10mn) x 1/4 + TP(EO, 10mn) x 1/4 + TP(CR) x 1/2

Practical work assessed by two oral examinations, each with a coefficient 1/4, and a practical work report, coefficient 1/2.

Proj (PA, Rap, Sout)

Project assessed by the active participation, a written report and an oral defense.

Sta (Tr, Rap, Sout

Work placement assessed by work, a written report and an oral defense.

CoE(PA) x 1/4 + CoO(PA) x 1/4 + ExE(EE, 1h) x 1/4 + Cert(TOEIC) x 1/4

Example for a foreign language: Reading comprehension assessed by the active participation, Listening comprehension assessed by the active participation, Writing assessed by a 1-hour written examination, no document allowed, Test of English (TOEIC). Same weighted grades for each assessment.

Semestre 9

LIST OF TEACHING UNITS (UE) OF THE SEMESTER

TC, Spe ou Path-ways	Code UE	Entitled UE	ECTS
GP-EN	EC9CI	Engineering Culture S9	4
GP-EN	EC9PR	Design Project S9	4
GP-EN	EC9SI	Industrial Intership S9	4
EN-TEDDI	EE9IP	Generation, conversion and distribution of energy S9	8
EN-TEDDI	EE9IT	Rational use of energy S9	6
EN-TEDDI	EE9IG	Global approach to the world of energy S9	4
EN-SB	EE9BC	Building S9	7
EN-SB	EE9BS	Energetic systems	7
EN-SB	EE9BI	IoT	4
GP-PE	PT9ET	Treatment Processes S9	7
GP-PE	PT9EB	Biology and Pollution control S9	7
GP-PE	PT9EN	Industrial implementation S9	4
GP-CPAO	EP9OO	Conception S9	7
GP-CPAO	EP9MS	Modelling and Simulation S9	7
GP-CPAO	EP9OI	Industry 4.0 S9	4
GEII	EG9AP	Apprenticeship S9	6
GEII	EG9CI	Culture of the Engineer S9	6
GEII	EG9HT	High tension	8
GEII	EG9PP	Pulsed Power	6
GEII	EG9SP	Safety, protection and industrial processes	4

Tronc Commun GP et EN

3rd Year - Semester 9 - Commun Course EN+GP															
UE Name	Code		EC Name	Teachers	Hours (h)									ECTS / Coef.	
	UE	EC			Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj.	ECTS UE	Coef. EC
Engineering Culture S9	EC9CI	EC9CI1	Quality and Security Management	Ricarde M.	107	28	20	10	10	0	8	0	4	0.25
		EC9CI2	Communication	Naudy F.		22	14	8	6	0	8	4		0.20
		EC9CI3	Professional Insertion and occupational health	Thibaud J-C., Picard G.		19	13	6	7	0	6	0		0.15
		EC9CI4	Human Ressource Management	Fall A.		24	18	14	4	0	6	0		0.25
		EC9CI5	Costs evaluation in industrial processes	Rouch F.		14	8	4	4	0	6	6		0.15
Design Project S9	EC9PR	EC9PR1	Design Project	Kousksou T.	100	100	0	0	0	0	100	100	4	1.00
Industrial Intership S9	EC9SI	EC9SI1	Industrial Intership / Supported Personal Project	Kousksou T., Vaxelaire J.		0	0	0	0	0	0	0	4	1.00
Total TC					207		73	42	31	0	134	110	12	

TEACHING UNIT (UE) :

Engineering Culture S9

ECTS : 4

Code UE : EC9CI

SKILLS COVERED BY THE UE :

- Demonstrate the knowledge of fundamental principles of quality management: standards, audit, certification...
- Demonstrate the knowledge of the issues and methods of business safety management
- Demonstrate the ability to fit into an organization, to animate it and to develop it: project management, human resource management, financial management, business management and/or legal management
- Understand the basic methods concerning process economic assessment

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EC9CI1	Quality and Security Management	0.25	CC(EE, 2h, ca)
EC9CI2	Communication	0.2	CC(participation)x0.4 + EO(10 min)x0.6
EC9CI3	Professional Insertion and occupational health	0.15	Insertion professionnelle : CC(PA) Santé au travail : Proj (Sout)
EC9CI4	Human Ressource Management	0.25	CC(EE, 2h)
EC9CI5	Costs evaluation in industrial processes	0.15	CC(EE, 1h, da : cours, ca)x1/2 + Proj(Rap)x1/2

EC : Quality and Security Management		EC9CI1	coeff : 0.25
Teacher In Charge : Ricarde M.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Quality occupies a central importance in companies. This training aims at preparing the engineers for this dimension, whether it is for the managerial aspects or for the more technical aspects bound to the industrial world. This education leans on concrete examples of production units or industrial projects. This course also approaches the management system HSE. Educational platform https://elearn.univ-pau.fr

LEARNING OUTCOMES

The skills developed by this course allow engineers to become integrated into a service quality or to decline the quality approach in other services.

DESCRIPTION

- The quality management system.
- Continuous improvement
- Plan Do Check Act
- Bases of auditing and the auditing techniques of examining, questioning, evaluating and reporting.
- Quality Standards and certification. ISO 9000 et ISO9001

- Quality tools :
- Methodology : Pareto chart
- Cause-and-Effect Diagram The "Five Ws" (and one H) Traceability
- Effective brainstorming and meetings Technical and Statistical Process Control (SPC)
- Random inspection (MIL STD 105.D/NFX 06-022) Process capability & control chart
- Design of experiments (initiation)

- Management system HSE:
- Accident (rate of gravity and rate of frequency)
- The prevention and risk assessment
- The actors of safety

- Regulations
- Responsibility
- Dangerous substances and chemicals
- The HSE organization in a company

RECOMMENDED READING

Normes ISO9000 et ISO9001.
Formulaires et outils qualité AFNOR.
Appliquer la maîtrise statistique des procédés MSP-SPC, Maurice PILLET, Editions d'organisation.
Méthodes et outils pour résoudre un problème, Alain-Michel CHAUVEL, L'USINE NOUVELLE.
Qualité en production, Daniel DURET & Maurice PILLET, Editions d'organisation.

PREREQUISITE

None

ASSESSMENT

CC(EE, 2h, ca)

EC : Communication		EC9CI2	coeff : 0.2
Teacher In Charge : Naudy F.			
CM : 8 h	TD : 6 h	TP : 0 h	Proj : 4 h
			Language Français

OVERVIEW

This course aims to provide tools and methods to improve written and oral communication, to understand communication situations and to adapt to be more efficient in the professional context.

LEARNING OUTCOMES

- Have a good understanding and command of the basics in oral and written communication
- Effectively use the methods for preparing an oral presentation
- Be familiar with the tools used in debating with and convincing an audience
- Be familiar with the varios ways of facilitating a group of persons
- Be able to manage difficult discussions
- Design a personal development plan so as to reinforce one's ability to communicate and co-operate.

DESCRIPTION

1- The fundamentals of communication
- Theoretical models and references
- Verbal and non-verbal communication
- The stakes of interpersonal oral communication

2- Self-knowledge and building a professional image
- Behavioural competencies (soft skills)
- Cv
- Covering letter

3- Communication and personality type
- Needs and motivation

- Process Communication
- Facilitating elements of the relationship

4- Professional Writing and Oral Presentations
- Writing emails, giving presentations
- Presentations in limited time (introducing yourself, pitching)
- Professional presentation

5- Communication and Collective Moments
- Group facilitation and active listening
- Negotiation
- Conflict Management

RECOMMENDED READING

Watzlawick Paul Une logique de communication
Damasio Antonio Looking for Spinoza: Joy, Sorrow and The Feeling Brain Kourilsky Françoise Du désir au plaisir de changer
Rosenberg M. T. Non-violent Communication: A Language of Life Audebert Patrick Bien négocier
Morel Christian Les décisions absurdes, tomes 1 et 2

PREREQUISITE

Personal reflection upon one's own communication practices

ASSESSMENT

CC(participation)x0.4 + EO(10 min)x0.6

EC : Professional Insertion and occupational health		EC9CI3	coeff : 0.15
Teacher In Charge : Thibaud J-C., Picard G.			
CM : 6 h	TD : 7 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

LEARNING OUTCOMES

PROFESSIONAL INSERTION:

Be able to understand and use all the tools used for recruitment and be prepared for the interview.

OCCUPATIONAL HEALTH:

To know the different aspects of occupational health

Know how to identify and understand the role of the different players in occupational health in the company.

To integrate benchmarks on the analysis of work situations.

Learn to integrate real working conditions into the conduct of projects.

CONTENT

PROFESSIONAL INSERTION:

- the 2.0 resume, the tools (Job Board, CV Video, social media)
- the recruitment interview : success or disaster

OCCUPATIONAL HEALTH:

Develop skills in the analysis of work situations

Develop knowledge on the physical and cognitive dimensions of work Develop knowledge on the ”ills” of work (MSD, RPS.)

Develop knowledge on the actors of health at work (internal and external) Study of a concrete case of project management integrating working conditions

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

Insertion professionnelle : CC(PA) Santé au travail : Proj (Sout)

EC : Human Ressource Management		EC9CI4	coeff : 0.25
Teacher In Charge : Fall A.			
CM : 14 h	TD : 4 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

This course is an introduction to Human Resource Management (HRM). The aim of this lecture is to teach students the key concepts and techniques required for decision making in this area.

LEARNING OUTCOMES

- Master the tools for the development of management for jobs and skills
- Know the steps of recruitment and optimization tools
- Know the different devices for professional training.
- Being able to have critical look at the remuneration system of a company
- Master the tools of individual evaluation
- Know the characteristics of teams and Management
- Being able to analyze an HR policy and taking measures of adjustment required

DESCRIPTION

General Introduction to HRM
Chapter 1 : Personnel Administration
Chapter 2 : Recruitment - process optimization
Chapter 3: Profesional training
Chapter 4: Pay systems
Chapter 5: Individual evaluating
Chapter 6: GPEC
Chapter 7: Team management

RECOMMENDED READING

- Encyclopédie des Ressources Humaines, sous la direction de José Allouche, Vuibert, 2006
- Fonction RH, Thévenet et ali., Pearson, 3ieme édition, 2012

- Gestion des ressources humaines, de Jean-Marie Peretti, Vuibert, 2007
- Organisation et gestion de l'entreprise, de Richard Soparnot, Dunod, 2006

PREREQUISITE

ASSESSMENT

CC(EE, 2h)

EC : Costs evaluation in industrial processes		EC9CI5	coeff : 0.15
Teacher In Charge : Rouch F.			
CM : 4 h	TD : 4 h	TP : 0 h	Proj : 6 h
			Language Français

OVERVIEW

The goal of this course is to present evaluation of methods of investments and process operating costs. This theoretical education is completed by feedback from industrial partners.

LEARNING OUTCOMES

- To know the basic methods of economic evaluation of processes.
- To be able to carry out the economic evaluation of a process.

DESCRIPTION

Chapter 1: Elements of economic calculation
- Study of the profitability of projects: Taxes and duties; Profitability criteria
- Operating cost and cost price: Definition and breakdown of the operating cost / cost price
- Investments: The various investment charges
- Labour costs

Chapter 2: Investments at the limits of the manufacturing units (ILUF)
- UBLI: average structure, evaluation and estimation
- Accuracy of investment calculation methods
- Adaptation of investment data

Chapter 3: Investment calculation methods
- Exponential (global) methods
- Factorial methods
- Pre-estimated IFP method: examples

RECOMMENDED READING

Manuel d'évaluation économique des procédés, A. Chauvel et al - Technip Cost Engineering Analysis, W.R. Park, D.E. Jackson - John Wiley & Sons

Plant Design and Economics for Chemical Engineers, Peters, Timmerhaus - Mc Graw Hill

PREREQUISITE

ASSESSMENT

CC(EE, 1h, da : cours, ca)x1/2 + Proj(Rap)x1/2

TEACHING UNIT (UE) :

Design Project S9

ECTS : 4

Code UE : EC9PR

SKILLS COVERED BY THE UE :

Demonstrate the ability to master at the same time all the previously acquired skills:

- scientific skills,
- work in teams,
- project management,
- English, technique and communication

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EC9PR1	Design Project	1	Proj(rap, sout)x1/4 + Proj(rap, sout)x3/4

EC : Design Project		EC9PR1	coeff : 1
Teacher In Charge : Kousksou T.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 100 h
			Language Français

OVERVIEW

This project, completed in a team from 3 to 5 students, consists in designing and in sizing an industrial installation.

LEARNING OUTCOMES

Demonstrate his(her) capacity to master simultaneously all the previously acquired skills in ENSGTI : scientific skills, teamwork, project management, technical English and communication.

DESCRIPTION

- Mass balance
- Energy balance
- Sizing of 3 or 4 unit operations or systems
- Safety research
- Process control research
- Economic research
- Environmental research
- Energy optimisation

RECOMMENDED READING

PREREQUISITE

First and second year at the ENSGTI

ASSESSMENT

Proj(rap, sout)x1/4 + Proj(rap, sout)x3/4

TEACHING UNIT (UE) :

Industrial Intership S9

ECTS : 4

Code UE : EC9SI

SKILLS COVERED BY THE UE :

- Apply acquired scientific skills in a professional environment.
- Acquire new scientific and technical skills.
- Demonstrate the ability to communicate results in all media.
- Develop interpersonal skills (demonstrate ability to work in a team).
- Develop cognitive skills (organise work, transfer scientific and technical knowledge).
- Demonstrate knowledge of occupational health and safety management.
- Demonstrate knowledge of Corporate Governance and Ethics management.

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EC9SI1	Industrial Intership / Supported Personal Project	1	Sta(Tr, Rap, Sout)

EC : Industrial Intership / Supported Personal Project		EC9SI1	coeff : 1
Teacher In Charge : Kousksou T., Vaxelaire J.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Internship in a company of 2 to 4 months, with engineering missions or Supervised Individual Project.

LEARNING OUTCOMES

- Apply acquired scientific skills in a professional environment.
- Acquire new scientific and technical skills.
- Demonstrate the ability to communicate results in all media.
- Develop interpersonal skills (demonstrate ability to work in a team).
- Develop cognitive skills (organise work, transfer scientific and technical knowledge).
- Demonstrate knowledge of occupational health and safety management.
- Demonstrate knowledge of Corporate Governance and Ethics management.

DESCRIPTION

The engineering internship must allow the student to
- consolidate and mobilise the knowledge acquired during the first two years of the engineering cycle
- to complete their training thanks to a real-life situation
- to analyse the adequacy between his professional project and the nature of the training course
- to be able to give an account of the work accomplished and the results obtained
- to evaluate oneself in terms of skills (personal assessment at the end of the course)
- to acquire knowledge in terms of safety and health at work
- to acquire knowledge in terms of Governance and management of the company's ethics.

Specific items to be developed during the engineering course

1. Occupational Health and Safety (OHS)

- Understand the issues (human, social, economic and legal) of occupational health and safety.
- Specify the classification of the industrial site in the regulatory sense (site subject to declaration, registration, authorisation, SEVESO site). Why this classification by the State services?
- To observe safety in the company
- Define the indicators (frequency rate, severity rate, work accident contribution rate, etc.). Do specific indicators exist for subcontracting?
- Identify the sources of available information (single document, occupational medicine, etc.).
- Define the organisation of feedback.
- The accident declaration (first aid, accident without/with work stoppage). Who does what?
- Accident analysis (collection of facts, accident analysis, accident analysis method - e.g. construction of a Cause Tree). Describe the organisation of these accident analysis procedures.
- Communication actions on safety ? Existence of a bulletin for general distribution, such as ”safety flash”, ”accident flash”.
- Know the organisation set up to manage a crisis situation: I.O.P. (Internal Operation Plan), I.P.P. (Particular Intervention Plan), etc.; identify the players.
- Indicate some preventive actions planned in the company
- Indicate the safety training of personnel and subcontractors planned.

Personal analysis: the student must indicate the repercussions of the safety constraints on his work station in the broad sense.

2. Governance and Management of the company's ethics. Governance of the company: Organisation of governance

Presentation of the company

- What is the status of the company (SA, SARL, subsidiary...)?
- Present the company's organisation chart.
- Explain the roles and responsibilities of the main departments in this governance.
- What are the company's strategic axes?
- What are the values promoted by the company (ethics, integrity, innovation, customer satisfaction, etc.)?
- What are the links between the governance of the company and the team (department) in which the internship takes place?

Ethics in business

The student-engineer will observe the behaviour of the company in relation to its economic partners

The student engineer will observe the company's behaviour in relation to its economic partners, study the company's values, the fight against fraud and corruption, compliance with rules and regulations, the fight against harassment and discrimination...

Personal analysis: for example, how governance has impacted the internship and/or give his/her opinion on governance.

The student must present the two compulsory items in his/her placement report (approximately 2 pages per item), firstly in a general way, and then he/she will develop his/her own analysis on the subjects.

RECOMMENDED READING

Référentiel BES&ST : Bases Essentielles en Santé et Sécurité au Travail

PREREQUISITE

ASSESSMENT

Sta(Tr, Rap, Sout)

SPECIALITY Energy - Pathways TEDDI

Energy Transition and Sustainable Development in Industry (TEDDI)

UE Name	Code		EC Name	Teachers	Hours (h)								ECTS / Coef.	
	UE	EC			Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj.	ECTS UE	Coef. EC
Generation, conversion and distribution of energy S9	EE9IP	EE9IP1	Nuclear energy	DOUCET S., POIXBLANC N.	225	54	**36**	*32*	*4*	***0***	18	*0*	8	0.24
		EE9IP2	Carbon Energy	DUCOUSSO M.		24	**16**	*8*	*8*	***0***	8	*0*		0.10
		EE9IP3	Renewable Energy I: Solar	GIBOUT S., MASSIP G., SERRA S.		52	**26**	*12*	*14*	***0***	26	*18*		0.23
		EE9IP4	Renewable energy II: Marine and wind	CHABANAS. C, LARA CRUZ J.		18	**12**	*8*	*4*	***0***	6	*0*		0.08
		EE9IP5	Renewable energy III: Developing technologies	Porfirio J., MARIAS F., CHABAB S., Rahain W., Lalanne L.		33	**22**	*14*	*8*	***0***	11	*0*		0.14
		EE9IP6	Energetic networks	ALBERDI G., RICAUD X. FONT-SALLES O., CONQUES F.		44	**20**	*12*	*8*	***0***	24	*12*		0.21
Rational use of energy S9	EE9IT	EE9IT1	Energy audits	BARBE L.	177	60	**30**	*30*	*0*	***0***	30	*10*	6	0.34
		EE9IT2	Energy efficiency	GUELLIL M., SOCHARD S.		48	**28**	*14*	*14*	***0***	20	*20*		0.27
		EE9IT3	Energy storage	BEDCARRATS J.–P.		16	**8**	*8*	*0*	***0***	8	*0*		0.09
		EE9IT4	Advanced physics modeling	CHABAB S., MANCEAU R.		53	**28**	*22*	*6*	***0***	25	*25*		0.30
Global approach to the world of energy S9	EE9IG	EE9IG1	Geopolitical situation and world panorama	GUERITTE C.	120	30	**20**	*20*	*0*	***0***	10	*0*	4	0.25
		EE9IG2	Business model and project financing	Latour S.		20	**10**	*2*	*8*	***0***	10	*14*		0.17
		EE9IG3	Energy legislation	De Fontenelle L., Drouiller C.		30	**12**	*12*	*0*	***0***	18	*0*		0.25
		EE9IG4	Energy economics	LE CACHEUX J., Guellil M.		40	**16**	*16*	*0*	***0***	24	*0*		0.33
Total Parcours					**402**		**226**	160	66	0	**176**	85	**14**	
Total TC + Parcours					**609**		**299**						**26**	

TEACHING UNIT (UE) :

Generation, conversion and distribution of energy S9

ECTS : 8

Code UE : EE9IP

SKILLS COVERED BY THE UE :

- Mastery of all energy production channels
- Mastery of energy vectors and energy operators and delivery methods
- Know-how in terms of dimensioning and operating modes

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EE9IP1	Nuclear energy	0.24	CC (EE, 2h, sd) *0.5 + CC (EE, 2h, sd) *0.5
EE9IP2	Carbon Energy	0.1	CC (EE, 1h, sd) x 0.5 + CC (EE, 1h, sd) x 0.5
EE9IP3	Renewable Energy I: Solar	0.23	CC (EE, 1h, sd) x 0.8 + CC (EE, 1h, sd, ca) x 0.2
EE9IP4	Renewable energy II: Marine and wind	0.08	CC (EE, 1h, sd) x 0.5 + CC (EE, 1h, sd) x 0.5
EE9IP5	Renewable energy III: Developing technologies	0.14	CC (EE, 1h, sd) x 0.4 + CC (EE, 1h, sd) x 0.3 + CC (EE, 1h, sd) x 0.3
EE9IP6	Energetic networks	0.21	CC (EE, 1h, sd) x 0.5 + Proj (rap) x 0.5

EC : Nuclear energy		EE9IP1	coeff : 0.24
Teacher In Charge : DOUCET S., POIXBLANC N.			
CM : 32 h	TD : 4 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The aim of this lecture is to present the basic principles of pressurized water reactor (PWR) and their intrinsic parameters. Fundamentals of nuclear security are also given.

LEARNING OUTCOMES

- Be able to describe how works a PWR.
- Be able to identify and describe the influence of each parameter.
- Be aware of nuclear security.
- Be able to analyze a nuclear accident

DESCRIPTION

Hazards and safety

1. Forewords
2. Radioprotection
3. Nuclear safety
4. Reporting a safety analysis
5. Impact during normal and incidental behavior
6. Case study

Reactors

7. Introduction : nuclear electricity.
8. Principles of a PWR
9. Nuclear physics
10. Interactions between primary and secondary coolants
11. Safety
12. Radiological protection
13. Nuclear accidents
14. Three Mile Island

15. Tchernobyl
16. Fukushima

RECOMMENDED READING

PREREQUISITE

Thermodynamique des cycles combinés, Transferts thermiques

ASSESSMENT

CC (EE, 2h, sd) *0.5 + CC (EE, 2h, sd) *0.5

EC : Carbon Energy		EE9IP2	coeff : 0.1
Teacher In Charge : DUCOUSSO M.			
CM : 8 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Anglais

OVERVIEW

The aim of this lecture is to present the basic principles of main power plants based on fossil energy, be it oil & gas or coal.

LEARNING OUTCOMES

- Be able to describe how works and to operate a themal power plant.
- Be able to identify and describe the influence of each parameter.

DESCRIPTION

- Context and challenges to produce electricity from thermal power plants
- Boiler cycle
- Gas turbine
- Combined cycles power station

RECOMMENDED READING

R. Gicquel, Systèmes énergétiques, Tomes 1 et 2, Paris : Presse de l'Ecole des Mines, 2009, 372 p et 378 p

J. H. Horlock, Advance gas turbine cycles, Elsevier Sciences, 2003, 230 p

PREREQUISITE

Cours de : Combustion industrielle (2A), Thermodynamique des cycles (2A)

ASSESSMENT

CC (EE, 1h, sd) x 0.5 + CC (EE, 1h, sd) x 0.5

EC : Renewable Energy I: Solar		EE9IP3	coeff : 0.23
Teacher In Charge : GIBOUT S., MASSIP G., SERRA S.			
CM : 12 h	TD : 14 h	TP : 0 h	Proj : 18 h
			Language Français

OVERVIEW

The aim of this lecture is to present the basic principles of solar renewable energy.

LEARNING OUTCOMES

- Be able to describe and distinguish the various solar energies.
- To be able to estimate the solar resource.
- Be able to develop and operate solar power plants.

DESCRIPTION

Solar potential

1. Forewords
2. Solar irradiation on the earth
3. Solar irradiation on the ground and interactions with atmosphere

Thermal solar

1. Introduction
2. Various captors
3. Heat and/or electricity production

PV

1. Electricity recalls
2. Photo-electrical conversion
3. Power plant (receptors, inverters. . .)

RECOMMENDED READING

PREREQUISITE

Thermodynamique, Transferts thermiques, Électricité

ASSESSMENT

CC (EE, 1h, sd) x 0.8 + CC (EE, 1h, sd, ca) x 0.2

EC : Renewable energy II: Marine and wind		EE9IP4	coeff : 0.08
Teacher In Charge : CHABANAS. C, LARA CRUZ J.			
CM : 8 h	TD : 4 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The purpose of this course is to introduce students to the specifics of renewable energy based on marine, hydro and wind resources.

LEARNING OUTCOMES

- Be able to describe and distinguish the various marine and wind energies.
- Know how to convert kinetic energy into electricity.
- Be able to develop and operate marine and wind power plants

DESCRIPTION

Marine & Hydro power

1. Force-vitesse trade-off
2. Hydro-electricity
3. Hydropower
4. Wave energy
5. Marine thermal energy
6. Tidal power

Wind power

1. Measurement and statistical representation of the wind resource
2. Principle of production estimation
3. Wind energy and recoverable part (Betz theory)
4. Wind turbine technology

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC (EE, 1h, sd) x 0.5 + CC (EE, 1h, sd) x 0.5

EC : Renewable energy III: Developing technologies		EE9IP5	coeff : 0.14
Teacher In Charge : Porfirio J., MARIAS F., CHABAB S., Rahain W., Lalanne L.			
CM : 14 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The aim of this lecture is to present the basic principles of developing and under-development renewable technologies.

LEARNING OUTCOMES

- Be able to describe and distinguish the future renewable technologies and the technological and/or economic leaps necessary for their development
- To know the various technological aspects of the development of these sectors.
- To master the physical bases of each sector

DESCRIPTION

Hydrogen
1. How to better know hydrogen
2. Energy storage
3. Fuel-cells
4. Fields of application

Geothermal energy 1. Context
2. Introduction
3. Applications
4. Case studies

Bio-energy
1. Introduction
2. Bio-combustibles
3. Bio-gases
4. Bio-fuels

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC (EE, 1h, sd) x 0.4 + CC (EE, 1h, sd) x 0.3 + CC (EE, 1h, sd) x 0.3

EC : Energetic networks		EE9IP6	coeff : 0.21
Teacher In Charge : ALBERDI G., RICAUD X. FONT-SALLES O., CONQUES F., PERRIN G.			
CM : 12 h	TD : 8 h	TP : 0 h	Proj : 12 h
			Language Français

OVERVIEW

The objective of this course is to introduce students to the various types of energy transmission networks, and the associated techniques and management methods in production.

LEARNING OUTCOMES

- Be able to describe the various energy networks.
- Master the concepts associated with their daily use.

DESCRIPTION

1. The electricity networks

1.1 Electricity production
1.2 Transport of electricity
1.3 Distribution
1.4 Concession regimes
1.5 Smart-grids

2. Gas networks

2.1 Generalities
2.2 The gas chain
2.3 The natural gas market

3. Heating and cooling networks

3.1 Introduction
3.2 Components of a DHC network

RECOMMENDED READING

PREREQUISITE

Thermodynamique des cycles combinés, Transferts thermiques

ASSESSMENT

CC (EE, 1h, sd) x 0.5 + Proj (rap) x 0.5

TEACHING UNIT (UE) :

Rational use of energy S9

ECTS : 6

Code UE : EE9IT

SKILLS COVERED BY THE UE :

- Mastering the global energy situation and the associated stakeholders
- Mastering the various socio-economical and political features of energy market
- Mastering energy consumption
- Mastering the overall impact of new projects

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EE9IT1	Energy audits	0.34	CC (EE, 1h, sd) x 0.5 + CC (EE, 1h, sd) x 0.5
EE9IT2	Energy efficiency	0.27	Proj (PA) x 0.5 + Proj (Rap) x 0.5
EE9IT3	Energy storage	0.09	CC (EE,2h, da:cours et TD, ca)
EE9IT4	Advanced physics modeling	0.3	CC (EE, 1h30min, da:tous, ca) x 0.25 + Proj (Rap) x 0.75

EC : Energy audits		EE9IT1	coeff : 0.34
Teacher In Charge : BARBE L.			
CM : 30 h	TD : 0 h	TP : 0 h	Proj : 10 h
			Language Français

OVERVIEW

L'objectif de ce cours est d'aborder les différentes méthodes de réalisation d'un audit énergétique, puis de proposer des sources d'économie en analysant le fonctionnement de certains appareils.

LEARNING OUTCOMES

- Be able to realize an electrical energy balance
- Be able to realize an thermal energy balance
- Master the different ways to save energy.

DESCRIPTION

1. Introduction

2. Basic notions

a. Ratios
b. Pricings
c. Methodology

3. Measurements tools

4. Potential energy savings

a. Heating and hot water production (DHW)
b. Lighting, air treatment
c. Cold production and air conditioning

5. Use of renewable energy

RECOMMENDED READING

Mémotech Génie Energétique

Guides techniques ADEME

PREREQUISITE

ASSESSMENT

CC (EE, 1h, sd) x 0.5 + CC (EE, 1h, sd) x 0.5

EC : Energy efficiency		EE9IT2	coeff : 0.27
Teacher In Charge : GUELLIL M., SOCHARD S.			
CM : 14 h	TD : 14 h	TP : 0 h	Proj : 20 h
			Language Fr/En

OVERVIEW

The objective of this course is to approach energy efficiency, whose goal is to produce as much or more while consuming less. This makes it possible to combine the imperatives of industrial and economic development with criteria of respect for the environment and reduction of consumption.

LEARNING OUTCOMES

- To know and control energy flows.
- Know how to conduct studies integrating the notions of efficiency.

DESCRIPTION

1. The challenges of energy efficiency

2. Energy efficiency in energy production

a. Fuels
b. Electricity production
c. Heat production

3. Management and management of industrial projects

4. Pinch analysis

RECOMMENDED READING

Mémotech Génie Energétique
Guides techniques ADEME

PREREQUISITE

ASSESSMENT

Proj (PA) x 0.5 + Proj (Rap) x 0.5

EC : Energy storage		EE9IT3	coeff : 0.09
Teacher In Charge : BEDCARRATS J.–P.			
CM : 8 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Anglais

OVERVIEW

Energy Storage (ES) systems can play an important role, as they provide great potential for facilitating energy savings and reducing environmental impact. ES appears to provide one of the most advantageous solutions for correcting the mismatch that often occurs between the supply and demand of energy. The objective of this course is to summarize and explain the most important basics and applications of energy storage.

LEARNING OUTCOMES

- Know how to store energy.
- Know how to design and manage electricity storage.
- Know how to design and manage heat and cold storage.
- Know how to design and manage carbon capture and storage.

DESCRIPTION

1. Introduction

2. Energy demand

3. Energy storage methods

a. Mechanical storage
b. Chemical storage
c. Magnetic storage
d. Thermal energy storage (TES)

4. Hydrogen for energy storage

a. Characteristics of hydrogen
b. Hydrogen storage technologies

c. Hydrogen production

5. Comparison of storage technologies

6. Carbon capture and storage (CCS)

RECOMMENDED READING

Thermal Energy Storage : Systems and Applications. Ibrahim Dincer, Marc Rosen. Wiley, 2002.
Stockage par chaleur latente. Jean-Pierre Dumas. Techniques de l'Ingénieur BE9-7751-22, 2002.
Heat and cold storage with PCM. An up to date introduction into basics and applications.
Harald Mehling. Luisa F. Cabeza. Series: Heat and Mass Transfer. Springer, 2008.

PREREQUISITE

ASSESSMENT

CC (EE,2h, da:cours et TD, ca)

EC : Advanced physics modeling		EE9IT4	coeff : 0.3
Teacher In Charge : CHABAB S., MANCEAU R.			
CM : 22 h	TD : 6 h	TP : 0 h	Proj : 25 h
			Language Anglais

OVERVIEW

This lecture gives additional theoretical backgrounds to deal with complex systems.

LEARNING OUTCOMES

- Be able to design every kind of system.
- Be able to optimize a given system.

DESCRIPTION

1. Gas turbines

a. Types of gas turbines
b. Principles
c. Design
d. Trials and certification

2. Turbulence modeling

a. CFD recalls
b. RANS
c. LES, URANS and hybrid RANS/LES

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC (EE, 1h30min, da:tous, ca) x 0.25 + Proj (Rap) x 0.75

TEACHING UNIT (UE) :

Global approach to the world of energy S9

ECTS : 4

Code UE : EE9IG

SKILLS COVERED BY THE UE :

- Develop a multifactorial and broad vision of the energy world
- Know how to apprehend energy problems with a cross-disciplinary approach
- Learn to communicate and work on cross-cutting themes

Accessible to students of the EN speciality: TEDDI

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EE9IG1	Geopolitical situation and world panorama	0.25	CC (EE, 1h30, da, ca)
EE9IG2	Business model and project financing	0.17	Proj (Rap)
EE9IG3	Energy legislation	0.25	CC (EE, 1h)
EE9IG4	Energy economics	0.33	CC(EE, 30 min, da)x0.5 + CC (EE, 30 min, sd)x0.5

EC : Geopolitical situation and world panorama		EE9IG1	coeff : 0.25
Teacher In Charge : GUERITTE C.			
CM : 20 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The aim of this course is to provide a global inventory of the state of forces and presences at play in the current energy world. A particular focus is put on the origin and the methods of exploitation of the main resources.

LEARNING OUTCOMES

- Be able to locate and quote the major centres and the main routes.
- Master the triptych of economic/societal/social notions.
- Know and anticipate the future evolution of energy needs and their impact on the economy, lifestyles and the planet
- Know how to articulate sustainable development approaches with economic and political constraints, both at local and national level.
- Know how to research, investigate, respect and anticipate standards and regulations.

DESCRIPTION

1. Energy and climate

Elements of context
Financing and regulation

2. The agenda

3. Fossil fuels

Definition
Origin and world distribution
Uses in the industrial chain
Issues

4. Renewable energies

Definition
Types and technologies
Development potential
Issues

5. Energy economics

Energy from an economic perspective
The current situation and future prospects
Financing sustainable development

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC (EE, 1h30, da, ca)

EC : Business model and project financing		EE9IG2	coeff : 0.17
Teacher In Charge : Latour S.			
CM : 2 h	TD : 8 h	TP : 0 h	Proj : 14 h
			Language Français

OVERVIEW

The purpose of this course is to learn how to put together presentation and business plan in order to demonstrate the economic and financial feasibility of a project.

LEARNING OUTCOMES

- Be able to design a business model.
- Be able to estimate and improve the profitability of a project.

DESCRIPTION

1. Construction of the business plan

a. Productible
b. Fixed and variable costs
c. Taxes and duties
d. Income

2. Micro-economic indicator

a. NPV, IRR, discount rate
b. The raising of debt financing
c. Vitality and sustainability of a project

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

Proj (Rap)

EC : Energy legislation		EE9IG3	coeff : 0.25
Teacher In Charge : De Fontenelle L., Drouiller C.			
CM : 12 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The purpose of this course is to learn the legal basis and competent authorities in the field of energy law.

LEARNING OUTCOMES

- Know the general organisation of the judicial authority.
- Be able to find a legislative text.
- Be able to understand judicial decisions.

DESCRIPTION

1. Introduction
2. The organisation of law and justice
3. Energy code
4. Origins of the law and sources
5. Judicial decisions

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC (EE, 1h)

EC : Energy economics		EE9IG4	coeff : 0.33
Teacher In Charge : LE CACHEUX J., Guellil M.			
CM : 16 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The purpose of this course is to learn about the functioning and context of the energy market.

LEARNING OUTCOMES

- Know the basics of energy economics.
- Be able to understand the economic context (type of competition, organisational role of the public authorities, etc.).
- Be able to understand the business models.
- Be able to understand the evolution of the energy market.

DESCRIPTION

1. Introduction
2. Basic economics and econometrics
3. Actors
4. The issues

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC(EE, 30 min, da)x0.5 + CC (EE, 30 min, sd)x0.5

SPECIALITY Energy - Pathways SB

3rd Year - Semester 9 - EN															
Smart Building (SB)															
UE Name	**Code**		**EC Name**	**Teachers**	**Hours (h)**									**ECTS / Coef.**	
	UE	**EC**			**Tot UE**	Tot EC	Tot Prés.	*CM*	*TD*	*TP*	*TA*	*Proj.*	**ECTS UE**	Coef. EC
Building S9	**EE9BC**	EE9BC1	Building technology	Garnesson T. ; S. Gibout, PEREVOZCHIKOV I.	**206**	52	**30**	*22*	*8*	***0***	22	*0*	**7**	0.25
		EE9BC2	Comfort	C. HORT, LARRIEU B., L. ZALEWSKI		62	**38**	*22*	*16*	***0***	24	*0*		0.31
		EE9BC3	Energetic	B. DELFORGES		92	**32**	*24*	*8*	***0***	60	*56*		0.44
Energetic systems	**EE9BS**	EE9BS1	Fluidics	N. CHARTRAIN	**210**	100	**40**	*20*	*20*	***0***	60	*60*	**7**	0.48
		EE9BS2	renewable and recovery energies 1 : solar energy	S. GIBOUT, R. SUBILEAU		68	**32**	*16*	*16*	***0***	36	*48*		0.32
		EE9BS3	renewable and recovery energies 2 : Biomass and	J.-P. BEDECARRATS, Marias F.		42	**18**	*12*	*6*	***0***	24	*0*		0.20
IoT	**EE9BI**	EE9BI1	Machine learning for energy	W. Maréchal, Philippe Cotte, Matteo Rizzato	**120**	46	**34**	*18*	*16*	***0***	12	*24*	**4**	0.38
		EE9BI2	Material design	C. PHAM, C. ARRABIE, S. GIBOUT		40	**20**	*12*	*8*	***0***	20	*20*		0.34
		EE9BI3	Software design	C. ARRABIE, S. GIBOUT		34	**16**	*8*	*8*	***0***	18	*28*		0.28
Total Parcours					**536**	**536**	**260**	**154**	**106**	**0**	**276**	**236**	**18**	
Total TC + Parcours					**743**		**333**						**30**	

TEACHING UNIT (UE) :

Building S9

ECTS : 7

Code UE : EE9BC

SKILLS COVERED BY THE UE :

- know the specific technical vocabulary in building field ;
- predict and understand the thermal behaviour of buildings ;
- Evaluate the performances of building and propose relevant remediation action

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EE9BC1	Building technology	0.25	CC (EE, 2h, sd, ca)
EE9BC2	Comfort	0.31	CC(2h,EE)*3/4 + CC(1h,EE)*1/8 + CC(1h,EE)*1/8
EE9BC3	Energetic	0.44	CC (EE, 1h, sd) x 1/2 + Proj(Rap,) x 1/2

EC : Building technology		EE9BC1	coeff : 0.25
Teacher In Charge : Garnesson T. ; S. Gibout, PEREVOZCHIKOV I.			
CM : 22 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The objective of this module is to provide students with the knowledge and basic vocabulary in the field of construction. Digital mock-ups (BIM) will be discussed.
It also includes an introduction to Building Management Systems.

LEARNING OUTCOMES

At the end of this module, students must be able to :

- Identify the different professions involved in the construction
- Know the different materials and their application areas
- Read and understand a plan
- Identify - from drawings or on site - the different singular points which can have an impact on thermal performance.
- To know the functionalities and uses of BMS/BMS systems.

DESCRIPTION

- Construction materials and use
- Construction Technology
- Reading of Plan
- Singular points: infiltration and thermal bridging
- Digital mock-ups and BIM
- On site visits (if possible,)
- BMS / BMS systems

RECOMMENDED READING

Building thermics course

PREREQUISITE

ASSESSMENT

CC (EE, 2h, sd, ca)

EC : Comfort		EE9BC2	coeff : 0.31
Teacher In Charge : C. HORT, LARRIEU B., L. ZALEWSKI			
CM : 22 h	TD : 16 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The primary role of a building is to create an ”inner space” in order to ensure a level of comfort for users. In the building sector, we first think of hydrothermal comfort, but one must also take into account the indoor air quality and lighting.

LEARNING OUTCOMES

At the end of this module, students should be able to:

- identify constraints comforts specific use
- evaluate the performance of a local with respect to these constraints
- identify ways to implement to achieve this goal

DESCRIPTION

• Air quality
• Thermal confort
• Ligthing

RECOMMENDED READING

PREREQUISITE

Building Heating, Air Treatment

ASSESSMENT

CC(2h,EE)*3/4 + CC(1h,EE)*1/8 + CC(1h,EE)*1/8

EC : Energetic		EE9BC3	coeff : 0.44
Teacher In Charge : B. DELFORGES			
CM : 24 h	TD : 8 h	TP : 0 h	Proj : 56 h
			Language Français

OVERVIEW
This module brings together in a coherent approach the tools for predicting and analysing the thermal behaviour of a building and the tools.

LEARNING OUTCOMES

- Understand the physical laws specific to the building industry
- Know how to use a STD software
- To analyse the results of STD and to identify the tracks of improvement
- Know how to carry out a regulatory study
- Master the Pleiades tool

DESCRIPTION
- Thermal regulations (RT)
- Dynamic Thermal Simulation
- Energy audit in the building

RECOMMENDED READING

PREREQUISITE
Building heating, Air treatment, Heat transfer

ASSESSMENT
CC (EE, 1h, sd) x 1/2 + Proj(Rap,) x 1/2

TEACHING UNIT (UE) :

Energetic systems

ECTS : 7

Code UE : EE9BS

SKILLS COVERED BY THE UE :

- To know the thermal equipment allowing to maintain the chosen level of comfort
- Know how to size the fluid networks
- Know how to size renewable production systems

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EE9BS1	Fluidics	0.48	Proj(Rap)
EE9BS2	renewable and recovery energies 1 : solar energy	0.32	CC (EE, 2h, sd) * 1/3 + Proj (Rap) x 2/3
EE9BS3	renewable and recovery energies 2 : Biomass and storage	0.2	CC (EE,2h, da:cours et TD, ca)x2/3+CC (EE, 1h, sd)x1/3

EC : Fluidics		EE9BS1	coeff : 0.48
Teacher In Charge : N. CHARTRAIN			
CM : 20 h	TD : 20 h	TP : 0 h	Proj : 60 h
			Language Français

OVERVIEW

Conception et dimensionnement des installations de ventilation, chauffage, climatisation et plomberie

LEARNING OUTCOMES

- Know how to dimension a complete installation
- Evaluate and select the different technological options
- Write calculation notes

DESCRIPTION

- Introduction : Ventilation

- Single/double flow ventilation

o Air handling unit
o Extraction and diffusion
o Fire protection Heating and air conditioning

- Reminders RT2012

o Heat and climate balances
o Types of emitters
o Distribution Network (Pressure Losses, Insulation, etc.)
o Heat and cooling production
o Typical installation diagrams

- Plumbing - Hot water

o Definition of requirements
o Types of production
o Typical installation diagrams

RECOMMENDED READING
Mémotech Génie Énergétique

PREREQUISITE
Thermique du bâtiment, traitement de l'air, Thermodynamique appliquée, réseaux fluides

ASSESSMENT
Proj(Rap)

EC : renewable and recovery energies 1 : solar energy		EE9BS2	coeff : 0.32
Teacher In Charge : S. GIBOUT, R. SUBILEAU			
CM : 16 h	TD : 16 h	TP : 0 h	Proj : 48 h
			Language Fr/En

OVERVIEW

This course deals with the different facets of solar energy, starting from the resource and focusing on the two conversion processes adapted to buildings: Solar thermal and photovoltaic.

LEARNING OUTCOMES

- Estimate the solar resource in a given location
- Know how to size thermal production equipment (individual / collective)
- Understand the principles of photovoltaic conversion
- Know how to size a photovoltaic production system and know the associated regulatory framework.

DESCRIPTION

1. Estimation of the solar resource
2. Thermal conversion
3. Photovoltaic conversion

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC (EE, 2h, sd) * 1/3 + Proj (Rap) x 2/3

EC : renewable and recovery energies 2 : Biomass and storage		EE9BS3	coeff : 0.2
Teacher In Charge : J.-P. BEDECARRATS, Marias F.			
CM : 12 h	TD : 6 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

This course is divided into two distinct parts concerning respectively the energy use of biomass (mainly combustion) and the problem of energy storage.

LEARNING OUTCOMES

- To be familiar with electricity storage facilities.
- Know the cold and heat storage facilities.
- Know the main energy uses of biomass.

DESCRIPTION

1. Thermal energy storage technologies (sensible, latent, chemical)
2. Electrical energy storage technologies
3. Biomass and energy recovery

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC (EE,2h, da:cours et TD, ca)x2/3+CC (EE, 1h, sd)x1/3

TEACHING UNIT (UE) :

IoT

ECTS : 4

Code UE : EE9BI

SKILLS COVERED BY THE UE :

- To know the new approaches in the analysis and intelligent control of buildings
- Know how to design and implement connected sensors

Accessible to students of the EN speciality: SB

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EE9BI1	Machine learning for energy	0.38	CC (EE, 1h, sd) * 1/3 + Proj(Rap) * 2/3
EE9BI2	Material design	0.34	CC (EE, 1h, sd) * 1/3 + Proj (Rap) x 2/3
EE9BI3	Software design	0.28	CC (EE, 1h, sd) * 1/3 + Proj (Rap) x 2/3

EC : Machine learning for energy		EE9BI1	coeff : 0.38
Teacher In Charge : W. Maréchal, Philippe Cotte, Matteo Rizzato			
CM : 18 h	TD : 16 h	TP : 0 h	Proj : 24 h
			Language Français

OVERVIEW

Machine learning techniques have revolutionised all strata of our societies and activities. The building industry is no exception to this trend. This introductory course will allow you, from concrete applications, to know and use the principal algorithms of machine learning (ML).

LEARNING OUTCOMES

- Know the use cases of the different ML methods
- Understand the use of the main algorithms in the context of Smart Building

DESCRIPTION

- Introduction : What is Machine Learning?
- The main types of learning: supervised, unsupervised, reinforcement
- Regression algorithms
- Classification algorithms
- Neural networks and Deep Learning

RECOMMENDED READING

PREREQUISITE

Calcul scientifique 1, Optimisation, Programmation

ASSESSMENT

CC (EE, 1h, sd) * 1/3 + Proj(Rap) * 2/3

EC : Material design		EE9BI2	coeff : 0.34
Teacher In Charge : C. PHAM, C. ARRABIE, S. GIBOUT			
CM : 12 h	TD : 8 h	TP : 0 h	Proj : 20 h
			Language Français

OVERVIEW

This course deals with the ”hardware” part of the data acquisition chain. It includes a reminder of the main sensors relevant to the building industry, as well as their implementation on the Arduino and Raspberry Pi platforms. Long distance / low speed wireless communication (LoRa / Sigfox) will also be presented.

LEARNING OUTCOMES

- Know how to specify and design an autonomous connected sensor
- Understand the issues related to autonomy
- Know how to transmit data to a ”cloud” service

DESCRIPTION

- Introduction to IoT
- Wireless communication
- Sensors and interfacing

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC (EE, 1h, sd) * 1/3 + Proj (Rap) x 2/3

EC : Software design		EE9BI3	coeff : 0.28
Teacher In Charge : C. ARRABIE, S. GIBOUT			
CM : 8 h	TD : 8 h	TP : 0 h	Proj : 28 h
			Language Français

OVERVIEW

The data produced by the sensors is intended to be exploited in order to deduce relevant information (see Audit and Data Mining). To do this, it is necessary that these data are stored, classified and accessible. This course approaches, always in practical form, the software technologies which allow it.

LEARNING OUTCOMES

- Know how to query an SQL database
- Know how to define a database structure
- Know the http protocol and WEB technologies
- Know how to interface with a third party data source (REST API)

DESCRIPTION

- Introduction to databases and the SQL language
- WEB technology
- Api Rest

RECOMMENDED READING

PREREQUISITE

Programmation

ASSESSMENT

CC (EE, 1h, sd) * 1/3 + Proj (Rap) x 2/3

SPECIALITY Process Engineering - Pathways PE

3rd Year - Semester 9 - GP

Processes for the Environment (PE)

UE Name	Code		EC Name	Teachers	Hours (h)								ECTS / Coef.	
	UE	EC			Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj.	ECTS UE	Coef. EC
Treatment Processes S9	**PT9ET**	PT9ET1	Wastewater Treatment	Vaxelaire J., Salin D.	**193**	55	**25**	*18*	*7*	***0***	30	*20*	**7**	0.29
		PT9ET2	Waste Treatment	Baron T., Le Boulicaut C. , Mercadier J., Vaxelaire J.		52	**27**	*27*	*0*	***0***	25	*8*		0.29
		PT9ET3	Air Treatment	Hort C., Sochard S.		56	**26**	*13*	*13*	***0***	30	*20*		0.29
		PT9ET4	Drinking Water and Water Distribution	Salin D.		30	**20**	*20*	*0*	***0***	10	*0*		0.13
Biology and Pollution control S9	**PT9EB**	PT9EB1	Biology and Microbiology	Aliaga C., Olivier J.	**190**	55	**30**	*20*	*10*	***0***	25	*20*	**7**	0.29
		PT9EB2	Biological Reactors Engineering	Vaxelaire J.,		27	**15**	*8*	*7*	***0***	12	*0*		0.14
		PT9EB3	Water Pollution Control	Vaxelaire J.		31	**16**	*8*	*8*	***0***	15	*0*		0.21
		PT9EB4	Air Pollution Control	Jambert C., Serça D.		45	**25**	*13*	*13*	***0***	20	*0*		0.21
		PT9EB5	Practical Works	Casas L., Vaxelaire J.		32	**32**	*0*	*0*	*32*	**0**	*0*		0.15
Industrial implementation S9	**PT9EN**	PT9EN1	Process Synthesis	Sochard S.	**110**	40	**18**	*4*	*14*	***0***	22	*30*	**4**	0.36
		PT9EN2	Industrial Risk Management	Baron T.		34	**24**	*0*	*24*	***0***	10	*0*		0.31
		PT9EN3	Introduction to construction contracts	Salin D.		16	**8**	*8*	*0*	***0***	8	*0*		0.15
		PT9EN4	Environmental Management	Tetgein T.		20	**10**	*5*	*5*	***0***	10	*8*		0.18
Total Parcours					**493**	**493**	**276**	**144**	**101**	**32**	**217**	**106**	**18**	
Total TC + Parcours					**700**		**349**						**30**	

TEACHING UNIT (UE) :

Treatment Processes S9

ECTS : 7

Code UE : PT9ET

SKILLS COVERED BY THE UE :

- Identify and be able to select wastewater and waste gas (liquid or solid) treatment processes
- Demonstrate the ability to dimension main unit operations specific to the different possible effluent treatments

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
PT9ET1	Wastewater Treatment	0.29	Proj(Rap, Sout)*1/2+CC(EE, 2h, sd, ca)*1/2
PT9ET2	Waste Treatment	0.29	CC (EE, 2h, sd, ca)x4/5 + Projx1/5
PT9ET3	Air Treatment	0.29	CC(EE, 2h, ca) x0.67+ Proj(Sout)x0.33
PT9ET4	Drinking Water and Water Distribution	0.13	CC (EE, 1,5h, da, ca)

EC : Wastewater Treatment		PT9ET1	coeff : 0.29
Teacher In Charge : Vaxelaire J., Salin D.			
CM : 18 h	TD : 7 h	TP : 0 h	Proj : 20 h
			Language Français

OVERVIEW

Due to environmental regulations many processes have been developed for wastewater treatment. The lecture presentes a review of the main processes implicated in industrial and domestic water treatment. Some design elements are also proposed.

LEARNING OUTCOMES

After this course, students should:

- have a basic knowledge in the wastewater treatment field
- have a basic knowledge on physics, chemistry and biology involved in the classical treatment processes
- be able to design and control wastewater treatment processes

DESCRIPTION

Part I: Physico-chemical treatments

Pretreatments (Screening, Sand removal, Grease removal)
Decantation
Flotation
Deep bed filtration

Part II: Biological treatment

Principles of biological treatment (Mechanisms involved; Carbon, nitrogen and phosphorus removal)
Free bacterial culture processes (activated sludge, lagoon, membrane bioreactor)
Fixed bacterial culture processes (biofilm, biofilters, trickling filters, biodiscs,)
Processes adapted to small communities

Part III: Experience feedback

RECOMMENDED READING

- DEGREMONT "Memento technique de l'eau", Ed. Degrémont Suez, 10th édition, 2005.
- HENDRICKS D., "Water treatment unit processes, physical and chemical", Ed. Taylor and Francis, 2006.
- HENZE M., HARREMOES P., LA COUR JANSEN J., ARVIN E. "Wastewater treatment", Ed. Springer, 1996.

PREREQUISITE

Introduction au génie chimique

ASSESSMENT

Proj(Rap, Sout)*1/2+CC(EE, 2h, sd, ca)*1/2

EC : Waste Treatment		PT9ET2	coeff : 0.29
Teacher In Charge : Baron T., Le Boulicaut C. , Mercadier J., Vaxelaire J.			
CM : 27 h	TD : 0 h	TP : 0 h	Proj : 8 h
			Language Français

OVERVIEW

Due to environmental regulations many processes have been developed for waste treatment and disposal. The lecture proposes a review of the main processes implicated in industrial and domestic waste treatment, and some design elements.

LEARNING OUTCOMES

After this course, students should:

- have a basic knowledge in the waste treatment field
- have a basic knowledge on physics, chemistry and biology involved in the classical treatment processes
- be able to design and control waste treatment processes

DESCRIPTION

Part I: Incineration

Introduction to waste management.
Incineration process: storage, furnace, boiler, cogeneration, flue gas treatment

Part II: Hydrothermal oxidation

Subcritical oxidation of organic wastes: presentation of different processes
Oxidation with supercritical water: interest and pilot plant

Part III: Sludge treatment

Production and regulations
Characterisation (physical, chemical and biological features)
Options for biosolids use and sludge disposal
Treatment options,
- Stabilisation (anaerobic and aerobic digestion, chemical stabilisation, composting)

- Dehydration (conditioning, thickening, mechanicaldewatering, thermal drying)

Part IV: Case study.
Plastic waste treatment
Plastic waste production and evolution.
Advantages and difficulties of plastic waste recycling: environmental, economical and social aspects.
Some treatment processes: mechanical, incineration with energy recycling. Life cycle assessment

RECOMMENDED READING

Sludge into biosolids. Processing, disposal and utilization, Ed L. Spinosa and P.A. Vesilind, IWA Publishing, 2001.
Sludge engineering, Ed. F.D. Sanin, W.W. Clarkson, P.A. Vesilind, DEStech Publications, Inc., 2011.
Traiter et valoriser les boues, OTV, 1997.
L'incinération des déchets ménagers, J.Y Legoux et C. Le Douce. Economica, 1995

PREREQUISITE

Notions de base de génie des procédés

ASSESSMENT

CC (EE, 2h, sd, ca)x4/5 + Projx1/5

EC : Air Treatment		PT9ET3	coeff : 0.29
Teacher In Charge : Hort C., Sochard S.			
CM : 13 h	TD : 13 h	TP : 0 h	Proj : 20 h
			Language Français

OVERVIEW

Due to environmental regulations many processes have been developed for air treatment. The lecture presents a review of the main processes implicated in industrial gas and domestic air treatment. Some design elements are also proposed.

LEARNING OUTCOMES

After this course, students should:

- have a basic knowledge in the air treatment field
- have a basic knowledge on physics, chemistry and biology involved in the classical treatment processes
- be able to design and control air treatment processes

DESCRIPTION

Part I: Gas waste treatment

- Introduction to air and gas waste treatment
  - Air pollutants
  - A global approach for air treatment
- Dust removal
- Acid gas treatment
- Flue gas denitrification
- Thermal and catalytic oxidation
- Adsorption
- Absorption
- Ground storage of CO2

Part II: Biological treatments

- Biofilters
- Bioscrubbers

•Biotrickling filters
•Other processes (membrane systems. . .)
•Modelling aspects
•Industrial biofilters and bioscrubbers
•Domestic air treatment

RECOMMENDED READING

Popescou M., Blanchard J.M., Carré J. – Analyse et traitement physicochimique des rejets atmosphériques industriels, Tec & Doc Lavoisier Paris, 1998, ISBN 2-7430-0247-6
Le Cloirec P. – Les composés organiques volatils (COV) dans l'environnement, Tec & Doc Lavoisier Paris, 1998, ISBN 2-7430-0232-8
Kennes C. and Veiga M.C. – Bioreactors for waste Gas Treatment, Kluwer Academic Publishers 2001
Shareefdeen Z. and Singh A. – Biotechnology for odor and air pollution control , Spinger, 2005
S. Bicocchi - Les polluants et les techniques d'épuration des fumées, Lavoisier Tec & Doc, Paris 1998

PREREQUISITE

Introduction to chemical engineering, thermodynamic of the solutions, modeling, bioreactors

ASSESSMENT

CC(EE, 2h, ca) x0.67+ Proj(Sout)x0.33

EC : Drinking Water and Water Distribution		PT9ET4	coeff : 0.13
Teacher In Charge : Salin D.			
CM : 20 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

To improve sanitary conditions, numerous processes have developed to insure drinking water production. The lecture presents a review of the main processes used, and some basic aspects for the design of drinking water distribution networks. Some design elements of the different systems are also proposed.

LEARNING OUTCOMES

After this course, students should:

- have a basic knowledge in drinking water and water distribution fields.
- have a basic knowledge on physics, chemistry and biology involved in the classical treatment processes
- be able to design and control usual processes

DESCRIPTION

Part I: Drinking water production
Introduction: basic needs, resources, regulations
Underground water treatment:
-iron removal, manganese removal
-ammonia treatment
-other treatments: arsenic, fluorine…
-disinfection by chlorination
-complementary treatments: neutralisation, calcium carbonate stability
Surface water treatment
-usual processes: pre-treatment, flocculation, decantation, filtration
-sterilisation: ozonization, UV, chlorination
-complementary treatments: membrane systems, activated carbon

Part II: Hydraulic and networks

Background relative to hydraulic

- -Energy notion : Bernouilli's theorem
- -Head loss notion
- -Simplified computation aspects

Design of drinking water distribution networks

- -the different types of pipes and network modules
- -design

Pumping stations

- -constitutive elements
- -design
- -main problems: water hammer

RECOMMENDED READING

- DEGREMONT "Memento technique de l'eau", Ed. Degrémont Suez, 10th édition, 2005.
- Techniques appliquées au traitement de l'eau, Ed ellipses, 2001
- Guide de conception (Canada) – www.mddep.gouv.qc.ca/eau/guide

PREREQUISITE

Introduction au génie chimique et à la mécanique des fluides

ASSESSMENT

CC (EE, 1,5h, da, ca)

TEACHING UNIT (UE) :

Biology and Pollution control S9

ECTS : 7

Code UE : PT9EB

SKILLS COVERED BY THE UE :

- Understand biological mechanisms and their utility in pollution treatment
- Identify and measure various pollutants

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
PT9EB1	Biology and Microbiology	0.29	Proj (Sout, Rap)
PT9EB2	Biological Reactors Engineering	0.14	CC (EE, sd, 2h, ca)
PT9EB3	Water Pollution Control	0.21	CC (EE, 2h)
PT9EB4	Air Pollution Control	0.21	CC (EE, 1,5 h, da : cours uniquement, ca)x1/2+ CC (EE, 1,5 h, da : cours uniquement, ca) x1/2
PT9EB5	Practical Works	0.15	TP(CR)

EC : Biology and Microbiology		PT9EB1	coeff : 0.29
Teacher In Charge : Aliaga C., Olivier J.			
CM : 20 h	TD : 10 h	TP : 0 h	Proj : 20 h
			Language Français

OVERVIEW

The aim of this subject is to give the basis of biochemistry (macromolecules) and cellular biology (procaryotics and eucaryotics organisms) to understand biotechnological applications in pollution control.

LEARNING OUTCOMES

After this course, students should be able to:

- know the structure and the properties of the main biological molecules
- know and recognise the major characteristics of micro-organisms used in industrial productions (bacterial , fungi)
- understand the major ways of metabolism used in industry (fermentation, production of enzymes . . .)
- understand the major ways of hygienization used in pollution control (drinking water, disinfection . . .)
- understand biological mechanisms involved in the process of waste water treatments
- have notions of genetics to understand the utilisation of GMO (genetics modified organisms)

DESCRIPTION

Part I : Biochemistry

Lipids, carbohydrates, proteins, nucleic acids, redox reactions

Part II : Cellular and molecular biology

Eucaryotic and procaryotic cell constituants

Part III : Genetics and biotechnology
DNA, RNA, protein synthesis and biotechnologies (GMO)

Part IV : Cellular metabolism and industrial applications
Respiration, fermentation, wastewater treatments, hygienization of drinking water...

RECOMMENDED READING

- G. KARP, ”Biologie cellulaire et moléculaire”, Ed. De Boeck Université, 1998
- D. VOET, J.G. VOET, ”Biochimie”, Ed. De Boeck Université, 1998
- K. ARMS, P.S. CAMP ”Biologie”, Ed. De Boeck Université, 1989
- P. ATKINS, L. JONES, ”Chimie”, Ed. De Boeck Université, 1998

PREREQUISITE

Notions of biology

ASSESSMENT

Proj (Sout, Rap)

EC : Biological Reactors Engineering		PT9EB2	coeff : 0.14
Teacher In Charge : Vaxelaire J.,			
CM : 8 h	TD : 7 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Biological reactors are the centre of many biological processes involved in chemical, pharmaceutical, food, waste treatment industry. Analysis and design of such reactors are presented in the lecture.

LEARNING OUTCOMES

After this course, students should:

- have a basic knowledge on enzymatic and microbial kinetics
- be able to write balances on enzymatic and microbial reactors
- have a basic knowledge to design and control biological reactors

DESCRIPTION

Part I: Kinetics

The kinetics of enzyme-catalysed reactions (simple enzyme kinetics with one or two substrates, activation and inhibition, immobilised-enzyme technology).
The kinetics of substrate use, product formation and biomass production in cell cultures.

Part II: Reactors design

Ideal enzyme reactors (Batch and plug-flow reactors, CSTR)
The different technologies of enzyme reactors
Ideal cell reactors (Batch, fed-batch and plug-flow reactors, CSTR)
Oxygen transfer
Analysis of multiple interacting microbial populations
Criteria for the selection of a cell reactor technology

RECOMMENDED READING

BAILEY J.E., OLLIS D.F. ”Biochemical engineering fundamentals”, Ed. Mac GRAW HILL,1986

SCRIBAN R. " Biotechnologie", Technique et Documentation, Ed. LAVOISIER, 1993, Paris

PREREQUISITE

Génie de la réaction

ASSESSMENT

CC (EE, sd, 2h, ca)

EC : Water Pollution Control		PT9EB3	coeff : 0.21
Teacher In Charge : Vaxelaire J.			
CM : 8 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The importance of water in our society requires some frequent controls of the quality. The lecture presents the main methods to analyse and control the quality of fresh water, wastewater and drinking water.

LEARNING OUTCOMES

After this course, students should:

- have a basic knowledge to implement sampling (and know how to store the samples)
- be able to understand and use water analysis data

DESCRIPTION

Part I: Sampling and storage of the samples

Part II: Usual parameters of water analysis
The results (units, ways to present the data, accuracy...)
The main analysis to carry out in situ: temperature, pH, conductivity, dissolved oxygen, turbidity)
Alkalinity: m-alk, p-alk, hardness,...
Pollution factors: organic pollution, nitrogen pollution, phosphorus pollution...

Part III: Critical analysis of an analysis report

RECOMMENDED READING

Rodier J., Legube B., Merlet N. et coll. ”L’analyse de l’eau”, 9ème édition, Dunod, 2009

PREREQUISITE

Chimie des solutions

ASSESSMENT

CC (EE, 2h)

EC : Air Pollution Control		PT9EB4	coeff : 0.21
Teacher In Charge : Jambert C., Serça D.			
CM : 12.5 h	TD : 12.5 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The change of reactive and radiation properties of the atmosphere ("global change") are, currently, of main interest for the environmental sciences. The lecture presents this problematic and the ways to study it, using atmospheric chemistry and meteorological methods.

LEARNING OUTCOMES

After this course, students should:

- have a basic knowledge in atmosphere chemistry allowing to understand the outcomes different phenomena relative to the air composition changes: climate warming, the ozone hole, photochemical pollution
- know the impacts (health, ecosystems, ...) and the trends of air pollution
- know the regulations and the management of the "atmospheric system"
- know the different techniques and approaches to measure the trace components in the atmosphere
- have a basic knowledge of the methods used to measure the atmospheric flux

DESCRIPTION

Part I: Introduction

The atmospheric system, physic and chemistry (dynamic, main trace components)/ biogeochemical cycles/ the main source of trace components/ notions of photochemistry, kinetic and catalysis, life time, concentration variability

Part II: Atmospheric chemistry

Gaseous phase chemistry of the stratosphere and the troposphere/ catalytic cycles of destruction/ free radical reactions/ troposphere photochemical production/ chemistry of the atmosphere in aqueous phase

Part III: Pollution

The pollution at different spatial scales/ impacts of the atmosphere pollution on the health, the ecosystems and the infrastructures/ history of the emission and the concentrations of pollutants/ regulation management (LAURE, international agreements, emission standards), control networks.

Part IV: Control of atmosphere concentrations

Introduction (notion of atmospheric concentrations, P and T corrections)/ passive/active measurement/ local measurement/ method to measure gaseous pollutants/ calibration methods/ standard laboratories.

Part V: Control of the flux at the interface ground/atmosphere

Introduction / box model/ flux measurement at different scales- micrometeorological approaches/ atmospheric deposit

RECOMMENDED READING

- Physique et Chimie de l'Atmosphère : R. Delmas, G. Mégie, V.-H. Peuch, Ed. Belin, Collection Echelles, octobre 2005, ISBN10 : 2-7011-3700-4.
- OMER7-A: Outil nuMERique pédagogique pour l'étude des Sciences de l'Environnement Terrestre-Atmosphère), site Internet (http://omer7a.obs-mip.fr/)

PREREQUISITE

Notions de base en chimie

ASSESSMENT

CC (EE, 1,5 h, da : cours uniquement, ca)x1/2+ CC (EE, 1,5 h, da : cours uniquement, ca) x1/2

EC : Practical Works		PT9EB5	coeff : 0.15
Teacher In Charge : Casas L., Vaxelaire J.			
CM : 0 h	TD : 0 h	TP : 32 h	Proj : 0 h
			Language Français

OVERVIEW

Laboratory pilot plants allow the students to have practical investigations on some common processes used to treat wastewater and carried out common pollution measurements.

LEARNING OUTCOMES

After this course, students should:
- have a basic knowledge to manage the main processes used to treat wastewater

DESCRIPTION

Wastewater treatment by activated sludge
Biofilter
Methanisation
Coagulation-flocculation and settling

RECOMMENDED READING

- G. KARP, ”Biologie cellulaire et moléculaire”, Ed. De Boeck Université, 1998
- D. VOET, J.G. VOET, ”Biochimie”, Ed. De Boeck Université, 1998
- K. ARMS, P.S. CAMP ”Biologie”, Ed. De Boeck Université, 1989
- P. ATKINS, L. JONES, ”Chimie”, Ed. De Boeck Université, 1998

PREREQUISITE

Basic background in chemical engineering and water pollution measurement

ASSESSMENT

TP(CR)

TEACHING UNIT (UE) :

Industrial implementation S9

ECTS : 4

Code UE : PT9EN

SKILLS COVERED BY THE UE :

- Have a basic understanding of the design and management of the implementation of an industrial process

Accessible to students of the GP speciality: PE

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EP9OO2	Process Synthesis	0.36	Proj (Rap)
PT9EN1	Industrial Risk Management	0.31	Proj (Soutx1/3 + Rapx2/3)
PT9EN3	Introduction to construction contracts	0.15	CC (EE, 30min, da, ca)
PT9EN4	Environmental Management	0.18	CC (EE, 2h)

EC : Process Synthesis		EP9OO2	coeff : 0.36
Teacher In Charge : Sochard S.			
CM : 4 h	TD : 14 h	TP : 0 h	Proj : 30 h
			Language Français

OVERVIEW

Process synthesis is a methodology based on the experience and know-how of engineers. These qualitative procedure leads to an acceptable (from a technical and economical point of view) process pre design using heuristic rules.

LEARNING OUTCOMES

After this course, students must:

- know the main steps of the hierarchical procedure proposed by Douglas
- know at each steps the main heuristics
- be able to image the pre design of a process based on these rules

DESCRIPTION

Based on the HDA process, the main steps of the method are illustrated:
1. definition of the inputs and outputs of the process
2. choice of reactors and definition of the recycle structure
3. definition of the vapour and liquid separation systems
4. definition of the heat exchanger network.

RECOMMENDED READING

Conceptual Design of Chemical Processes ; J.M. Douglas; McGraw-Hill, Inc.; New York, 1988

PREREQUISITE

Unit Operation, mass and heat balances

ASSESSMENT

Proj (Rap)

EC : Industrial Risk Management		PT9EN1	coeff : 0.31
Teacher In Charge : Baron T.			
CM : 24 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Process synthesis is a methodology based on the experience and know-how of engineers. This qualitative procedure leads to an acceptable (from a technical and economical point of view) process pre design using heuristic rules.

LEARNING OUTCOMES

After this course, students must:

- know the main steps of the hierarchical procedure proposed by Douglas
- know at each step the main heuristics
- be able to image the pre design of a process based on these rules

DESCRIPTION

1.Definition of process inputs (raw materials) and outputs,
2.General process structure
3.Reactive zone : heat effect, reactor type
4.Design of gas and liquid separation, 5.Heat exchanger network design.

RECOMMENDED READING

Conceptual Design of Chemical Processes ; J.M. Douglas; McGraw-Hill, Inc.; New York, 1988
Process Design Principles; W.D. Seider, J.D. Seader, D.R. Lewin. J Wiley&Sons 1999
Analysis, Synthesis and Design of chemical Processes; R. Turton, RC Bailie, W.B. Whiting, J.A. Shaeiwitz. Prentice Hall 1998

PREREQUISITE

Opérations unitaires, bilans de matière et de chaleur

ASSESSMENT

Proj (Soutx1/3 + Rapx2/3)

EC : Introduction to construction contracts		PT9EN3	coeff : 0.15
Teacher In Charge : Salin D.			
CM : 8 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The main goal of the lecture is to provide vocabulary and the basic background to understand how construction contracts work.

LEARNING OUTCOMES

After this course, students should:

- Know partners acting in a construction contract
- Have the basic knowledge about the role of everybody and about the running of the different stages from the design to the construction
- Be able to understand the different types of contracts and the documents relative to the contracts
- Have the basic knowledge about work site progress, about the documents to prepare and about the financial and the administrative aspects

CODESCRIPTIONNTENU

Part I: Generalities and vocabulary
The notion of construction contracts
The people acting in construction :
-Leader
-Design and management
-Security
-Companies, groups and subcontracting

Part II: The design stage
Operations Schedule
-Preliminary studies
-Choice of the type of contract

Role of the prime contractor
-Definition of the goal and of the type of contract
-Content of the studies and of the documents to established
Other partners
-SPS manager
-Technical manager
-OPC

Part III: Contract signing
Usual rules
-Contract price
-Call for tenders (procedure)
Rules about private or public construction contract signing
Consultation files and companies answers
Companies choice and contract establishment

Part IV: Construction stage
Preparation stage
-Documents to prepare
-Meeting
-Planning
Construction stage
-Service order
-Meeting and report
-Administrative and financial management
End of construction
-Tests stage
-Acceptance procedure
-Final report
-Litigation

RECOMMENDED READING

- CODE DES MARCHES PUBLICS – www.legifrance.fr - Guide de bonnes pratiques en matière de marchés publics -2012 -Circulaire du 14 février 2012 - Guide pratique des conducteurs de chantiers – 2006 – www.fntp.fr - 170 séquences pour mener une opération de construction – H. Debaveye et P. Haxaire – 7ème Ed 2010 Edition Le Moniteur

PREREQUISITE

ASSESSMENT

CC (EE, 30min, da, ca)

EC : Environmental Management		PT9EN4	coeff : 0.18
Teacher In Charge : Tetgein T.			
CM : 5 h	TD : 5 h	TP : 0 h	Proj : 8 h
			Language Français

OVERVIEW

This lecture is complementary to lectures dealing with water, air and waste treatment. It presents industrial field in terms of organisation and environmental regulation.

LEARNING OUTCOMES

After this course, students should:

- know how the ISO 14001 standard (environmental management) is applied in manufactures to be in coherence with a society already under ISO 14001 standard or to develop an environmental management system.
- be able to carry out a analysis of environmental risks due to manufacture activity
- know the main environmental regulations and their impact on the design and the management of industrial processes

DESCRIPTION

Part I: Environmental management system: ISO 14001 standard

Continuous improving cycle presenting the main stages to establish an environmental management system :
-impact analysis
-planning
-construction
-control
-improvement

Part II: Analysis of Hygiene, Security and Environmental (HSE) risks
●Hygiene:
chemicals management
●Environment:
- Laws relative to the Installations Classified for the Protection of the Environment

- Prevention and control of atmospheric pollution
- Protection of water resource and aquatic environments
- The waste
- Prevention and control of noise and vibrations

●Security: prevention of technological risk and security at workplace

RECOMMENDED READING

Techniques de l'ingénieur : Environnement (vol G1 à G5)

Réglementation sur les déchets, eaux, ICPE, air (Collection Recueils de textes réglementaires ACFCI, AFNOR)

PREREQUISITE

Notions de base en génie chimique

ASSESSMENT

CC (EE, 2h)

SPECIALITY Process Engineering - Pathways CPAO

3rd Year - Semester 9 - GP															
Computer Aided Process Design (CPAO)															
UE Name	Code		EC Name	Teachers	Hours (h)									ECTS / Coef.	
	UE	EC			Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj.		ECTS UE	Coef. EC
Conception S9	EP9OO	EP9OO1	Contrôle commande - Régulation avancée	Ricarde M. Marias F.	210	48	30	10	20	0	18	0		7	0.28
		EP9OO2	Synthèse des procédés	Sochard S.		40	18	4	14	0	22	36			0.14
		EP9OO3	Optimisation des procédés	Baudet P. (Proesis)		47	20	0	20	0	27	47			0.14
		EP9OO4	Supply chain management - Scheduling	Lelkes Z.		54	30	30	0	0	24	54			0.29
		EP9OO5	Validation de données	Sochard S.		21	10	4	6	0	11	17			0.15
Modelling and Simulation S9	EP9MS	EP9MS1	Modélisation des opérations unitaires II	Marias F.	209	44	24	2	22	0	20	42		7	0.21
		EP9MS2	Modélisation et simulation en mécanique des fluide	David M. (INRIA)		48	20	4	16	0	28	44			0.21
		EP9MS3	Simulation des procédés industriels	Baudouin O.		32	20	20	0	0	12	32			0.21
		EP9MS4	Procédés Batch	Serin J-P., Contamine F., Cézac P.		44	24	8	0	16	20	0			0.16
		EP9MS5	Modeling, Simulation and optimization using gPRO	Nauta M.		41	30	10	20	0	11	0			0.21
Industry 4.0 S9	EP9OI	EP9OI1	Machine Learning and Data Science	Kobayashi M.	116	28	14	10	4	0	14	5		4	0.25
		EP9OI2	Artificial Intelligence and Industrial Systems	Lenir Y., JOURDAN A.		28	14	10	4	0	14	5			0.25
		EP9OI3	Industry 4.0 cyber-physical Systems Engineering	Alexandrouiu F., Baron T.		60	40	40	0	0	20	5			0.50
Total Parcours					419		226	92	118	16	193	272		14	
Total TC + Parcours					626		299							26	

TEACHING UNIT (UE) :

Conception S9

ECTS : 7

Code UE : EP9OO

SKILLS COVERED BY THE UE :

- Have notions of economic evaluation of processes and industrial risk management
- Master the tools (computer, heuristic, thermodynamic...) of process design and optimisation

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EP9OO1	Advanced Process Control	0.28	CC(EE, 2h, ca)
EP9OO2	Process Synthesis	0.14	Proj(Rap)
EP9OO3	Utilities Optimization	0.14	Proj (Rap, Prog)
EP9OO4	Supply Chain Management - Scheduling	0.29	CC(EE)x0.2 + CC(PA)x0.4 + Proj(Rap)x0.4
EP9OO5	Data Reconciliation	0.15	Proj(Rap)

EC : Advanced Process Control		EP9OO1	coeff : 0.28
Teacher In Charge : Ricarde M. Marias F.			
CM : 10 h	TD : 20 h	TP : 0 h	Proj : 0 h
			Language Fr/En

OVERVIEW
Process automation and control methods: theory and use for petrol, chemical and pharmaceuticals industries. Educational platform : https://elearn.univ-pau.fr/

LEARNING OUTCOMES
This education allows students to plan and to specify process control systems:

- safety loops,
- starting sequences,
- control loops.

DESCRIPTION

Digital control system
-PLC architecture / Supervision
-Alarm management
-Sequence and grafcet
-Introduction to BATCH control.

Safety loops
-Matrix or flowchart representation
-Safety instrumented system SIS
-Safety integrity level SIL.

Advanced regulation
-PID recall
-split-range
-Ratio regulation
-Cascade regulation
-Predictive control

Examples and applications: boiler, exchanger, distillation column. Computer simulator for the implementation of advanced regulations and for the parameterization of the gain and the integral.

RECOMMENDED READING

Régulation industrielle, Emmanuel Godoy, Collectif Dunod, L'Usine Nouvelle. Régulation P.I.D, Daniel Lequesne, Lavoisier.
Régulation de chaudières (Conférence Framatome).
Système et instrumentation de sécurité (Yokogawa, Triconex, ICS. . .). RsBatch (Rockwell). SIMATIC Safety Matrix (Siemens)

PREREQUISITE

Connaissances en régulation PID

ASSESSMENT

CC(EE, 2h, ca)

EC : Process Synthesis		EP9OO2	coeff : 0.14
Teacher In Charge : Sochard S.			
CM : 4 h	TD : 14 h	TP : 0 h	Proj : 36 h
			Language Fr/En

OVERVIEW
Process synthesis is a methodology based on the experience and know-how of engineers. These qualitative procedure leads to an acceptable (from a technical and economical point of view) process pre design using heuristic rules.

LEARNING OUTCOMES
After this course, students must:

- know the main steps of the hierarchical procedure proposed by Douglas
- know at each steps the main heuristics
- be able to image the pre design of a process based on these rules

DESCRIPTION
Based on the HDA process, the main steps of the method are illustrated:
1. definition of the inputs and outputs of the process
2. choice of reactors and definition of the recycle structure
3. definition of the vapour and liquid separation systems
4. definition of the heat exchanger network.

RECOMMENDED READING
Conceptual Design of Chemical Processes ; J.M. Douglas; McGraw-Hill, Inc.; New York, 1988

PREREQUISITE
Unit Operation, mass and heat balances
ASSESSMENT
Proj(Rap)

EC : Utilities Optimization		EP9OO3	coeff : 0.14
Teacher In Charge : Baudet P. (Proesis)			
CM : 0 h	TD : 20 h	TP : 0 h	Proj : 47 h
			Language Fr/En

OVERVIEW

Optimisation is one of the major quantitative tools for decision-making in Chemical Engineering. Students are familiarized with Process Optimization (operating and design parameter optimization) using flowsheeting environments (ProSim Plus and/or Pro II).
The production of utilities has become very common practice in the context of energy transition. In this course, the students are brought, working on a project, to optimize the operating parameters of a utility production plant, in a Flowsheeting environment (Ariane)

LEARNING OUTCOMES

At the end of this course, students should :

- Have advanced knowledge of the main optimization algorithms in continuous and mixed variables
- Be able to formulate and solve a complex problem, using commercial tools: Ariane

DESCRIPTION

During this project, the students will become familiar with the very fashionable world of utility production, initially through the Ariane software. In a second time, the piloting of the Ariane software in various configurations will be the occasion to work on :
- VBA in Excel
- The vbs for the piloting of executables, whatever they are
- Numerical methods (implementation of a Newton method in Ariane piloting)

RECOMMENDED READING

Optimization of Chemical Processes T.F. Edgar, D.M. Himmelblau – McGraw Hill International Edition

PREREQUISITE

Utilities, optimization methods and common sense

ASSESSMENT

Proj (Rap, Prog)

EC : Supply Chain Management - Scheduling		EP9OO4	coeff : 0.29
Teacher In Charge : Lelkes Z.			
CM : 30 h	TD : 0 h	TP : 0 h	Proj : 54 h
			Language Fr/En

OVERVIEW

The aim of the course is the familiarization the students with the AIMMS optimization platform. Understanding the SCM and scheduling problems (capacity optimization, short term planning, flow-shop, job-shop).

LEARNING OUTCOMES

After the course the students will be able to do:

- Use AIMMS platform for optimization
- Formalization of Supply Chain optimization problem
- Know different heuristics and meta-heuristics methods for scheduling optimization
- Understand the parts of a complete scheduling planning system (capacity planning, operation scheduling optimization, reactive scheduling)

DESCRIPTION

During the course we will present the followings:
-AIMMS optimization platform
-AIMMS project, model tree, algorithmic features, GUI, integration
-Case study: SCM optimization problem in SAB Miller company
-Programming a simple SCM optimization problem in AIMMS
-Programming rolling horizon optimization in AIMMS
-Flow-shop, job-shop scheduling, heuristics and meta-heuristics methods
-Case study: a simple job-shop scheduling problem in AIMMS
-Case study: Scheduling in Graboplast company

RECOMMENDED READING

Johannes Bisschop: AIMMS Optimization Modeling

Marcel Roelofs, Johannes Bisschop: AIMMS User's Guide

PREREQUISITE

Méthodes d'optimisation (GC2MI2)

ASSESSMENT

CC(EE)x0.2 + CC(PA)x0.4 + Proj(Rap)x0.4

EC : Data Reconciliation		EP9OO5	coeff : 0.15
Teacher In Charge : Sochard S.			
CM : 4 h	TD : 6 h	TP : 0 h	Proj : 17 h
			Language Fr/En

OVERVIEW

In a wide range of situations, chemical engineers point out differences between experiments and theories. So the main question is : “are my experiments bad or have I used a wrong theory?”. This course gives some answers based on a systematic approach to this central question.

LEARNING OUTCOMES

After this course, students must:

- The problem
- Calculation of a coherent set of measurements
- Diagnosis of the operation of the sensors
- Validation on incompletely observed systems
- Discovering the VALI software

CONTENU

The course is structured as follows
-THE PROBLEMATIC
-CALCULATION OF A COHERENT SET OF MEASUREMENTS
-DIAGNOSIS ON THE FUNCTIONING OF SENSORS
-VALIDATION ON INCOMPLETELY OBSERVED SYSTEMS

RECOMMENDED READING

Validation de données et diagnostic ; J. Ragot, D. Maquin, G. Bloch, M. Darouach ; HERMES, Paris 1990.
Ensembles et statistique ; C. Tricot, J.M. Picard ; Mac Graw Hill, Montréal, 1969.
Modélisation et estimation des erreurs de mesure ; M. Neuilly ; Tech. et Doc., Lavoisier, 1993.
Méthodes numériques appliquées ; A. Gourdin, M. Bouhmeurat ; Tech. et Doc., 1983.

PREREQUISITE

ASSESSMENT

Proj(Rap)

TEACHING UNIT (UE) :

Modelling and Simulation S9

ECTS : 7

Code UE : EP9MS

SKILLS COVERED BY THE UE :

- To master the computer tools for modelling and simulating processes
- To know how to model and simulate a complex industrial problem which is not necessarily completely defined

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EP9MS1	Modeling Process Operation II	0.21	Proj(Rap)
EP9MS2	Computation Fluid Mechanics	0.21	Proj(Rap)
EP9MS3	Industrial Process Simulation	0.21	Proj(Rap)
EP9MS4	Batch Proceses	0.16	TP(PA)1/3 + TP(PA)1/3 + TP(CR)1/3
EP9MS5	MODELLING, SIMULATION AND OPTIMISATION USING GPROMS	0.21	CC(EM,2h)

EC : Modeling Process Operation II		EP9MS1	coeff : 0.21
Teacher In Charge : Marias F.			
CM : 2 h	TD : 22 h	TP : 0 h	Proj : 42 h
			Language Fr/En

OVERVIEW

This lecture gives insights on the skills and knowledge in the topic of modelling process operation. In this subject, students will be able to derive a mathematical model for a multistage and multi components distillation column.

LEARNING OUTCOMES

After the lecture, students must know how

- to derive equations translating mass, species and energy conservation in a distillation column.
- to write the model in such way that it can be solved using a Newton Raphson algorithm/model
- to use the numerical tool (developed during the lecture) to strengthen their knowledge in the field of distillation

DESCRIPTION

Reminding on numerical skills for solving of linear systems
Modelling of multistage and multi components separation process
Solving
Conclusion

RECOMMENDED READING

Techniques de l'ingénieur (J1076, J1021, J 2623)
Process modeling simulation and control for chemical engineers, W.L. Luyben, Mc Graw-Hill 1990

PREREQUISITE

Thermodynamique-Operations unitaires, Modélisation des opérations unitaires I

ASSESSMENT

Proj(Rap)

EC : Computation Fluid Mechanics		EP9MS2	coeff : 0.21
Teacher In Charge : David M. (INRIA)			
CM : 4 h	TD : 16 h	TP : 0 h	Proj : 44 h
			Language Fr/En

OVERVIEW

Computational Fluid Dynamics is a recent tool which is commonly used for the design of new unitary operations (reactors, separators, heat excnahgers. . .). The knowledge of such a tool is important for students that aim at designing new processes.

LEARNING OUTCOMES

After the course the students will be able to:

- Know the numerical methods used in Computational Fluid Dynamics
- Know the main mathematical models allowing the description of physical phenomena
- Handle a complete simulation using Fluent (sketching,, CAD, Meshing, solving)
- Know the influence of the main parameters allowing the simulation to converge (meshing, relaxation, interpolation)
- Analyse et validate the results

DESCRIPTION

1) Introduction to computational Fluid Dynamics

•Main goals of CFD
•Main strategies used in CFD
•Discretisation using finite volume methods
•Examples
•Turbulence modeling

2) Software environment Ansys WorkBench

3) Case Studies

RECOMMENDED READING

An Introduction to Computational Fluid Dynamics : 2nd Edition (H. Henk Kaarle Versteeg, Weeratunge Malalasekera) Pearson Education
Ansys Fluent User Guide

PREREQUISITE

Notions de mécanique des Fluides. Méthodes numériques

ASSESSMENT

Proj(Rap)

EC : Industrial Process Simulation		EP9MS3	coeff : 0.21
Teacher In Charge : Baudouin O.			
CM : 20 h	TD : 0 h	TP : 0 h	Proj : 32 h
			Language Fr/En

OVERVIEW

The main objective of this course is to let students perform some relatively complex problems of steady state process simulation. This course is built around the process simulation of a gas treatment unit. Several thermodynamics models will be used and students will use different complexity level of models of unit operation in the process. ProSimPlus ®will be the steady state process simulation software that will be used.

LEARNING OUTCOMES

After this course, abilities acquired by students:

- Distillation curves (TBP, ASTM. . .) and pseudo-components
- Selection of thermodynamics models
- Phase envelope and equilibrium curves analysis (retrograde condensation)
- Methodology for modelling of complex units with a steady state process simulation software (numerous cycling networks, process constraints, absorbers, distillation columns, user defined unit operations. . .)

DESCRIPTION

During this course, students will think about the material system modelling, which is linked to unit operations used in the simulation file (streams characteristics from a distillation curve, acid gas treatment with amine solutions, liquid phase splitting with water presence. . .).
A methodology for the creation of a complex simulation file will be presented, the complexity of the units operation modelling will be introduced step by step. An example of a user defined unit operation with a windows script module (VBS language) will also be done by students (this kind of unit operation is often used in the industry to introduce its know-how in a commercial simulation software).
Analysis tools, particularly thermodynamics tools, available in the process simulation software will be widely used.

RESSRECOMMENDED READINGOURCES

PREREQUISITE
Language Visual Basic

ASSESSMENT
Proj(Rap)

EC : Batch Proceses		EP9MS4	coeff : 0.16
Teacher In Charge : Serin J-P., Contamine F., Cézac P.			
CM : 8 h	TD : 0 h	TP : 16 h	Proj : 0 h
			Language Fr/En

OVERVIEW

The aim of this course is to familiarize students with the simulation of a batch process. The coupling of the simulation with two practical examples (distillation column, reactor) will allow them to compare the numerical approach and experimental constraints

LEARNING OUTCOMES

At the end of this course, students should be able to use simulators (BATCHREACTOR©and BATCHCOLUMN©) to simulate the operation of a distillation column and a reactor in batch mode.

DESCRIPTION

•Modelling

•Presentation of batchreactor©and batchcolumn©

•Application:
Dynamic simulation of the thermal runaway of a reactor
Simulation and optimization of a distillation column for the mixture Acetone

•Water / IPA

RECOMMENDED READING

Process modeling, simulation, and control for chemical engineers W.L. Luyben McGraw-Hill, 1990

PREREQUISITE

Modélisation, distillation, cinétique, thermodynamique des solutions, thermochimie

ASSESSMENT

TP(PA)1/3 + TP(PA)1/3 + TP(CR)1/3

EC : MODELLING, SIMULATION AND OPTIMISATION USING GPROMS			EP9MS5	coeff : 0.21
Teacher In Charge : Nauta M.				
CM : 10 h	TD : 20 h		TP : 0 h	Proj : 0 h
				Language Anglais

OVERVIEW

This course introduces the students to the use of the gPROMS software tool for the modelling of the steady-state and transient behaviour of chemical processes.

LEARNING OUTCOMES

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

- translate a mathematical model expressed in terms of a mixed system of integral, ordinary and partial differential, and algebraic equations (IPDAEs) to a working gPROMS model
- use the above model to perform steady-state and dynamic simulations
- express operating procedures in the gPROMS language
- perform steady-state and dynamic optimisation calculations in gPROMS
- estimate model parameters using data from steady-state and dynamic experiments
- use the gPROMS ModelBuilder to build, debug and manage model.

DESCRIPTION

This involves a number of topics that are closely aligned with the above Learning Outcomes.

RECOMMENDED READING

gPROMS Introductory Training Course notes
gPROMS Dynamic Optimisation/Parameter Estimation Training Course notes.

PREREQUISITE

Modélisation des Opérations Unitaires (I)

ASSESSMENT

CC(EM,2h)

TEACHING UNIT (UE) :

Industry 4.0 S9

ECTS : 4

Code UE : EP9OI

SKILLS COVERED BY THE UE :

- Understand the digital tools and methods being implemented for the design, management and monitoring of industrial production units
- To discern the interest of their implementation and the associated feasibility

Accessible to students of the EN speciality: CPAO

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EP9OI1	Machine Learning and Data Science	0.25	Proj (Rap, Sout)
EP9OI2	Artificial Intelligence and Industrial Systems	0.25	Proj(Rap)
EP9OI3	Industry 4.0 cyber-physical Systems Engineering	0.5	Proj (Rap, Sout)

EC : Machine Learning and Data Science		EP9OI1	coeff : 0.25
Teacher In Charge : Kobayashi M.			
CM : 10 h	TD : 4 h	TP : 0 h	Proj : 5 h
			Language Français

OVERVIEW

LEARNING OUTCOMES

- Master the use of the main Machine Learning techniques
- Apply these techniques to industrial production situations

DESCRIPTION

1. Data Science at the service of Process Modelling (1/2)

o What can a process engineer learn from statistics, machine learning, and data analysis?
o How can a process engineer take part in the digital transformation?
o How is the ”Industry 4.0” changing our daily activities and companies’ organizational charts?
o How important is data and what is its Technology Readiness Level in the energy sector?
o principles of AI, machine learning, and deep learning;
o other use cases outside the industrial sector;
o discovering some existing online free tools to start a project;
o Understand Process Modeling using:
- Process modeling software: using physical and chemical-based
- Mathematical expressions: physical and chemical-based and statistical-based
- Machine learning: data-based

2. Data Science at the service of Process Modelling (1/2)

o Process optimization
o How process models are integrated into the economic optimization chain
o How AI models can improve industrial profitability
o How to optimize the supply chain using linear programming
o Digital twin: the importance of process models

3. Data Driven Strategy Project
In this workshop students will solve an industrial and business problem applying a data-driven solution method. They will first identify the real problem, the scope of the project, pertinent features, necessary data, and usefull technologies. They will apply a mathematical and/or machine learning algorithm to solve the proposed problem. Students will work individually or in pairs and will have a couple of days to complete the project.

RECOMMENDED READING

In this hands-on session, students will work individually or in pairs. We will need one computer for each student/group. We will focus on process modeling using:
1. Mathematical expressions. We will do some exercises using Excel.
a. physical and chemical-based models
b. statistical-based models
2. Machine learning. We'll apply Python to analyze industrial data, using Google Notebook Colab, a free and online tool. Students will receive a Python start guide to be able to use right away some functions and visualizations.
a. data-based models, so called black-box models

PREREQUISITE

ASSESSMENT

Proj (Rap, Sout)

EC : Artificial Intelligence and Industrial Systems		EP9OI2	coeff : 0.25
Teacher In Charge : Lenir Y., JOURDAN A.			
CM : 10 h	TD : 4 h	TP : 0 h	Proj : 5 h
			Language Français

OVERVIEW

Introduction to machine learning techniques, machine learning trees and networks and deep learning neural networks

LEARNING OUTCOMES

- the notion of learning from data
- the need to prepare the input data
- the different types of supervised learning
- the evaluation of the quality of the learning
- the specificities of deep learning

DESCRIPTION

- History of AI
- Generalities of machine learning
- Learning by decision trees and random forests
- Learning by neural networks
- Learning by deep neural networks
- Notebook in Python

RECOMMENDED READING

PREREQUISITE

- Know the basics of algorithmic (variables, functions, conditions, loops)
- Have a gmail address and use google colab: https://colab.research.google.com/

ASSESSMENT

Proj(Rap)

EC : Industry 4.0 cyber-physical Systems Engineering	EP9OI3	coeff : 0.5
Teacher In Charge : Alexandrouiu F., Baron T.		
CM : 40 h TD : 0 h	TP : 0 h	Proj : 5 h
		Language Français

OVERVIEW

Evolution of the organization of industrial activity with the fast arrival of new technologies including the treatment of large amounts of information (big data, algorithms for learning systems & artificial intelligence, digital twins, etc. . .)

LEARNING OUTCOMES

- Methodology to implement new technologies into an industrial organization
- Different project management and risk analysis aspects to succed

DESCRIPTION

• Factory X.0: general view, what could it be? Why? How? Data science for dums!
• Maintenance and unmanned installations: how to move from traditional maintenance to predictive maintenance then to remote-operated and ultimately autonomous interventions?
• Safety: same approach to avoid human intervention / exposure on site, how to move from traditional safety to preventive safety then to remotely operated and ultimately autonomous interventions?
• Operational philosophy to be completely overhauled: real-time control without field access with weak signals taking into account the entire industrial context (not just the process but weather. . .). What information sent to whom to do what? Human Centered Design methodology, capitalization of operational experience, cognitive and neuroscience aspects to support decision ...
• Human and operational factors: how the introduction of this new paradigm (technos, data, philosophy) leads to a fundamental modification of the organization of the activity so that it is successful (accepted and used)

RECOMMENDED READING

PREREQUISITE

Formal presentation & Use cases
• Remote operation of offshore platforms at Total in the Netherlands,

• European gas production units of Air Liquide in Lyon,
Industrial early anomaly detection implementation on an oil rig…

ASSESSMENT

Proj (Rap, Sout)

SPECIALITE GEII

3rd Year - Semestre 9 - GEII

High Voltage Processes (HT)

UE Name	Code UE	Code EC	EC Name	Teachers	Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj.	ECTS UE	Coef. EC
Apprenticeship S9	EG9AP	EG9AP1	Skills developed in the company	Pécastaing L.	0	0	0	0	0	0	0	5	6	0.80
		EG9AP2	Project management	Pécastaing L.		0	0	0	0	0	0	0		0.20
Culture of the Engineer S9	EG9CI	EG9CI1	Human Ressource Management	Fall A.	158	36	18	14	4	0	18	0	6	0.23
		EG9CI2	Costs evaluation in industrial processes	Rouch F.		22	8	4	4	0	14	6		0.14
		EG9CI3	Design Project	Rivaletto M.		100	0	0	0	0	100	100		0.63
High tension	EG9HT	EG9HT1	High voltage	Reess T., Pécastaing L.	204	40	20	10	10	0	20	0	8	0.20
		EG9HT2	High Voltage Measurements	Reess T.		24	12	12	0	0	12	0		0.12
		EG9HT3	Rail traction	Guilloux P.		40	20	20	0	0	20	0		0.20
		EG9HT4	Transmission of electrical energy	Sierra F.		32	16	8	8	0	16	0		0.16
		EG9HT5	HT design tools	Reess T., Rivaletto M.		68	24	0	4	20	44	20		0.32
Pulsed Power	EG9PP	EG9PP1	Pulsed Power	Pécastaing L., Reess T.	168	60	30	20	10	0	30	0	6	0.4
		EG9PP2	Conference series	Reess T.		12	12	12	0	0	0	0		0.1
		EG9PP3	Electromagnetic compatibility	Pécastaing L.		44	24	8	8	8	20	0		0.2
		EG9PP4	TP electromagnetic simulations	Pécastaing L.		52	16	0	4	12	36	20		0.3
Safety, protection & industrial processes	EG9SP	EG9SP1	Plasma processes and applications	Paillol J.	104	40	20	10	10	0	20	0	4	0.40
		EG9SP2	Lightning & Protection of networks and buildings	Sigogne C.		20	10	10	0	0	10	0		0.24
		EG9SP3	Safety in an industrial environment	Rey-Bethbeder F., Hertzberg J.		44	22	18	4	0	22	0		0.36
Total GEII (TC + Spé)					634	634	252	146	66	40	382	151	30	
Total TC + Parcours					634		252						30	

TEACHING UNIT (UE) :

Apprenticeship S9

ECTS : 6

Code UE : EG9AP

SKILLS COVERED BY THE UE :

- Validate previously designed and built devices in order to certify compliance with all the requirements of the specifications.
- Study specific electrical energy supply or conversion devices, based on specifications, in order to ensure a secure continuous service, in compliance with environmental standards, in accordance with the challenges of sustainable development, and guaranteeing the safety of goods and people.
- Write design and validation reports in order to ensure traceability, which is essential for a continuous improvement process.
- Know and understand a complex and interdisciplinary scientific and technical field of specialisation in order to ensure the interface between the different partners by communicating on the progress of the work/project with both internal and external partners.
- Understand how to work in an international context, by mastering one or more foreign languages, by being culturally open, by taking into account all the constraints (managerial, environmental, CSR.) in order to favour synergy within the team.
- Mastering communication techniques adapted to the situation and the people involved in order to lead the development of a project in accordance with the company's strategy.
- Leading a multicultural team by adapting to the constraints and specificities of each person, taking into account the cultural mix in its interactions, using adapted communication tools and methods, in order to establish an environment conducive to the success of the project in compliance with regulations, ethics, safety and health.

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EG9AP1	Skills developed in the company	0.8	EvalC (entreprise)*0.6 + PA (entreprise)*0.4
EG9AP2	Project management	0.2	EvalC (Rap)

EC : Skills developed in the company		EG9AP1	coeff : 0.8
Teacher In Charge : Pécastaing L.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 5 h
			Language Français

INTRODUCTION

During this nine-week period in the company, including a five-week period that extends the 2AS8 period, the apprentice will be confronted with a potentially multidisciplinary project that he will be able to organise and structure. In the management of his project he will emphasise the sustainable development issues he has taken into account.

TARGETED SKILLS

- Know and understand a complex and interdisciplinary scientific and technical field of specialisation in order to ensure the interface between the different partners by communicating on the progress of the work/project with both internal and external partners.
- Understand how to work in an international context, by mastering one or more foreign languages, by being culturally open, by taking into account all the constraints (managerial, environmental, CSR.) in order to favour synergy within the team.
- Mastering communication techniques adapted to the situation and the people involved in order to lead the development of a project in accordance with the company's strategy.
- Leading a multicultural team by adapting to the constraints and specificities of each person, taking into account the cultural mix in its interactions, using adapted communication tools and methods, in order to establish an environment conducive to the success of the project in compliance with regulations, ethics, safety and health.

CONTENT

The activities developed in this EC are established according to the specific needs of the company and in order to complete the targeted skills.

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES
EvalC (entreprise)*0.6 + PA (entreprise)*0.4

EC : Project management		EG9AP2	coeff : 0.2
Teacher In Charge : Pécastaing L.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

From the beginning of their career, engineers join project teams and can quickly become project managers. The aim of this course is to prepare them for managerial tasks, in order to control the quality, cost and deadline aspects of projects.

TARGETED SKILLS

- Understand the organisations of industrial projects (client, project manager, service provider, supplier, subcontractor).
- Draw up a schedule.
- Assessing risks,
- Build a management plan.
- Monitor a project in terms of quality, cost and deadlines.
- Establish the progress of the work and the financial balance sheets.

CONTENT

The apprentice will submit a written report that will allow the level of project management skills acquired to be judged.
In this report he/she will also highlight the sustainable development issues that he/she has taken into account.

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

EvalC (Rap)

TEACHING UNIT (UE) :

Culture of the Engineer S9

ECTS : 6

Code UE : EG9CI

SKILLS COVERED BY THE UE :

- Demonstrate the ability to fit into an organization, to animate it and to develop it: project management, human resource management, financial management, business management and/or legal management
- Understand the basic methods concerning process economic assessment
- Demonstrate the ability to simultaneously master all the scientific and human sciences skills (written and oral communication, economic evaluation, English ...) acquired during his studies at the ENSGTI as well as the aptitude for teamwork and project management.

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EG9CI1	Human Ressource Management	0.23	CC(EE, 2h)
EG9CI2	Costs evaluation in industrial processes	0.14	CC(EE, 1h, da : cours, ca)x1/2 + Proj(Rap)x1/2
EG9CI3	Design Project	0.63	Proj(rap, sout)x1/4 + Proj(rap, sout)x3/4

EC : Human Ressource Management		EG9CI1	coeff : 0.23
Teacher In Charge : Fall A.			
CM : 14 h	TD : 4 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

This course is an introduction to Human Resource Management (HRM). The aim of this lecture is to teach students the key concepts and techniques required for decision making in this area.

LEARNING OUTCOMES

- Master the tools for the development of management for jobs and skills
- Know the steps of recruitment and optimization tools
- Know the different devices for professional training.
- Being able to have critical look at the remuneration system of a company
- Master the tools of individual evaluation
- Know the characteristics of teams and Management
- Being able to analyze an HR policy and taking measures of adjustment required

DESCRIPTION

General Introduction to HRM
Chapter 1 : Personnel Administration
Chapter 2 : Recruitment - process optimization
Chapter 3: Profesional training
Chapter 4: Pay systems
Chapter 5: Individual evaluating
Chapter 6: GPEC
Chapter 7: Team management

RECOMMENDED READING

- Encyclopédie des Ressources Humaines, sous la direction de José Allouche, Vuibert, 2006
- Fonction RH, Thévenet et ali., Pearson, 3ieme édition, 2012

- Gestion des ressources humaines, de Jean-Marie Peretti, Vuibert, 2007
- Organisation et gestion de l'entreprise, de Richard Soparnot, Dunod, 2006

PREREQUISITE

ASSESSMENT

CC(EE, 2h)

EC : Costs evaluation in industrial processes		EG9CI2	coeff : 0.14
Teacher In Charge : Rouch F.			
CM : 4 h	TD : 4 h	TP : 0 h	Proj : 6 h
			Language Français

OVERVIEW

The goal of this course is to present evaluation of methods of investments and process operating costs. This theoretical education is completed by feedback from industrial partners.

LEARNING OUTCOMES

- To know the basic methods of economic evaluation of processes.
- To be able to carry out the economic evaluation of a process.

DESCRIPTION

Chapter 1: Elements of economic calculation
- Study of the profitability of projects: Taxes and duties; Profitability criteria
- Operating cost and cost price: Definition and breakdown of the operating cost / cost price
- Investments: The various investment charges
- Labour costs

Chapter 2: Investments at the limits of the manufacturing units (ILUF)
- UBLI: average structure, evaluation and estimation
- Accuracy of investment calculation methods
- Adaptation of investment data

Chapter 3: Investment calculation methods
- Exponential (global) methods
- Factorial methods
- Pre-estimated IFP method: examples

RECOMMENDED READING

Manuel d'évaluation économique des procédés, A. Chauvel et al - Technip Cost Engineering Analysis, W.R. Park, D.E. Jackson - John Wiley & Sons

Plant Design and Economics for Chemical Engineers, Peters, Timmerhaus - Mc Graw Hill

PREREQUISITE

ASSESSMENT

CC(EE, 1h, da : cours, ca)x1/2 + Proj(Rap)x1/2

EC : Design Project		EG9CI3	coeff : 0.63
Teacher In Charge : Rivaletto M.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 100 h
			Language Français

INTRODUCTION

This project consists of proposing to students, in groups of 2 to 3, research topics related to the activities developed by the "High Voltage Processes" team of the SIAME laboratory. The proposed projects are only design projects but this does not rule out a partial or even total realization of the designed device. The projects will take place at the SIAME laboratory or on the GEII TP technical platform.

TARGETED SKILLS

- Demonstrate the ability to simultaneously master all the scientific and human sciences skills (written and oral communication, economic evaluation, English ...) acquired during his studies at the ENSGTI as well as the aptitude for teamwork and project management.
- This design project is positioned at the end of the cycle in order to complement the critical learning defined in the third year. It thus allows students who have not yet reached the required skill levels to validate all the skill blocks of the training.

CONTENT

1. Developing high-tech industrial electrical devices
2. Study and design electrical energy supply and conversion equipment
3. Design and operate automated systems in industrial environments
4. Design and build systems in supervised electrical engineering, potentially in high voltage
5. Managing multidisciplinary projects in an international context

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

Proj(rap, sout)x1/4 + Proj(rap, sout)x3/4

TEACHING UNIT (UE) :

High tension

ECTS : 8

Code UE : EG9HT

SKILLS COVERED BY THE UE :

- Understand how continuous HV generators work
- Master the circuits for generating strong impulse currents
- Know how to implement HV measurement devices and strong currents
- Mastering the environment of a railway powertrain
- Understand the problem of semiconductor module / traction motor combinations
- Know, understand and analyze an adjustment mechanism for electricity production
- Know the principles of building a daily production program based on projected consumption
- Know how to simulate the main HT generators and associated measuring devices using electronic circuit design software

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EG9HT1	High voltage	0.2	CC (EE, 1h30)
EG9HT2	High Voltage Measurements	0.12	CC (EE, 1h30)
EG9HT3	Rail traction	0.2	CC (EE, 1h30)
EG9HT4	Transmission of electrical energy	0.16	CC (EE, 1h30)
EG9HT5	HT design tools	0.32	TP (PA)*0.5 + Proj (Rap)*0.5

EC : High voltage		EG9HT1	coeff : 0.2
Teacher In Charge : Reess T., Pécastaing L.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The objective of this module is to provide engineering students with knowledge about the main DC high voltage generators and current shock wave generators.

TARGETED SKILLS

At the end of this module, students must:

- Acquire knowledge in the field of high voltages and strong currents
- Understanding the influence of electric field distribution on dielectric stiffness
- Know the standards on impact testing
- Know how to size a generator of high current

CONTENT

Overview of high voltage
Electric fields
Electrostatic generators and static rectifiers
Design of high current generators

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

CC (EE, 1h30)

EC : High Voltage Measurements		EG9HT2	coeff : 0.12
Teacher In Charge : Reess T.			
CM : 12 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

Measurements of high currents and high DC and impulse voltages require the implementation of specific devices. The objective of this course is to present these different devices and highlight their limitations of use.

TARGETED SKILLS

At the end of this module, students must:

- Understand the physical laws involved in the measurement of current and voltage
- Know and understand high voltage measurement techniques
- Know how to determine the frequency limits of a measurement chain
- Know how to design HT measuring devices by integrating transmission and acquisition elements

CONTENT

Principle of a spintermeter and the electrostatic voltmeter
The resistive divisor - Principle and frequency limitations
The capacitive divisor - Principle and frequency limitations
Trade compensated probes
Principle of measuring strong currents

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

CC (EE, 1h30)

EC : Rail traction		EG9HT3	coeff : 0.2
Teacher In Charge : Guilloux P.			
CM : 20 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION
The objective of this course is to present students with a concrete approach to the problems encountered in major industrial sectors, which call on skills in electrical engineering, such as railway traction. This teaching is provided by an engineer from Alstom

TARGETED SKILLS
At the end of this module, students must:

- Understand the fundamental functions of electric rail traction.
- Master the environment of a railway powertrain.
- Understand the problem of semiconductor module / traction motor combinations.

CONTENT
The basics of the railway system
General information on electric traction.
Converters
Power semiconductor modules.
Semiconductor cooling
Traction motors .

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES
CC (EE, 1h30)

EC : Transmission of electrical energy		EG9HT4	coeff : 0.16
Teacher In Charge : Sierra F.			
CM : 8 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The purpose of this course is to introduce students to the main principles of electrical energy transport.

TARGETED SKILLS

At the end of this module, students must:

- Describe the operation of the electrical network and its protections
- Understand the adjustment of the network (frequency, production, consumption)

CONTENT

Part 1: Basic knowledge: market participants and means of production
Part 2: The energy transition
Part 3: The structure of the French electricity network
Part 4: The protections of the electricity network
Part 5: Inspection of the installations (200kV Marsillon substation)

RESSOURCES

PREREQUISITE

Electrical safety balance
Energy Transition for Green Growth Act

EVALUATION PROCEDURES

CC (EE, 1h30)

EC : HT design tools		EG9HT5	coeff : 0.32
Teacher In Charge : Reess T., Rivaletto M.			
CM : 0 h	TD : 4 h	TP : 20 h	Proj : 20 h
			Language Français

INTRODUCTION

PSpice software is an electronic circuit design software that simulates major high voltage (HV) shock generators and transmission line HV generators. It is also very useful for dimensioning the constituent elements of HT dividers by taking into account the parasitic elements as well as the entire measuring chain.

TARGETED SKILLS

At the end of this module, students must:

- Strengthen their knowledge of HPP generators using a circuit-type simulation tool
- Know how to determine the frequency limits of a measurement chain
- Be able to design normalized shock generators
- Be able to simulate generators with training lines and oscillating transformers

CONTENT

Simulation of a 10kA shock generator standardized 8/20?s
Simulation of a single-stage shock generator associated with a complete capacitive divider
Simulation of a 3-stage Marx: sizing of a shock 150kV standardized 1.2/50?s
Simulation of pulse formation lines: the Blumlein generator
Simulation of oscillating HT transformers: Tesla and Pichugin

RESSOURCES

PREREQUISITE

High Voltage, HV Measurements and High Pulsed Powers

EVALUATION PROCEDURES

TP (PA)*0.5 + Proj (Rap)*0.5

TEACHING UNIT (UE) :

Pulsed Power

ECTS : 6

Code UE : EG9PP

SKILLS COVERED BY THE UE :

- Master the principles of high power pulses and the associated technological specificities
- Know how to implement the main high power pulsed generators
- Know the coupling modes and the effects of parasites on the systems
- Master the means of shielding and protection against EM fields
- Learn how to use electrostatic and electromagnetic simulation software and carry out simple simulations

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EG9PP1	Pulsed Power	0.38	CC (EE, 1h30)*0.5 + CC (EE, 1h30)*0.5
EG9PP2	Conference series	0.08	CC (EE, 1h30)
EG9PP3	Electromagnetic compatibility	0.21	CC (EE, 1h30)*0.7 + TP (CR)*0.3
EG9PP4	TP electromagnetic simulations	0.33	TP (PA)*0.5 + Proj (Rap)*0.5

EC : Pulsed Power		EG9PP1	coeff : 0.38
Teacher In Charge : Pécastaing L., Reess T.			
CM : 20 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The principle of Pulsed Power consists in switching, towards a load, a quantity of energy but minimising the switching time so as to deliver instantaneous powers of a few kilowatts up to several Terawatts, even Petawatts. This course presents the principles and technologies implemented in this field.

TARGETED SKILLS

At the end of this module, students should

- Master the principles of Pulsed Power
- Know the technological specificities associated with Pulsed Power
- Know how to implement the main Pulsed Power generators
- Be familiar with the main areas of application of Pulsed Power
- Know the fields of application of high power microwaves in pulsed mode

CONTENT

Introduction to HPP
- The main power switches (gas, solid, liquid)
- Voltage surge testing
- Mathematical definition of the voltage surge
- The Marx generator
- Transmission lines in transient mode
- High voltage (HV) devices based on transmission lines
- High power pulsed microwaves and applications
- Other devices generating transient HV

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

CC (EE, 1h30)*0.5 + CC (EE, 1h30)*0.5

EC : Conference series		EG9PP2	coeff : 0.08
Teacher In Charge : Reess T.			
CM : 12 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

Various researchers from the socio-economic world intervene to present their activities in the field of high voltage. These are mainly engineers from the CEA and the company ITHPP specialized in switching and generation of very high voltages (THT) of several MVs, MA.

TARGETED SKILLS

At the end of this module, students must:

- Be informed of the activities of the CEA and ITHPP in the field of HV generation
- Strengthen their knowledge of High Pulsed Power machines
- Understand the physical laws involved in the fields of power switching

CONTENU

Presentation of CEA/DAM/CESTA and ITHPP
Solid state modulators with HPP
The HBPs integrated into the Laser Megajoule (LMJ) installation
HBPs for curing (CESAR generator - Diodes and electron beams - Z pinch)
HPP for flash radiography
Induction technologies, ltd
HPP for flash radiography
Electron beam sterilization

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

CC (EE, 1h30)

EC : Electromagnetic compatibility		EG9PP3	coeff : 0.21
Teacher In Charge : Pécastaing L.			
CM : 8 h	TD : 8 h	TP : 8 h	Proj : 0 h
			Language Français

INTRODUCTION

Electromagnetic compatibility (EMC) is the ability of an electrical or electronic device or system to function satisfactorily in its electromagnetic environment without itself producing electromagnetic disturbances that are detrimental to anything in that environment. This course is a pragmatic introduction to EMC. It aims to expose the origins, to describe the modes of coupling, to outline the effects of the parasites on the systems and finally to present the way to shield a device and to protect it.

TARGETED SKILLS

At the end of this module, students should:

- Understand the issues and acquire the basics of electromagnetic compatibility (EMC)
- Take into account all the key EMC parameters when designing equipment
- Know the orders of magnitude of potential electromagnetic interference
- Understand the concepts of shielding and optimise protection methods

CONTENT

- Sources of disturbance
- Propagation vectors - Coupling
- Effects on victims - Susceptibility
- Electromagnetic shielding

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

CC (EE, 1h30)*0.7 + TP (CR)*0.3

EC : TP electromagnetic simulations		EG9PP4	coeff : 0.33
Teacher In Charge : Pécastaing L.			
CM : 0 h	TD : 4 h	TP : 12 h	Proj : 20 h
			Language Français

INTRODUCTION

The objective of this course is to demonstrate to students the value of electromagnetic simulation through the use of the 3D electromagnetic (EM) analysis software solution CST Studio Suite®. This solution is dedicated to the design, analysis and optimisation of electromagnetic components and systems. The electromagnetic field solvers for applications are offered over the entire EM spectrum. Solvers can be combined to perform hybrid simulations, giving engineers the flexibility to analyse entire systems with many components efficiently and easily.

TARGETED SKILLS

At the end of this module, students should

- Be able to use the basic features of the CST Studio Suite software solution
- Understand the issues and potential benefits of electromagnetic and multiphysics simulation
- Be able to analyse electrostatic and electromagnetic simulation results and critically assess their veracity

CONTENT

- Potential of the CST Studio Suite software solution
- Getting to grips with static and transient solvers
- Electrostatic system simulations - Electric field distribution
- Transient simulation of EM emission systems

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

TP (PA)*0.5 + Proj (Rap)*0.5

TEACHING UNIT (UE) :

Safety, protection and industrial processes

ECTS : 4

Code UE : EG9SP

SKILLS COVERED BY THE UE :

- Understanding the basic principles of ionized gases
- Know the main processes using plasma
- Know the risks related to lightning and the associated electrical quantities
- Know the lightning protection devices and their sizing
- Mastering the challenges of safety in an industrial environment
- Master the means of electrical protection

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EG9SP1	Plasma processes and applications	0.4	CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7
EG9SP2	Lightning and Protection of networks and buildings	0.24	CC (EE, 1h)
EG9SP3	Safety in an industrial environment	0.36	CC (EE, 30min)*0.3 + CC (EE, 1h)*0.7

EC : Plasma processes and applications		EG9SP1	coeff : 0.4
Teacher In Charge : Paillol J.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

This module presents the basics of partially ionized gas physics, both microscopically and macroscopically, the various types of cold plasma reactors, and the main industrial applications.

TARGETED SKILLS

At the end of this module, students must:

- Master the physical mechanisms of the operation of a cold plasma reactor.
- Acquire basic notions about plasma reactivity and active species created in a reactor
- To know the main uses of plasmas in the treatment of gases, liquids and solids

CONTENT

1. Microscopic phenomena in a partially ionized gas.
2. Statistical laws, macroscopic phenomena.
3. Ionization, transport, influence of walls, sheaths.
4. Types of electric shocks and reactors.
5. Active species, kinetic in the landfill.
6. Applications of cold plasmas in the health field.
7. Applications to the treatment of gases, liquids and solids

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7

EC : Lightning and Protection of networks and buildings	EG9SP2	coeff : 0.24
Teacher In Charge : Sigogne C.		
CM : 10 h TD : 0 h	TP : 0 h	Proj : 0 h
		Language Français

INTRODUCTION

The purpose of this course is to introduce students to the development of lightning, the consequences on electrical networks and buildings as well as the means to be implemented to protect themselves from it.

TARGETED SKILLS

At the end of this module, students must:

- Be able to identify the phenomena involved in the lightning of an installation.
- Be able to understand the parameters necessary for the designing protections of electrical network and a building against lightning.
- Understand the experiments and models developed for the study of lightning.

CONTENT

Phenomenology of lightning
Direct protection of buildings
Indirect protection of power grids

RESSOURCES

PREREQUISITE

• Rakov and Uman, Lightning : Physics and Effects, Cambridge University Press
• Norme NF EN 62305 : Protection against lightning
• Norme IEC 61643-11 : Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods

EVALUATION PROCEDURES

CC (EE, 1h)

EC : Safety in an industrial environment EG9SP3 coeff : 0.36

Teacher In Charge : Rey-Bethbeder F., Hertzberg J.

CM : 18 h TD : 4 h TP : 0 h Proj : 0 h

Language Français

INTRODUCTION

Security, whether physical or digital, is a key issue in the sustainable development of the industry. This course, positioned at the end of the engineering cycle, takes up and completes the issues on safety at work, especially electrical, presented at the beginning of the formation. It also introduces the basics of corporate cybersecurity. The objective is thus to give a first level of competence on security needs in the professional environment both in terms of engineering activities and in terms of Information System (IS) and risks related to the Internet.

TARGETED SKILLS

At the end of this module, students must:

- Understand and analyze the different electrical risks ,
- Master the means of prevention,
- Identify collective and individual means of protection
- Understand the company's Information System and its security needs
- Know the main types of cyberattacks that can affect the company
- Know the basics of personal data protection (GDPR)
- Manage your usernames and passwords
- Know how to analyze Internet links to identify malicious cyber intent
- Understand the principles of computer encryption

CONTENT

1. Electrical risks for humans
2. Prevention of electrical risk
3. Protection of workers
4. Static electricity risks

5. Security Awareness
6. Cyberattacks
7. Protect your computer
8. GDPR and protection of personal data (PD)
9. Usernames and passwords
10. Internet addresses and links

RESSOURCES

Video Server
Online Forum

PREREQUISITE

EVALUATION PROCEDURES

CC (EE, 30min)*0.3 + CC (EE, 1h)*0.7

Semestre 10

LIST OF TEACHING UNITS (UE) OF THE SEMESTER

TC, Spe ou Path-ways	Code UE	Entitled UE	ECTS
GP-EN	EC0SS	Final Internship S10	30
GEII	EG0AP	Apprenticeship S10	30

Tronc Commun GP et EN

3rd Year - Semestre 10 -GP+EN													
UE Name	Code		EC Name	Hours (h)								ECTS / Coef.	
	UE	EC		Tot UE	Tot EC	Tot Prés.	*CM*	*TD*	*TP*	*TA*	*Proj*	ECTS UE	Coef. EC
Final Internship S10	**EC30SS**	EC30SS1	Specialised engineer work placement			-						**30**	1.00
Total TC				**0**		**0**	*0*	*0*	***0***		**0**	**30**	

TEACHING UNIT (UE) :

Final Internship S10

ECTS : 30

Code UE : EC0SS

SKILLS COVERED BY THE UE :

- Apply the scientific skills acquired in a professional environment.
- Acquire new scientific and technical skills
- Demonstrate their ability to communicate their results in a professional manner.
- Develop interpersonal skills (demonstrate ability to work in a team)
- Demonstrate their ability to work independently, to manage a long-term project in relation to the constraints of the department...
- Develop your cognitive skills (organise, plan, show creativity, be a force of proposal, mobilise your scientific and technical knowledge according to the target audience, mobilise your critical mind...)
- Understand economic intelligence and its consequences in terms of protection.
- Demonstrate knowledge of sustainable development management (environmental policy, LCA, circular economy, social policy, disability, etc.) in the company.

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EC0SS1	Specialised engineer work placement	1	Sta(Tr, Rap, Sout)

EC : Specialised engineer work placement		EC0SS1	coeff : 1
Teacher In Charge : Kousksou T., Vaxelaire J.			
CM : h	TD : h	TP : h	Proj : h
			Language Français

OVERVIEW

6-month internship in a company, with engineering assignments or end-of-study project

LEARNING OUTCOMES

- Apply the scientific skills acquired in a professional environment.
- Acquire new scientific and technical skills
- Demonstrate their ability to communicate their results in a professional manner.
- Develop interpersonal skills (demonstrate ability to work in a team)
- Demonstrate their ability to work independently, to manage a long-term project in relation to the constraints of the department...
- Develop your cognitive skills (organise, plan, show creativity, be a force of proposal, mobilise your scientific and technical knowledge according to the target audience, mobilise your critical mind...)
- Understand economic intelligence and its consequences in terms of protection.
- Demonstrate knowledge of sustainable development management (environmental policy, LCA, circular economy, social policy, disability, etc.) in the company.

DESCRIPTION

The end-of-studies engineering internship (the project) must enable the student to
- to put into practice the knowledge acquired during the three years of study in the engineering cycle
- consolidate and refine their professional project and their knowledge of the professional world
- to complete one's aptitude for the missions of an engineer
- to show initiative and creativity
- to know how to give an account of the work accomplished, to defend one's results according to

one's interlocutor
- to fit into the professional world
- to acquire knowledge in terms of economic intelligence
- to acquire knowledge of sustainable development management (environmental policy, LCA, circular economy, social policy, disability, etc.) in the company.

Two specific items will be developed during the end-of-studies engineering internship

1. Economic intelligence, the constraints of protection

Economic intelligence is the coordinated collection, processing and dissemination of information useful to economic players, to which must be added actions of influence and notoriety. Within this complex field, the student must describe the protection within the company

1/ Data protection

What measures are taken to protect data? How are the employees made aware of this?

2/ The protection of innovation

Does the company protect its innovation by legal action (patent, trademark registration, etc.)?

Personal analysis: for example, what is the interaction between economic intelligence and the internship and/or the team (department) in which the internship took place? What are your remarks on economic intelligence and protection within the company?

2. Sustainable development

The student should describe the company's policy on one or more of the following themes: environmental policy and LCA (life cycle analysis), circular economy and/or social policy, disability, with regard to the company's own activities (and not the product or service sold) and indicate the impact of this policy on his or her mission, his or her work station and the team in which the placement took place.

As far as disability is concerned (rather for companies with more than 20 employees), the student should know in particular
- the rate of employment of people with a RQTH (Recognition of Disabled Worker Status) in the company
- the amount of the contribution paid to AGEFIPH (Association Nationale de Gestion du Fonds pour l'Insertion Professionnelle des Personnes Handicapées)
- FIPHFP (fund for the integration of disabled people in the civil service)
- agreements signed with AGEFIPH or FIPHFP
- the policy for recruiting disabled staff, raising awareness of disability, the procedures in place for maintaining employment and the existing links with the occupational medicine service for the adaptation of workstations.

The student must develop the two compulsory items in his or her placement report (approximately 2 pages per item), first in a general manner, then he or she will develop his or her own analysis of the subjects.

RECOMMENDED READING

https://travail-emploi.gouv.fr/emploi/emploi-et-handicap/
https://www.agefiph.fr/
http://www.fiphfp.fr/

PREREQUISITE

stage d'ingénieur S9

ASSESSMENT

Sta(Tr, Rap, Sout)

SPECIALITE GEII

3rd Year - Semestre 10 - GEII													
UE Name	Code		EC Name	Hours (h)								ECTS / Coef.	
	UE	EC		Tot UE	Tot EC	Tot Prés.	*CM*	*TD*	*TP*	*TA*	*Proj*	ECTS UE	Coef. EC
Apprenticeship S10	**EG0AP**	EG0AP1	Skills developed the company	**0**	0	**0**					**5**	**30**	0.70
		EG0AP2	Mission in the company		0	**0**							0.30

TEACHING UNIT (UE) :

Apprenticeship S10

ECTS : 30

Code UE : EG0AP

SKILLS COVERED BY THE UE :

- Specify industrial manufactured devices involving electrical engineering and industrial computing, based on established and anticipated needs, in order to establish requirements essential to their design.
- Understand the general operation of electrical energy supply or conversion equipment, in order to determine the constraints of continuity of service and safety.
- Document the study and design of the equipment concerned in order to explain its operation, monitor its implementation or have it maintained.
- Understand the general operation of systems in supervised electrical engineering potentially under high voltage, in order to understand the operating and safety constraints.
- Know and understand a complex and interdisciplinary scientific and technical field of specialty to ensure the interface between the different partners by communicating on the progress of the work / project with both internally and with partners of the company.
- Apprehend a job in an international context, by mastering one or more foreign languages, by having a cultural openness, taking into account all the constraints (managerial, environmental, HR, CSR.) in order to promote synergy in the team.
- Master communication techniques adapted to the situation and the interlocutors in order to lead the development of a project in accordance with the company's strategy.
- Lead a multicultural team by adapting to the constraints and specificities of each, taking into account the cultural mix in its interactions, using adapted communication tools and methods, in order to establish an environment conducive to the success of the project in compliance with regulations, ethics, safety and health.

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

CODE EC	INTILTLED EC	COEF	EVALUATION
EG0AP1	Skills developed the company	0.7	EvalC (entreprise)*0.6 + PA (entreprise)*0.4
EG0AP2	Mission in the company	0.3	EvalC (Rap*0.5 + sout*0.5)

EC : Skills developed the company		EG0AP1	coeff : 0.7
Teacher In Charge : Pécastaing L.			
CM : h	TD : h	TP : h	Proj : 5 h
			Language Français

INTRODUCTION

During this last period of twenty-nine weeks in the company, which includes the longest continuous period of the cycle (27 weeks), the apprentice will be confronted with a multidisciplinary project that he will be able to manage and organize.

TARGETED SKILLS

The level of development of the 5 targeted skills must be reached at the end of the cycle:

- Developing complex industrial electrical devices
- Develop and implement electrical energy equipment
- Automate industrial environments
- Design and monitor potentially high-voltage systems
- Mobilizing a multidisciplinary team in an international context

CONTENT

The activities developed in this EC are established according to the specific needs of the company and with the aim of finalizing the acquisition of the targeted skills.

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

EvalC (entreprise)*0.6 + PA (entreprise)*0.4

EC : Mission in the company		EG0AP2	coeff : 0.3
Teacher In Charge : Pécastaing L.			
CM : h	TD : h	TP : h	Proj : h
			Language Français

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