Ecole Nationale Supérieure en Génie
des Technologies Industrielles

COURSE CATALOGUE

Second Year (M1, Sem. 7 and 8)

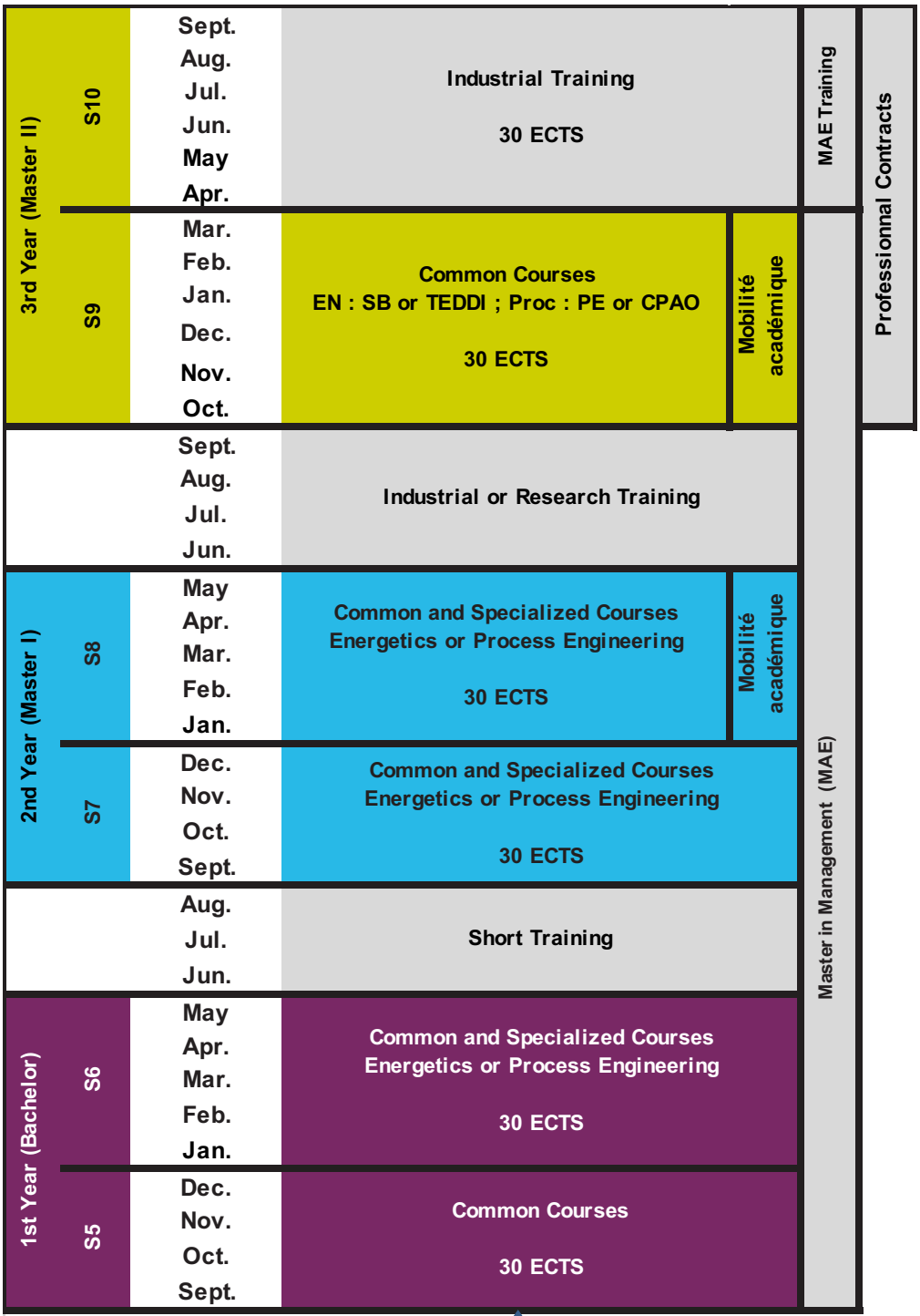
2023 - 2024

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

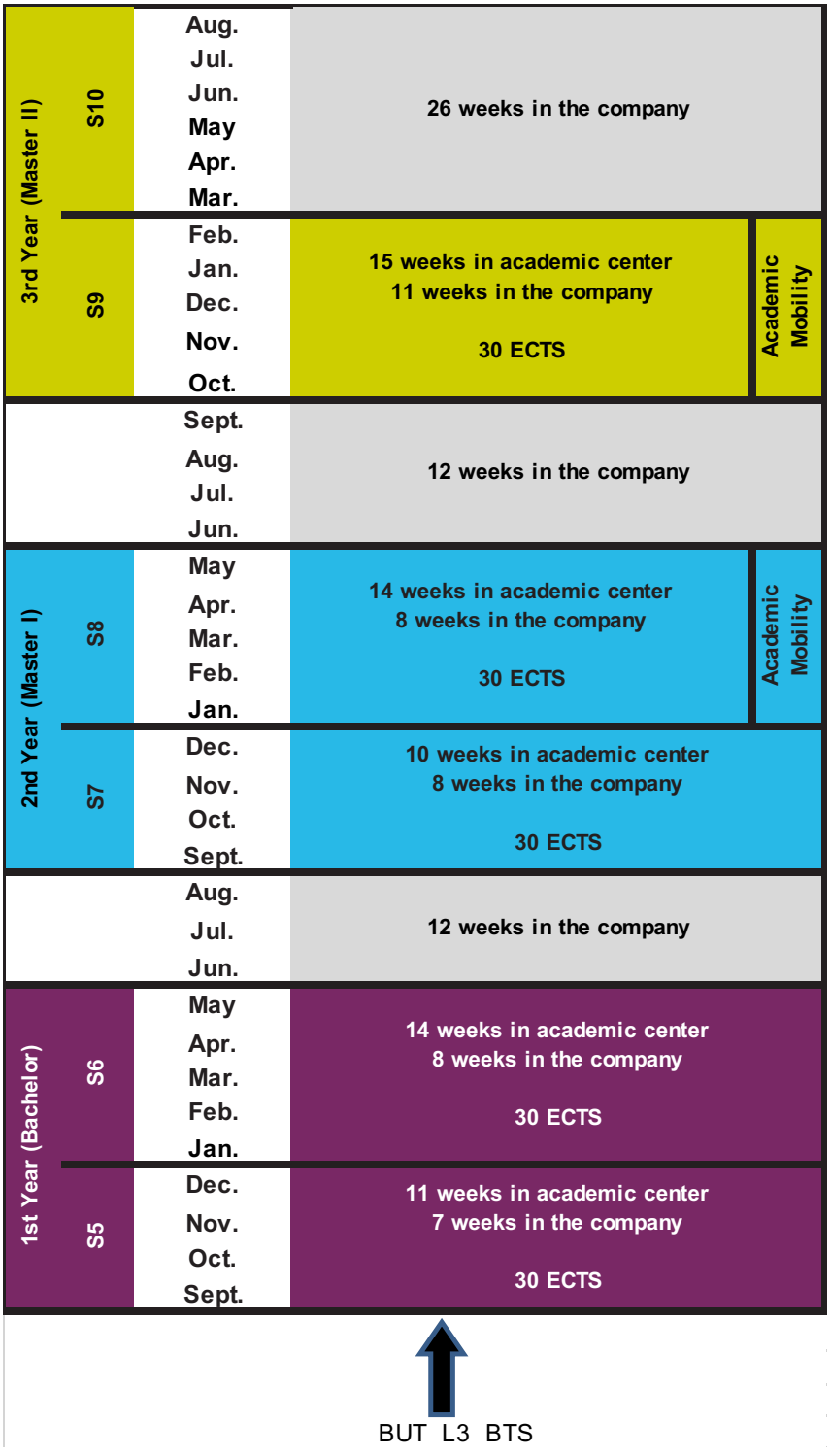
GENERAL CHRONOLOGY
Speciality Energetics and Process Engineering



CPGE BUT L3

Course Catalogue

GENERAL CHRONOLOGY
Speciality Electrical Engineering and Computer Science



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 7

LIST OF TEACHING UNITS (UE) OF THE SEMESTER

TC, Spe ou Path-ways	Code UE	Entitled UE	ECTS
GP-EN	EC7LC	Languages - Engineering Culture S7	6
GP-EN	EC7TM	Transport Phenomena – Mechanics S7	9
EN	EE7EA	Applied Energetics S7	6
EN	EE7MS	System Modeling and Simulation S7	9
GP	EP7OU	Unit Operation S7	10
GP	EP7RE	Reactor S7	5
GEII	EG7AP	Apprenticeship S7	5
GEII	EG7LC	Language and Culture of the Engineer S7	6
GEII	EG7II	Computer Science for Engineer S7	5
GEII	EG7EE	Electrical energy S7	6
GEII	EG7EL	Electronic S7	8

Tronc Commun GP et EN

2nd Year - Semester 7 - Commun Course EN+GP																
UE Name	Code UE	Code EC	EC Name	Teachers	Hours (h) Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj	ECTS / Coef. ECTS UE	Coef. EC
Languages - Engineering Culture S7	EC7LC	EC7LC1	English	Beigbeder S., Grenier A-C.	179	60	**30**	*0*	30	***0***	30	**0**	6	0.33
		EC7LC2	Second Foreign Language (Spanish/German)	Armenta A., Requena S., Perez Olivia I. / K. Hahn		40	**20**	*0*	*20*	***0***	20	**0**		0.17
		EC7LC3	Ethics - Sustainable Development	Ducousso M., Latour S., Rapin S.		70	**40**	*36*	*4*	***0***	30	**0**		0.33
		EC7LC4	Professional Insertion II	Mercadier J., Naudy F.		9	**4**	*2*	*2*	***0***	5	**5**		0.17
Transport Phenomena – Mechanics S7	EC7TM	EC7TM1	Mass Transfer	Contamine F.	240	20	**10**	*6*	*4*	***0***	10	**0**	9	0.12
		EC7TM2	Convective Heat and Mass Transfer	Alexandrova S., Bernada P.		56	**28**	*12*	*16*	***0***	28	**0**		0.22
		EC7TM3	Coupled Transfers I	Schmidmayer Kevin (INRIA)		24	**12**	*4*	*8*	***0***	12	**0**		0.11
		EC7TM4	Heat Exchangers	Alexandrova S.		36	**16**	*10*	*6*	***0***	20	*4*		0.11
		EC7TM5	Fluid Mechanics II	Lara Cruz J.		52	**26**	*12*	*14*	***0***	26	**0**		0.22
		EC7TM6	Boiling - Condensation	Bernada P., Kousksou T.		52	**26**	*12*	*14*	***0***	26	**0**		0.22
Total TC					**419**		**212**	94	118	0	**207**	9	**15**	

TEACHING UNIT (UE) :

Languages - Engineering Culture S7

ECTS : 6

Code UE : EC7LC

SKILLS COVERED BY THE UE :

- Demonstrating the ability to communicate in English in various professional situations
- Deepening the knowledge of a second language
- Demonstrating the knowledge of general business organisation and legal status
- Demonstrating the knowledge of key sustainable development issues
- Understanding issues in ethical risk management for business

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EC7LC1	English	0.33	Niveau intermédiaire : CoO+CoE (EE)x1/4 + CoO+CoE (EE)x1/4 + Cert(TOEIC 1)x1/4 +Cert(TOEIC 2)x1/4 Niveau avancé : ExO (EO)x2/6 + IntO(PA)x1/6 + ExE(EE)x2/6 + CoO/E (EE, 1h30)x1/6
EC7LC2	Second Foreign Language (Spanish/German)	0.17	CoOx1/5 + ExOx1/5 + IntOx1/5 + CoEx1/5 + ExEx1/5
EC7LC3	Ethics - Sustainable Development	0.33	CC(EE, 2h)
EC7LC4	Professional Insertion II	0.17	Sta(Rap)x3/4 + Proj(Rap)x1/4

EC : English		EC7LC1	coeff : 0.33
Teacher In Charge : Beigbeder S., Grenier A-C.			
CM : 0 h	TD : 30 h	TP : 0 h	Proj : 0 h
			Language Anglais

OVERVIEW

The course covers vocabulary and grammar useful for the business environment and future engineers in particular. It is also aimed at students preparing for the Test of English for International Communication (TOEIC).

TARGET SKILLS

Intermediate level

Students will practise the five skills as described in the Common European Framework of Reference for Languages (CEFR) : Listening, Speaking (including spoken interaction), Reading, and Writing (target level : Vantage/threshold : B2?C1).

Advanced level

Students will increase their knowledge through further practice of the five basic communicative skills : Listening, Speaking (including spoken interaction), Reading, and Writing. The goal is to enable them to communicate and interact fluently in an international business environment (target level : C1).

DESCRIPTION

Intermediate level

General and Business English : Toeic preparation, especially Listening and Reading comprehension. The course includes at least two complete mock Toeic exams and two mini tests.

Advanced level

Oral Business English for independent users : simulations of real?life business situations such as meetings, negotiations, presentations, debates, job interviews, phone calls...
Written expression: students will learn how to write their CV and cover letter, and general business correspondence.

BIBLIOGRAPHY

La Bible Officielle du test Toeic (Cassandra Harvey, Sandra von Barany, Danuta Langner, ETS Global/Hachette, 2018) Grammaire Vocabulaire du test Toeic, Cassandra Harvey et Danuta Langner (ETS Global/Hachette, 2018) Les Tests Officiels corrigés (ETS Global/Hachette, 2018).

REQUIREMENTS

Intermediate: No.
Advanced: 785 points for Toeic score or level CEFR (Common European Framework of Reference for Languages) B2 confirmed.

ASSESSMENT

Niveau intermédiaire : CoO+CoE (EE)x1/4 + CoO+CoE (EE)x1/4 + Cert(TOEIC 1)x1/4 +Cert(TOEIC 2)x1/4
Niveau avancé : ExO (EO)x2/6 + IntO(PA)x1/6 + ExE(EE)x2/6 + CoO/E (EE, 1h30)x1/6

EC : Second Foreign Language (Spanish/German)		EC7LC2	coeff : 0.17
Teacher In Charge : Armenta A., Requena S., Perez Olivia I. / K. Hahn			
CM : 0 h	TD : 20 h	TP : 0 h	Proj : 0 h
		Language Espagnol ou Allemand	

OVERVIEW

Sapnish

El objetivo es mejorar y consolidar las diferentes competencias definidas por el Marco común europeo de referencia para las lenguas.

German

Leveverstehen (Presseartikel)

LEARNING OUTCOMES

Spanish

Nivel A1 o Acceso:

Es capaz de comprender y utilizar expresiones cotidianas de uso muy frecuente así como frases sencillas destinadas a satisfacer necesidades de tipo inmediato. Puede presentarse a sí mismo y a otros, pedir y dar información personal básica sobre su domicilio, sus pertenencias y las personas que conoce. Puede relacionarse de forma elemental siempre que su interlocutor hable despacio y con claridad y esté dispuesto a cooperar.

Nivel A2 o Plataforma:

Es capaz de comprender frases y expresiones de uso frecuente relacionadas con áreas de experiencia que le son especialmente relevantes (información básica sobre sí mismo y su familia, compras, lugares de interés, ocupaciones, etc). Sabe comunicarse a la hora de llevar a cabo tareas simples y cotidianas que no requieran más que intercambios sencillos y directos de información sobre cuestiones que le son conocidas o habituales. Sabe describir en términos sencillos aspectos de su pasado y su entorno así como cuestiones relacionadas con sus necesidades inmediatas.

Nivel B1 o Intermedio:

Es capaz de comprender los puntos principales de textos claros y en lengua estándar si tratan sobre cuestiones que le son conocidas, ya sea en situaciones de trabajo, de estudio o de ocio. Sabe desenvolverse en la mayor parte de las situaciones que pueden surgir durante un viaje por zonas donde

se utiliza la lengua. Es capaz de producir textos sencillos y coherentes sobre temas que le son familiares o en los que tiene un interés personal. Puede describir experiencias, acontecimientos, deseos y aspiraciones, así como justificar brevemente sus opiniones o explicar sus planes.

Nivel B2 o Intermedio alto:
Es capaz de entender las ideas principales de textos complejos que traten de temas tanto concretos como abstractos, incluso si son de carácter técnico siempre que estén dentro de su campo de especialización. Puede relacionarse con hablantes nativos con un grado suficiente de fluidez y naturalidad de modo que la comunicación se realice sin esfuerzo por parte de ninguno de los interlocutores. Puede producir textos claros y detallados sobre temas diversos así como defender un punto de vista sobre temas generales indicando los pros y los contras de las distintas opciones.

Nivel C1 o Dominio operative eficaz:
Es capaz de comprender una amplia variedad de textos extensos y con cierto nivel de exigencia, así como reconocer en ellos sentidos implícitos. Sabe expresarse de forma fluida y espontánea sin muestras muy evidentes de esfuerzo para encontrar la expresión adecuada. Puede hacer un uso flexible y efectivo del idioma para fines sociales, académicos y profesionales. Puede producir textos claros, bien estructurados y detallados sobre temas de cierta complejidad, mostrando un uso correcto de los mecanismos de organización, articulación y cohesión del texto.

German
ODer student sollte in der lage sein, einen kurzen presseartikel zu verstehen, dn inhalt wiederzugeben bzw.fragen zu beantworten and sich kurz zum thema zu aubern.

DESCRIPTION

Sapnish
Variable en función del nivel.
Documentos auténticos de la vida cotidiana y de especialidad.
Documentos audio y video con trabajo de comprensión oral acompañdos de parrillas de comprensión.
Comunicación interna y externa. Interculturalidad.
Escritos profesionales (carta de presentación, CV, noticias, correos, documentos técnicos, informes...)
Trabajo en la red: www.ver-taal.com comprensión oral de reportajes, fragmentos de informaciones televisivas, enriquecimiento del vocabulario
Búsquedas sobre España y América Latina
Búsquedas sobre empresas españolas y latinoamericanas

German
Arbeit mit leichten presseatikeln zu aktuellen themen + grammatik

RECOMMENDED READING

Spanish

Documents fournis indiqués par les enseignantes en fonction du niveau.
Monde du travail :http://www.oficinaempleo.com/content/manualcv1.html
TV : http://www.rtve.es/
Presse: http://elpais.com/
Espagnol : www.ver-taal.com
Plateforme Chamilo de l'UPPA.

German

Website der welle : www.dw.world.de
Zeitschrift Fluter der Bundeszentrale fur politische bildung (kann kostenlos abonniert werden) : www.fluter.de
Grammatik : le memento du germaniste (JP Vasseur)

PREREQUISITE

Spanish

Ninguno para el grupo 1, nivel A2:B1 para el grupo 2, nivel B1/B2 para el grupo 3

German

Deutsch als zweite fremsprache

ASSESSMENT

CoOx1/5 + ExOx1/5 + IntOx1/5 + CoEx1/5 + ExEx1/5

EC : Ethics - Sustainable Development		EC7LC3	coeff : 0.33
Teacher In Charge : Ducousso M., Latour S., Rapin S.			
CM : 36 h	TD : 4 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The goal of this course is to raise awareness about corporate social responsibility, sustainable development and ethics

LEARNING OUTCOMES

S. Latour:

Understanding the corporate social responsibility

M.Ducousso:

Understanding the issues and impacts associated with (the required) use of fossil fuels and renewable energies

S. Rapin:

Understanding the ethics in company

DESCRIPTION

S. Latour:

- Concept of corporate social responsibility and its institutionalization
- New business models

M. Ducousso:

- The origin of resources and consumption (consumers)
- Greenhouse effect and global warming
- Renewable resources (technology and state of places)

S. Rapin:

- Struggle against corruption, fraud, anti-competitive practices and respect for human rights
- Ethical risk management

RECOMMENDED READING

GIEC, 2014 :Changements climatiques 2014 : Rapport de synthèse. Contribution des groupes de travail, I, II et III au cinquième rapport d'évaluation du groupe d'experts intergouvernemental sur l'évolution du climat [sous la direction de l'équipe de rédationc principale, R. K Pachauri et L.A. Meyer], GIEC, Genève, Suisse, 161 p.
"La RSE" théories et pratiques de Lépineux, éditions DUNOD

PREREQUISITE

ASSESSMENT

CC(EE, 2h)

EC : Professional Insertion II		EC7LC4	coeff : 0.17
Teacher In Charge : Mercadier J., Naudy F.			
CM : 2 h	TD : 2 h	TP : 0 h	Proj : 5 h
			Language Français

OVERVIEW

Internship

The major purpose of this internship is to discover the working world.

LEARNING OUTCOMES

- Being able to integrate in a professional environment
- Being able to work within a team
- Being able to communicate in writing
- Being able to summarize the main elements of a working task
- Analyse parity between men and women in compagnies

DESCRIPTION

The internship (one to three months) takes place in private companies when it is possible. Its essential purpose is enabling the student to discover the professional world.

During the internship period, the student must analyze how the parity is implemented in the company.

RECOMMENDED READING

Not applicable

PREREQUISITE

None

ASSESSMENT

Sta(Rap)x3/4 + Proj(Rap)x1/4

TEACHING UNIT (UE) :

Transport Phenomena – Mechanics S7

ECTS : 9

Code UE : EC7TM

SKILLS COVERED BY THE UE :

- Demonstrate proficiency in the use of heat and mass transfer principles (simple or coupled, with or without any phase change)
- Deepen the notions encountered in fluid mechanics: turbulent flow
- Demonstrate the ability to size and to use simple heat exchangers and heat exchangers network

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EC7TM1	Mass Transfer	0.12	CC(EE, 2h)
EC7TM2	Convective Heat and Mass Transfer	0.22	CC(EE, 2h, da : notes de cours, ca)
EC7TM3	Coupled Transfers I	0.11	CC(EE, 2h, sd, ca)
EC7TM4	Heat Exchangers	0.11	CC(EE, 1h, ca)x0.5+Proj(rap)x0.5
EC7TM5	Fluid Mechanics II	0.22	CC(ES, 45min, da, st,ca)x0,25 +CC(EE, 2h, da, st,ca)x0,75
EC7TM6	Boiling - Condensation	0.22	CC(EE 2h, da : notes de cours, ca)

EC : Mass Transfer		EC7TM1	coeff : 0.12
Teacher In Charge : Contamine F.			
CM : 6 h	TD : 4 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Description of mass transfer – Mass transfer from an interface into a well mixed solution

LEARNING OUTCOMES

Students are able to:

- Use some classic model for mass transfer's description
- Know definitions of mass transfer coefficients
- Describe mass flux across interfaces

DESCRIPTION

Models for transfer at fluid-fluid interface :
- Two films theory (Lewis et Whitman)
- Surface renewal theory (Higbie et Danckwerts)
- Mass transfer coefficients

RECOMMENDED READING

PREREQUISITE

Mass balance

ASSESSMENT

CC(EE, 2h)

EC : Convective Heat and Mass Transfer		EC7TM2	coeff : 0.22
Teacher In Charge : Alexandrova S., Bernada P.			
CM : 12 h	TD : 16 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The first part of this module concerns the convective transfers, and the analogies between momentum, heat and mass transfer. Then in the last part, natural and mixed convection are treated. Special attention is given to coupled heat and mass transfer during these phenomena

LEARNING OUTCOMES

The student will be able to :

- Predict rates of heat transfer and mass transfer in simple geometries;
- Predict heat and mass transfer coefficients (local, average and global) in flowing systems using appropriate correlations for forced and/or natural convection;
- Analyse and use the analogies between momentum, heat and mass transfers
- Understand the difference between natural and forced convection
- Apply the theory to calculate the heat flux in industrial processes where these phenomena take place.

DESCRIPTION

Forced convection
-Boundary Layers
-Viscous Drag and effect on Pressures
-Boundary Layer Theory, Laminar and Turbulent Boundary Layers, Transition
-Heat and mass transfer with laminar flow
-Heat and mass transfer with turbulent flow
-Analogies between momentum, heat and mass transfer Natural convection
-Description of the physical mechanisms occurring during natural convection
-Industrial examples,
-Detailed study of heat transfer between a vertical isothermal wall and a fluid at rest, determination

of a heat transfer coefficient.

Mixed convection
-Definition of mixed convection, quantitative criterion
-Heat transfer correlation for simple geometries

RECOMMENDED READING

Fundamentals of Heat and Mass transfer, F. P. INCROPERA, D. P. DEWITT, John Wiley&Sons, Inc, 2006
Transferts thermiques, J. TAINE, J.-P. PETIT, Dunod, 1995
Principles of Heat Transfer, M. KAVIANY, John Wiley&Sons, Inc, 2002

PREREQUISITE

ASSESSMENT

CC(EE, 2h, da : notes de cours, ca)

EC : Coupled Transfers I		EC7TM3	coeff : 0.11
Teacher In Charge : Schmidmayer Kevin (INRIA)			
CM : 4 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The coupled (or combined) heat transfers correspond to problems where the three modes of heat transfers are combined simultaneously (conduction, convection and radiation).

LEARNING OUTCOMES

After this course the students should:

- Be able to consider a simple problem of coupled heat transfers.
- Be able to judge preponderance of each of the three modes of heat transfers.

DESCRIPTION

1. Different modes of heat transfer (conduction, convection, radiation)
2. Methodologies (parietal or global balances...)
3. Main general results
4. Approaches
4.1. The exchange radiative coefficient
4.2. Analytical Methods
5. Examples
5.1. Problems involving radiative and conductive heat transfers
5.2. Problems involving radiative and convective heat transfers
5.3. Problems involving radiative conductive and convective heat transfers

RECOMMENDED READING

A Heat Transfer Textbook. Third Edition. John H. Lienhard IVand John H. Lienhard V., Phlogiston Press Cambridge Massachusetts
Heat Transfer. A. Bejan. John Wiley & Sons, New York, 1993

PREREQUISITE

Heat conduction 1 (EC15TM2), radiation (EC15TM4), convection (EC27TM2)

ASSESSMENT

CC(EE, 2h, sd, ca)

EC : Heat Exchangers		EC7TM4	coeff : 0.11
Teacher In Charge : Alexandrova S.			
CM : 10 h	TD : 6 h	TP : 0 h	Proj : 4 h
			Language Français

OVERVIEW

Heat exchangers are the most common components of energetic systems and cycles. For that reason, it's very important to be perfectly familiar with the ways they are selected or designed face to particular predetermined conditions. Particular attention is paid to the different technologies of heat exchangers that are available on the market.

LEARNING OUTCOMES

After this courses, student must be able:

- to correctly select a heat exchanger from manufacturer brochures
- to design an efficient heat exchanger
- be familiar with selection and calculation tools for heat exchangers

DESCRIPTION

-Theoretical approach
-Industrial heat exchangers and sizing methods
-Network of heat exchangers
-Conclusions and recent developments

RECOMMENDED READING

Initiation aux transferts thermiques J. F. Sacadura (tech&doc) ISBN 2-85206-618-1
Heat exchangers S. Kakac, A. E. Bergles, F. Mayinger (HPC) ISBN 0-89116-225-9

PREREQUISITE

Heat conduction, Convection

ASSESSMENT

CC(EE, 1h, ca)x0.5+Proj(rap)x0.5

EC : Fluid Mechanics II		EC7TM5	coeff : 0.22
Teacher In Charge : Lara Cruz J.			
CM : 12 h	TD : 14 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The course is divided in two parts and objectives. The first part deals with the use of global theorems of Fluid Mechanics (conservation of energy and momentum) for the scaling of hydraulics systems. The second part deals with turbulence, describing the principles of turbulence governing mixing phenomena and transfer processes in flows.

LEARNING OUTCOMES

At the end of the course, the student is able to analyse and to scale a hydraulic system. He/She can estimate the head losses and pressure variations for stationary conditions in an hydraulic system et can set recommendation for choosing a pump. He can predict the occurrence of cavitation. He knows the water-hammer phenomena.
The student is able to express a physical result in terms of non-dimensional quantities consistent with the equations describing the dynamics of the system.
The student knows how to characterize the mechanical properties of a solid and of a fluid and knows the principle of rheometers.
The student knows the physical principles of turbulence in a flow (dissipation, turbulent diffusion). He is aware of the respective roles of large and small scale eddies in the process of turbulent mixing. He knows the basic modelling tools for a turbulent flow (mixing length model, k-? model, IEM model).

DESCRIPTION

The course is divided in seven chapters:
I - Dimensional analysis, and non-dimensional numbers relevant for a flow
II - Scaling of an hydraulic systems in stationary conditions
III- Non-stationary phenomena in an hydraulic system (water hammer)
IV- Elements for rheometers
V - The large scales of turbulence - dissipation - turbulent diffusion
VI- The small scales of turbulence - Micromixing
VII - Elementary tools for modelling a turbulent flow and the transport of a passive or reactive quantity

RECOMMENDED READING

Ecoulements pour les procédés, M. Mory, Hermès-Lavoisier, 2010. Fluid Mechanics for chemical engineering, M. Mory, ISTE-J. Wiley, 2011.

PREREQUISITE

It is assumed that the student knows the Navier-Stokes equations and is able to use the global theorems of fluid mechanics (conservation of energy and momentum). He/She knows also the scaling for head losses in pipes and for pumps.

ASSESSMENT

CC(ES, 45min, da, st,ca)x0,25 +CC(EE, 2h, da, st,ca)x0,75

EC : Boiling - Condensation		EC7TM6	coeff : 0.22
Teacher In Charge : Bernada P., Kousksou T.			
CM : 12 h	TD : 14 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Boiling and condensation take an important place in many unit operations of chemical engineering (evaporator, condenser, distillation etc...). Special attention is given to coupled heat and mass transfer during these phenomena.

LEARNING OUTCOMES

After this course, students should be able to:

- Understand the difference between natural and forced convection, pool and convective boiling, and which are the governing forces for these phenomena,
- be able to determine heat transfer coefficients in simple cases of natural convection, boiling and condensation,
- apply the theory to calculate the heat flux in industrial processes where these phenomena take place.
- Modeling of two phase flow

DESCRIPTION

I Boiling

•Heat transfer during pool boiling,
•Heat transfer during convective boiling,

II Condensation

•Detailed study of heat transfer between a vertical isothermal wall and a condensing pure vapor, determination of the heat transfer coefficient, Nusselt theory,
•Influence of turbulence, vapor shear stress, non condensable gases

III Two phase flow (Ebullition/condensation)

•Governing equations (Mass, Momentum, Energy, Entropy)

RECOMMENDED READING

Fundamentals of Heat and Mass transfer, F. P. INCROPERA, D. P. DEWITT, John Wiley&Sons, Inc, 2006
Transferts thermiques, J. TAINE, J.-P. PETIT, Dunod, 1995
Principles of Heat Transfer, M. KAVIANY, John Wiley&Sons, Inc, 2002

PREREQUISITE

Conduction 1 (EC15TM2), fluid mechanics (EC16TM4), Thermodynamics (EC15TB2

ASSESSMENT

CC(EE 2h, da : notes de cours, ca)

SPECIALITE EN

2nd Year - Semester 7 - EN															
UE Name	Code UE	Code EC	EC Name	Teachers	Hours (h) Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj.	ECTS / Coef. ECTS UE	Coef. EC
Applied Energetics S7	EE7EA	EE7EA1	Humid Air	Gibout S.	164	28	14	6	8	0	14	0	6	0.20
		EE7EA2	Compressible Flow	Bernanda P.		40	20	10	10	0	20	0		0.20
		EE7EA3	Coupled Heat Transfers II	Bédécarrats J-P.		36	18	8	10	0	18	0		0.20
		EE7EA4	Industrial Combustion	Dupuy Fabien (GDTech)		60	30	14	16	0	30	0		0.40
System Modeling and Simulation S7	EE7MS	EE7MS1	Computational Fluid Dynamics	Serra S.	268	148	48	16	32	0	100	50	9	0.50
		EE7MS2	Numerical Modeling	Gibout S.		120	40	8	32	0	80	40		0.50
Total Spec EN					432		170	62	108	0	262	90	15	
Total TC + Spec EN					851		382						30	

TEACHING UNIT (UE) :

Applied Energetics S7

ECTS : 6

Code UE : EE7EA

SKILLS COVERED BY THE UE :

- Understand the advanced principles of heat transfer (coupled transfer) and momentum (compressible flow)
- Understand the principles of industrial combustion

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EE7EA1	Humid Air	0.2	CC(EE, 1h30, da: une feuille A4 recto manuscrite)
EE7EA2	Compressible Flow	0.2	CC(EE, 2h, sd, sc)
EE7EA3	Coupled Heat Transfers II	0.2	CC(EE, 2h, sd, ca)
EE7EA4	Industrial Combustion	0.4	CC(EE, 2h, sd, sc)

EC : Humid Air		EE7EA1	coeff : 0.2
Teacher In Charge : Gibout S.			
CM : 6 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Air is the preferred vehicle of heat, cold or moisture in order to cool a building. It should be treated to obtain the required specifications in terms of temperature and humidity.

LEARNING OUTCOMES

This course provides:

- The acquisition of basic knowledge of humid air,
- The description of the thermodynamic evolution of humid air for different types of transformations and the use of the psychometric diagram,
- Knowledge of the different elements of air treatment unit and how to design them.

DESCRIPTION

Introduction
1) Properties of humid air
2) Psychometric diagram
3) Climatisation and air treatment
4) Examples of humid air transformation
5) Heat recovery
Conclusion

RECOMMENDED READING

Jannot Y. 2005, L'air humide, accessible via : www.thermique55.com/principal/airhumide.pdf
Crétinon B., Blanquard B., Air humide : Notions de base et mesures, Techniques de l'ingénieur.
Bensafi A. Air Humide : Traitement et conditionnement de l'air, Techniques de l'ingénieur.

PREREQUISITE

Thermodynamics

ASSESSMENT

CC(EE, 1h30, da: une feuille A4 recto manuscrite)

EC : Compressible Flow		EE7EA2	coeff : 0.2
Teacher In Charge : Bernanda P.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

One of the basic notions in the energy field deals with the behaviour of compressible flows, which are know to present some intrinsic differences in comparison with the incompressible ones. The aim here is to present these specifications (waves propagation and speed of sound, expansion and shock waves...), as well as some concrete real applications (nozzle operating, design of a safety valve for pressurized vessels...).

LEARNING OUTCOMES

- Being capable to characterize a compressible flow and the associated specifications.
- Extend the study capabilities to more realistic situations
- Masterize the behaviour of devices operating in the compressible regime

DESCRIPTION

0 Introduction
1 Forewords
1.1 Thermodynamics
1.2 Fluid mechanics
2 One-dimensional steady flow
2.1 Adiabatic flow
2.2 Isentropic flow
2.3 Thrust force
3 Normal shock waves
3.1 Steady normal shock waves
3.2 Weak shock waves
3.3 Shock tube
4 Adiabatic flow in nozzles
4.1 Converging nozzles
4.2 Converging-diverging nozzles (Laval nozzles)
5 Fanno flows

5.1 Constitutive equations
5.2 Critical state, Fanno tables
6 Non-adiabatic flows
6.1 Constitutive equations
6.2 Critical state, Rayleigh tables
7 Conclusion

RECOMMENDED READING

Y. A. Cengel and M. A. Boles. Thermodynamics : an engineering approach. McGraw-Hill, fifth edition, 2006.
Didier Desjardins, Michel Combarnous, and Natalie Bonneton. Mécanique des fluides. Problèmes résolus avec rappels de cours. Dunod, 2002.
Thierry Faure. Dynamique des fluides appliquée. Dunod, 2008.
M. J. Moran and H. N. Shapiro. Fundamentals of Engineering Thermodynamics. John Wiley and Sons, fifth edition, 2006.
Roger Ouziaux and Jean Perrier. Mécanique des fluides appliquée. Dunod, 1998.
Inge L. Ryhming. Dynamique des fluides. Presses polytechniques et universitaires romandes, 2nd edition, 2009.
A. Shapiro. The Dynamics and Thermodynamics of Compressible Fluid Flow, volume 1. The Ronald press company, 1953.
A. Shapiro. The Dynamics and Thermodynamics of Compressible Fluid Flow, volume 2. The Ronald press company, 1954.
R. D. Zucker and O. Biblarz. Fundamentals of gas dynamics. John Wiley & Sons, Ltd, second edition, 2002.

PREREQUISITE

Thermodynamique générale (EC15TB2)
Mécanique des fluides I (EC16TM4)

ASSESSMENT

CC(EE, 2h, sd, sc)

EC : Coupled Heat Transfers II		EE7EA3	coeff : 0.2
Teacher In Charge : Bédécarrats J-P.			
CM : 8 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The coupled heat transfers correspond to problems where the three modes of heat transfers are combined simultaneously (conduction, convection and radiation). This part is the continuation of the course "coupled heat transfers 1" where more complex problems closer to the industrial problems will be dealt with.

LEARNING OUTCOMES

After this course the students should:

- Be able to consider a complex problem of coupled transfers.
- Be able to judge preponderance of each of the three modes of transfers in non steady state.

DESCRIPTION

1. Problem of coupled heat transfer in a non steady state regime
1.1. Biot criterion
1.2. Study of thin bodies
1.3. Study of thick bodies
2. Radiative heat transfer with gases
2.1. Thermal radiation properties of gases
2.2. Analogic scheme for gases
2.3. Examples
3. Heat transfer by radiation in furnaces
3.1. Introduction
3.2. Variation of temperature versus time
3.3. Non isothermal systems

RECOMMENDED READING

A Heat Transfer Textbook. Third Edition. John H. Lienhard IVand John H. Lienhard V. Phlogiston Press Cambridge Massachusetts
Heat Transfer. A. Bejan. John Wiley & Sons, New York, 1993

PREREQUISITE

Heat conduction 1 et 2 (EC15TM2) et (EE16MT1), radiation (EC15TM4), convection (EC27TM2), coupled heat transfers 1 (EC27TM3)

ASSESSMENT

CC(EE, 2h, sd, ca)

EC : Industrial Combustion		EE7EA4	coeff : 0.4
Teacher In Charge : Dupuy Fabien (GDTech)			
CM : 14 h	TD : 16 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Beyond the basic physical phenomenon, which is a cornerstone in the energy field, most of the human devices rely on combustion. Consequently, the aim here is to present the theoretical knowledges as well as the practical parameters allowing the design and operation of industrial processes.

LEARNING OUTCOMES

- Fundamental knowledges about combustibles, comburants and the associated reactions
- Identification and analysis of any kind of combustion
- Integration of a combustion reaction in an industrial process

DESCRIPTION

0 Introduction
1 Forewords
1.1 System description
1.2 Heat of reaction
1.3 Thermochemical equilibrium
1.4 Thermochemical kinetics
2 General features
2.1 Reactives and products of combustion
2.2 Apparition of a combustion reaction
2.3 Stoechiometric combustion
2.4 Real combustion
2.5 Combustion analysis devices
3 Industrial installations
3.1 Technologie for energy applications
3.2 Total balance
4 Pollution
4.1 Dusts and ashes
4.2 Hydrocarbons

4.3 Carbon monoxyde
4.4 Sulphur oxides
4.5 Nitrogen oxides
4.6 Green-houses gases (GHG)
5 Conclusion

RECOMMENDED READING

P. Arquès. La Combustion. Inflammation, combustion, pollution. Applications. Ellipses, 2004.
J.-P. Bédécarrats. Cycles moteurs avancés. U.E. Thermodynamique - Transfert (ENSGTI 2A).
J.-P. Bédécarrats. Thermodynamique appliquée à l'énergétique. U.E. Applications Energétiques 2ème année (ENSGTI).
L. Borel and D. Favrat. Thermodynamique et Énergétique. Volume 1, de l'énergie à l'exergie. Presses polytech-niques et universitaires romandes, 2005.
L. Borel, D. Favrat, D. L. Nguyen, and M. Batato. Thermodynamique et Énergétique. Volume 2, problèmes résolus et exercices. Presses polytechniques et universitaires romandes, 3rd edition, 2008.
M. W. Jr. Chase. JANAF Thermochemical Tables. J. of Phys. and Chem. Ref. Data, 1998.
Y. Deschamps. Combustibles gazeux. utilisation et combustibilité des gaz. Techniques de l'Ingénieur, A 1751, 1990.
E. Esposito. Température et composition des gaz brûlés. Techniques de l'Ingénieur, A 1610, 1990.
M. Feidt. Energétique : Concepts et applications. Dunod, 2006.
W. Fickett and W. C. Davis. Detonation. University of California Press, 1979.
E. Franquet. Ecoulements compressibles. U.E. Thermodynamique -Transfert 2ème année (ENSGTI).
E. Franquet. Technologies de conversion. U.E. Conversion et Distribution de l'énergie 3ème année, parcours Energétique Industrielle (ENSGTI).
I. Glassman and R. A. Yetter. Combustion. Elsevier, 2008.
J.-C. Guibet. Les carburants et la combustion. Techniques de l'Ingénieur, B 2520,1990.
J.-C. Guibet. Carburants et moteurs. Editions Technip, 1997.
D. Haillot. Air humide. U.E. Thermodynamique -Transfert 2ème année (ENSGTI).
A. Lallemand. Energétique de la combustion - aspects fondamentaux. Techniques de l'Ingénieur, BE 8311, 2013.
A. Lallemand. Energétique de la combustion - caractéristiques techniques. Techniques de l'Ingénieur, BE 8312, 2013.
S. Laurent. Thermodynamique chimique. U.E. Themodynamique-Bilan 1ère année (ENSGTI).
P. Le Cloirec. Traitement des fumées. Techniques de l'Ingénieur, BE 8856, 1990.
A. Linan and F. A. Williams. Fundamentals aspects of combustion. Oxford University Press, 1993.
M.J. Moran and G. Tsatsaronis. Engineering thermodynamics. CRC Press LLC, 2000.
M. Mory. Mécanique des fluides II. U.E. Transfert-Mécanique II 2ème année (ENSGTI).
R. Pachauri and A. Reisinger. Bilan 2007 des changements climatiques : Rapport de synthèse. Groupe d'experts intergouvernemental sur l'évolution du climat, 2007.

J. Parisot. Conception et calcul des chaudières : généralités et bilans. Techniques de l'Ingénieur, B 1460, 1990.
N. Peters. Turbulent Combustion. Cambridge University Press, 2000.
G. Prudhon, F. Jacquesson, J. Lete, and S. Paris. Combustibles solides. charbon. Techniques de l'Ingénieur, BE 8 531, 1990.
J.-P. Serin. Thermodynamique générale. U.E. Themodynamique-Bilan 1ère année (ENSGTI).
American Chemical Society and the American Institute of Physics for the National Bureau of Standards, editors.The NBS tables of chemical thermodynamic properties : selected values for inorganic and C1 and C2 organic substances in SI units. J. of Phys. and Chem. Ref. Data, 1982.
J. Warnatz, U. Maas, and R. W. Dibble. Combustion. Physical and Chemical Fundamentals, Modeling and Simulations, Experiments, Pollutant Formation. Springer, 1999.

PREREQUISITE

Thermodynamique générale (EC15TB2) Thermodynamique chimique (EC15TB3) Mécanique des fluides I (EC16TM4)

ASSESSMENT

CC(EE, 2h, sd, sc)

TEACHING UNIT (UE) :

System Modeling and Simulation S7

ECTS : 9

Code UE : EE7MS

SKILLS COVERED BY THE UE :

- Demonstrate the ability to develop a model for a thermal or an energy issue. Implement and use different means or computer simulation tools and computer programming tools

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EE7MS1	Computational Fluid Dynamics	0.5	Proj(Tr, Rap)
EE7MS2	Numerical Modeling	0.5	Proj(Rap, code)

EC : Computational Fluid Dynamics		EE7MS1	coeff : 0.5
Teacher In Charge : Serra S.			
CM : 14 h	TD : 32 h	TP : 0 h	Proj : 50 h
			Language Français

OVERVIEW

Advantages of CFD for the design or the improvement of industrial processes or products are now well-known. Consequently, the associated concepts have to be fully understood, those last ones being very general and independant of any software. Eventually, having its own- experiment being here very important, practical cases are developped so as to practice (in the Ansys workbench).

LEARNING OUTCOMES

- Masterize the basic notions of CFD so as to build, criticize or realize any study
- Being capable to solve a real problem with a CFD code
- Know the strengths and weaknesses of CFD solutions

DESCRIPTION

0 Introduction
1 Geometry and mesh
2 Physical modeling
3 Numerical modeling
4 Post-treatment
5 Conclusion

RECOMMENDED READING

M. Bôhle, D. Etling, U. Müller, K.R. Sreenivasan, U. Riedel, and J. Warnatz. Prandtl's essential of Fluid Mechanics. Springer, 2004
F. P. Incropera, D. P. DeWitt, T. L. Bergman, and A. Lavine. Fundamentals of heat and mass transfer. Wiley, 6th edition, 2007
Y. Nakayama. Introduction to Fluid Mechanics. Butterworth-Heinemann, 2000
J. Blazek. Computational fluid dynamics : principles and applications. Elsevier, 2001
T. Cebeci, J. P. Shao, F. Kafyeke, and E. Laurendeau. Computational Fluid Dynamics for Engineers. Horizons Publishing, 2005.
K. A. Hoffmann and S. T. Chiang. Computational Fluid Dynamics. Volume I. fourth edition, 2000.

K. A. Hoffmann and S. T. Chiang. Computational Fluid Dynamics. Volume II. fourth edition, 2000.
J. F. Wendt, editor. Computational Fluid Dynamics. An Introduction. Springer, 2009.
John D. Jr Anderson. Computational Fluid Dynamics. The basics with applications. McGraw-Hill, New York, 1995.
Suhas V. Patankar. Numerical heat transfer and fluid flow. McGraw-Hill, New York, 1980.
H. K. Versteeg and W. Malalasekera. An Introduction to computational fluid dynamics. The finite volume method. Pearson Education Limited, Harlow, second edition, 2007.
AIAA guide for the verification and validation of computational fluid dynamics simulations. Technical report, 1998.
Best practice guidelines for industrial computational fluid dynamics of single-phase flows. Technical report, European Research Community on Flow, Turbulence And Combustion (ERCOFTAC), 2000
Best practice guidelines for industrial computational fluid dynamics of multi-phase flows. Technical report, European Research Community on Flow, Turbulence And Combustion (ERCOFTAC), 2000.
William L. Oberkampf and Timothy G. Trucano. Verification and validation in computational fluid dynamics. Sandia report, 2002.

PREREQUISITE

Thermodynamique générale (EC15TB2)
Thermodynamique chimique (EC15TB3)
Bilans (EC15TB4)
Conduction I (EC95TM2)
Diffusion(EC15TM3)
Rayonnement (EC15TM4)
Mécanique des fluides I (EC16TM4)
Calcul scientifique I (EC16MI2)
Conduction II (EE16MT1)

ASSESSMENT

Proj(Tr, Rap)

EC : Numerical Modeling		EE7MS2	coeff : 0.5
Teacher In Charge : Gibout S.			
CM : 8 h	TD : 32 h	TP : 0 h	Proj : 40 h
			Language Français

OVERVIEW

The purpose of this course is to provide the student with the techniques and tools to numerically solve differential equations and partial derivative commonly encountered in the field of energy.

LEARNING OUTCOMES

At the end of this course, students should know how to:

- Impose the hypotheses required for modeling and then write the main equations
- Choose the best discretization scheme, depending on the type of problem
- Implement the algorithms
- Report, analyze and criticize the results

DESCRIPTION

The finite volume method
Spatial discretization: 1D, 2D, 3D cases in cartesian, cylindrical and spherical geometry
Time discretization: explicit and (semi-) implicit schemes
Different types of boundary condition space and time varying parameters
Modeling phase changes
fluid Flows

RECOMMENDED READING

PREREQUISITE

This course uses the skills acquired in the first year in the field of scientific computing, programming and course of physics.

ASSESSMENT

Proj(Rap, code)

SPECIALITE GP

2nd Year - Semester 7 - GP																
UE Name	Code UE	Code EC	EC Name	Teachers	Hours (h) Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj.	ECTS / Coef. ECTS UE	Coef. EC
Unit Operation S7	EP7OU	EP7OU1	Crystallisation	Serin J-P.	268	20	**10**	*4*	*6*	***0***	10	**0**	10	0.08
		EP7OU2	Humid Air - Drying	Bernada P.		40	**20**	*10*	*10*	***0***	20	**0**		0.15
		EP7OU3	Thermodynamic Modeling I	Cézac P.		68	**10**	*10*	*0*	***0***	58	*48*		0.25
		EP7OU4	Distillation	Olivier J.		36	**18**	*10*	*8*	***0***	18	***0***		0.13
		EP7OU5	Liquid-Liquid Extraction	Alexandrova S.		32	**16**	*8*	*8*	***0***	16	**0**		0.12
		EP7OU6	Absorption	Castéran F.		32	**16**	*8*	*8*	***0***	16	**0**		0.12
		EP7OU7	Physical Chemistry of Interfaces	Alexandrova S.		40	**20**	*10*	*10*	***0***	20	**0**		0.15
Reactor S7	EP7RE	EP7RE1	Heterogeneous Reactors	Contamine F.	136	80	**40**	*20*	*20*	***0***	40	**0**	5	0.58
		EP7RE2	Residence Time Distribution	Mercadier J.		32	**16**	*8*	*8*	***0***	16	**0**		0.24
		EP7RE3	Agitation and Mixing	Alexandrova S.		24	**12**	*6*	*6*	***0***	12	**0**		0.18
Total Spec GP					404		178	94	84	0	226	48	15	
Total TC + Spec GP					823		390						30	

TEACHING UNIT (UE) :

Unit Operation S7

ECTS : 10

Code UE : EP7OU

SKILLS COVERED BY THE UE :

- Demonstrate the knowledge of the theoretical foundations for the selection, the sizing and the modelling of separation unit operations: crystallisation, drying, distillation, absorption, extraction...

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EP7OU1	Crystallisation	0.08	CC(EE, 1h30, ca)
EP7OU2	Humid Air - Drying	0.15	CC(EE, 2h, da : notes de cours, ca)
EP7OU3	Thermodynamic Modeling I	0.25	Proj(Rap, Prog)
EP7OU4	Distillation	0.13	CC(EE, 2h, ca)
EP7OU5	Liquid-Liquid Extraction	0.12	CC(EE, 2h, ca)
EP7OU6	Absorption	0.12	CC(EE, 2h, ca)
EP7OU7	Physical Chemistry of Interfaces	0.15	CC(EE, 1h30min, da:formulaire, ca)

EC : Crystallisation		EP7OU1	coeff : 0.08
Teacher In Charge : Serin J-P.			
CM : 4 h	TD : 6 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Chemical industries use crystallisation units to purify solutions or to form crystal products such as sugar, medicine…
The main objective of this subject is to provide crystallisation basis.

LEARNING OUTCOMES

After this course, students should:

- understand the phenomena of meta-stability and supersaturation
- have a basic knowledge of the crystallisation processes
- be able to make balances on a crystallisation unit
- know some elements to select a crystalliser.

DESCRIPTION

Part I: Crystallisation process

The processes occurring during crystallisation are presented (supersaturation, nucleation, crystal grow, evolution of systems).
Influencing parameters are identified from the energetic and the kinetic aspects.

Part II: Industrial Crystalliser

Different types of industrial crystallizers are presented.
The methods to obtain supersaturation, agitation are described and the corresponding constraints and impacts on the crystal product.

Part III: Crystalliser Design

-Industrial constraints and thermodynamic data
-Choice of supersaturation generation and agitation method

-Balances (mass, energy, population)

RECOMMENDED READING

Puel F., Veesler S., Mangin D., Cristallisation Aspects Théoriques, TI J2 710. Mullin J. W., Crystallization 3rev. ed., Butterworth-Heinemann 1993.
Klein J-P., Boistelle R., Dugua J., Cristallisation industrielle Aspects Pratiques J2 788.

PREREQUISITE

General thermodynamics , balances (first year, common course)

ASSESSMENT

CC(EE, 1h30, ca)

EC : Humid Air - Drying		EP7OU2	coeff : 0.15
Teacher In Charge : Bernada P.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

After a brief presentation of the psychometric properties of humid air, two cases of evaporation (Stefan tube and convective evaporation) are treated and lead to the core of the lecture : drying of a solid product, treated as a unit operation.

LEARNING OUTCOMES

After this course, students should be able to:

- Evaluate all the psychometric properties of humid air, given two of them,
- Calculate the evaporation rate in simple cases as Stefan tube or convective evaporation over a horizontal wall,
- Design a dryer (calculate his section, length) given a production rate.

DESCRIPTION

I Humid air

Psychometric properties of humid air, humid air diagram

II Evaporation

•Evaporation in a stagnant gas (Stefan tube),
•convective evaporation,

III Drying

•study of water in porous solids,
•characterization of the different types of products destined to drying,
•description of some drying processes (convective drying, vacuum drying, contact drying. . .)
•detailed study of convective drying of a porous medium

RECOMMENDED READING

handbook of industrial drying, Mujumdar, 1992

séchage : des processus physiques aux procédés industriels, ed Tec&Doc, Nadau et Puiggali, 1995.

PREREQUISITE

ASSESSMENT

CC(EE, 2h, da : notes de cours, ca)

EC : Thermodynamic Modeling I		EP7OU3	coeff : 0.25
Teacher In Charge : Cézac P.			
CM : 10 h	TD : 0 h	TP : 0 h	Proj : 48 h
			Language Français

OVERVIEW

A general methodology is presented for process modelling (CAPE approach). A Classification is proposed according to the nature of the model equations: algebraic or differential equations. Numerical methods are presented and illustrative examples are taken from Chemical Engineering. During their project, the students have to formulate a model and to develop a FORTRAN code in order to solve it.

LEARNING OUTCOMES

- be able to formulate the model: variables (state variables/parameters) and equations (constitutive equations, balances, constraints. . .)
- be able to choose a solution strategy and numerical methods (according to the nature of the equations)
- be able to write a general and structured FORTRAN code in order to solve the problem.

DESCRIPTION

Part I: Algebraic Equations
-Illustrative Model: Multistage Separation Processes of Multicomponent Mixtures (MESH Equations)
-Numerical Methods: Linear Systems (direct and iterative methods, sparse systems . . .), Non Linear Systems (Newton – Raphson and Quasi - Newton methods)

Part II: Ordinary Differential Equations
-Illustrative Model: Plugged Flow Reactor (Steady State)
-Numerical Methods : Euler, Runge Kutta, Predictor – Corrector

Part III: Partial Differential Equations
-Illustrative Model: Plugged Flow Reactor (Dynamic)

-Numerical Methods : Discretisation (see EC28MI1 Subject for more details)

RECOMMENDED READING

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

PREREQUISITE

Programming FORTRAN – EC15MI2

ASSESSMENT

Proj(Rap, Prog)

EC : Distillation		EP7OU4	coeff : 0.13
Teacher In Charge : Olivier J.			
CM : 10 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Basic concepts of Distillation are introduced.

LEARNING OUTCOMES

- Have a basic knowledge of Distillation
- Be able to write mass and energy balances in this context
- Be able to evaluate the Number of Equilibrium Stages of the separation using graphical methods and ShortCuts
- Have a basic knowledge of azeotropic and extractive distillation
- Be able to propose the Distillation column design (diameter . . .)

DESCRIPTION

Single-stage and Multi-stage Distillation
-Mac Cabe – Thiele Method (Minimum Reflux, Total Reflux . . .)
-Ponchon – Savarit Method (Minimum Reflux, Total Reflux . . .)
-Multiple Feed, Side – Stream Withdrawal . . .
-Azeotropic Distillation
-Batch Distillation
-Multi - Component Distillation (Short Cuts)
-Design and Dimensioning

RECOMMENDED READING

Mass transfer operations R.E. Treybal Mac Graw Hill Co, New York, 1982
Separation processes K.C. King Mac Graw Hill Co, New York, 1980
Distillation design H. Kister Mc GrawHill, New York, 1992
Distillation - Principles and Practice J.G. Stichlmair; J.R. Fair Wiley-VCH New-York, 1998.

PREREQUISITE

ASSESSMENT

CC(EE, 2h, ca)

EC : Liquid-Liquid Extraction		EP7OU5	coeff : 0.12
Teacher In Charge : Alexandrova S.			
CM : 8 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Basic concepts for Liquid – Liquid Extraction is introduced.

LEARNING OUTCOMES

- Have a basic knowledge of Liquid-Liquid Extraction
- Be able to write mass and energy balances in this context
- Be able to evaluate the Number of Equilibrium Stages of the separation using graphical methods and Short Cuts

DESCRIPTION

-Distribution and Selectivity lines
-Crosscurrent and Countercurrent Operations
-Rectangular, Triangular and Jacnecke co-ordinates

RECOMMENDED READING

Mass transfer operations R.E. Treybal Mac Graw Hill Co, New York, 1982
Separation processes K.C. King Mac Graw Hill Co, New York, 1980
Liquid-Liquid Extraction Equipment J.C. Godfrey, M.J. Slater John Wiley & Sons, Chichester, 1994

PREREQUISITE

ASSESSMENT

CC(EE, 2h, ca)

EC : Absorption		EP7OU6	coeff : 0.12
Teacher In Charge : Castéran F.			
CM : 8 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Basic concepts for the following Unit Operations are introduced: Absorption, Désorption.

LEARNING OUTCOMES

After this course, students should:

- Have a basic knowledge of Absorption and Desorption
- Be able to write mass and energy balances in this context
- Be able to evaluate the Number of Equilibrium Stages of the separation using graphical methods and Short Cuts
- Be able to evaluate the Numbre of Transfer Unit and the Height of Transfer Unit of the separation using graphical methods and short cuts
- Be able to propose the absorption column design (diameter . . .)

DESCRIPTION

-Introduction - Defintion of Absorption
-Vapour – Liquid Equilibrium
-Isothermal Absorption
- Mass and heat balances
- Minimum Solvant Rate
- Equilibrium Stage Concept
- Mac Cabe - Thiele Method
- Transfer Unit Concept
- Non - Isothermal Absorption

RECOMMENDED READING

- Mass transfer operations R.E. Treybal Mac Graw Hill Co, New York, 1982
- Separation processes K.C. King Mac Graw Hill Co, New York, 1980.

PREREQUISITE

ASSESSMENT

CC(EE, 2h, ca)

EC : Physical Chemistry of Interfaces		EP7OU7	coeff : 0.15
Teacher In Charge : Alexandrova S.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

This course provides the physical-chemical fundamentals of surface and interface science: one-component and multi-component systems, segregation and adsorption, self-organization at interfaces, structure of surfaces and interfaces, interfacial forces.

LEARNING OUTCOMES

By the end of the module the students should be able to:

- Define terms (surface tension, contact angle, interfacial region,...)
- Explain the physical basis of surface tension in liquids, surface excesses, wetting, ...
- Perform calculations based on spreading of liquids on liquids, wetting of solids, surface excess
- Predict the shape of a surface tension vs concentration plot for different solvents/solutes
- Explain physical basis for techniques used to measure surface or interface tension
- Explain adsorption of gas/vapours at plans or capillary surfaces: adsorption isotherms, heats of adsorption, kinetics of adsorption...

DESCRIPTION

Surface and interface phenomena :
interfacial and superfacial tensions, fluid – liquid interfaces , fluid – solid interfaces (Laplace equation, Kelvin equation, Young –Dupre equation, Langmuir and BET Isotherms)

Surface and interface phenomena application to :
Super Saturation, Capillary condensation, Adsorption, Wetting, Porosity and pores radii determinations, Detergency, Crystallisation and others chemical engineering applications.

RECOMMENDED READING

Physical Chemistry of Surfaces, A. W. ADAMSON, John Wiley&Sons, Inc, 1990
Interfacial Transport Phenomena, J. C. Slattery, Springer-Verlag, 1990.

PREREQUISITE

Thermodynamics, Mass transfer

ASSESSMENT

CC(EE, 1h30min, da:formulaire, ca)

TEACHING UNIT (UE) :

Reactor S7

ECTS : 5

Code UE : EP7RE

SKILLS COVERED BY THE UE :

- Demonstrate the ability to measure the gas-liquid mass transfer and the transport phenomena in porous media; apply these notions to heterogeneous reactors sizing
- Demonstrate the ability to develop nonideal flow models in homogeneous chemical reactors
- Demonstrate the ability to design mixing unit operations during homogeneous phase or heterogeneous phase

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EP7RE1	Heterogeneous Reactors	0.58	CC(EE, 2h)
EP7RE2	Residence Time Distribution	0.24	CC(EE, 45 min)x0,35 + CC(EE, da, 1h15)x0,65
EP7RE3	Agitation and Mixing	0.18	CC(EE, 30 min, sd)x1/3 + CC(EE, 1h, da: cours+formulaire, ca)x2/3

EC : Heterogeneous Reactors		EP7RE1	coeff : 0.58
Teacher In Charge : Contamine F.			
CM : 20 h	TD : 20 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Chemical heterogeneous reactor analysis and design

LEARNING OUTCOMES

The students must be able to:

- describe effect of reaction on mass transfer
- write mass balance in fluid-fluid reactors
- choose fluid-fluid reactor
- describe effect of diffusion and reaction inside catalyst particles
- know the concept of effectiveness factor
- describe external mass and heat transfer resistance
- write mass balance in catalyst-fluid reactors

DESCRIPTION

Mass transfer accompagnied by irreversible reaction
Methods of discerning controlling mecanism
Enhancement factor, HattaNumber
Design for fluid-fluid reactors Solid catalyzed reaction
Action of a catalyst Film resistance control
Pore diffusion resistance
Method for measuring the resistance of pore diffusion on reaction Thiele modulus-Effectiveness factor
Heat effects during

RECOMMENDED READING

PREREQUISITE

Chemical reaction engineering, Kinetics

ASSESSMENT

CC(EE, 2h)

EC : Residence Time Distribution		EP7RE2	coeff : 0.24
Teacher In Charge : Mercadier J.			
CM : 8 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Residence time distribution is a simple method to model the hydrodynamic behaviour of a non ideal reactor.

LEARNING OUTCOMES

After this course, students should be able to:

- Identify hydrodynamic problems from experimental residence time distribution like short-circuits, dead zones...
- Determine parameters like average residence time, variance, or number of tanks-in-series from experimental data
- Build simple compartment models
- Determine the conversion rate in reactors represented by such models especially for first order reaction

DESCRIPTION

Residence Time Distribution (RTD)
Residence time.
Experimental methods for the determination of RTD, pulse experiment, step experiment.
Mathematical expression for RTD.
Van Der Laan's theorem for the calculation of moments of RTD.
Flow models; Tanks-in-series model, dispersion model, compartment models.
Conversion in non ideal flow reactors.

RECOMMENDED READING

Villermaux J., Génie de la réaction chimique - Conception et fonctionnement des réacteurs, Lavoisier, technique et documentation, 1993 (2ème édition)
Euzen J.P., P. Trambouze , J.P. Wauquier, Méthodologie pour l'extrapolation des procédés chimiques, éditions Technip, 1993

Trambouze P., H. Van Landeghem, J.P. Wauquier, Les réacteurs chimiques (conception, calcul, mise en œuvre), Technip, 1984

PREREQUISITE

Chemical reaction engineering: Heat and mass balance in ideal reactors

ASSESSMENT

CC(EE, 45 min)x0,35 + CC(EE, da, 1h15)x0,65

EC : Agitation and Mixing		EP7RE3	coeff : 0.18
Teacher In Charge : Alexandrova S.			
CM : 6 h	TD : 6 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The aim of this course is to communicate the principles of mixing of liquid, gas-liquid and solid-liquid systems, to provide recommendations for process design and scale up, and to discuss specifications for the selection and operation of mixing equipment.

LEARNING OUTCOMES

After this course, students should be able to :

- describe with precision the mixing problems for each system (dispersed or not)
- explain and use the concepts related to heat and mass transfer in mixing equipment
- choose the type of mixer to use for every specific operation and estimate the operation cost
- scale-up mixing installations

DESCRIPTION

-Mixing in industrial processes
-Mixing Concepts: Process requirements, dimensionless groups, flow, power requirements, rules for scale-up and scale-down
-Liquid homogenizing et Liquid-Liquid Dispersions
-Mixing in Gas-liquid system
-Mixing in Solid-Liquid system

RECOMMENDED READING

Engineering data on Mixing, R. Mezaki, M. Mochizuki, K. Ogawa, Elsevier, 2000
Agitation et Mélange, Catherine Zuereb, Martine Poux, Joël Bertrand, Dunod, 2006
Techniques de l'ingénieur, Ed. Techniques de l'ingénieur, 1993
Mecanics of Fluids , I. H. Shames, McGraw-Hill, Inc., New York, 1992
Mécanique des fluides et hydrolique, R.V. Giles, J. B. Evett, C. Liu, Série Schaum, McGraw-Hill, Inc., New York, 1995

PREREQUISITE

Fluid mechanics

ASSESSMENT

CC(EE, 30 min, sd)x1/3 + CC(EE, 1h, da: cours+formulaire, ca)x2/3

SPECIALITE GEII

2nd Year - Semester 7 - GEII															
UE Name	Code UE	Code EC	EC Name	Teachers	Hours (h) Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj.	ECTS / Coef. ECTS UE	Coef. EC
Apprenticeship S7	EG7AP	EG7AP1	Skills developed in the company	Pécastaing L.		0	**0**	*0*	*0*	***0***	**0**	**5**	**5**	0.80
		EG7AP2	Project: Coporate social responsability	Pécastaing L.		0	**0**	*0*	*0*	***0***	0	**0**		0.20
Language and Culture of the Engineer S7	EG7LC	EC7LC1	English	Beigbeder S., Grenier A-C.	**180**	60	**30**	*0*	30	***0***	30	**0**	**6**	0.33
		EC7LC2	Second Foreign Language (Spanish/German)	Meunier C., Requena S., Perez Olivia I. / K. Hahn		40	**20**	*0*	*20*	***0***	20	**0**		0.23
		EC7LC3	Ethics - Sustainable Development	Ducousso M., Latour S., Rapin S.		80	**40**	*36*	*4*	***0***	40	**0**		0.44
Computer Science for Engineer S7	EG7II	EG7II1	Linux and Language C	Rivaletto M.	**136**	80	**40**	*16*	*24*	***0***	40	*20*	**5**	0.52
		EG7II2	Object oriented programming	Dumas P.		56	**32**	12	12	*8*	24	*20*		0.48
Electrical energy S7	EG7EE	EG7EE1	Power converters	GUSEV A.	**156**	56	**28**	*10*	*10*	*8*	28	*0*	**6**	0.30
		EG7EE2	Electrical power generationtrique	Ruscassié R.		32	**16**	*6*	*10*	*0*	16	*0*		0.18
		EG7EE3	Lighting	Ruscassié R.		28	**14**	*6*	*8*	*0*	14	*0*		0.16
		EG7EE4	Mechanical design tools	De Ferron A.		40	**16**	0	4	*12*	24	*20*		0.36
Electronic S7	EG7EL	EG7EL1	Analog filtering	Pécastaing L.	**232**	64	**32**	*10*	*10*	*12*	32	*0*	**8**	0.27
		EG7EL2	Microwave circuits	Pécastaing L.		64	**32**	*10*	*10*	*12*	32	*0*		0.28
		EG7EL3	Electronic components	Ruscassié R.		32	**16**	*6*	*10*	***0***	16	**0**		0.14
		EG7EL4	System Specification	Rivaletto M.		32	**16**	*6*	*10*	***0***	16	**0**		0.14
		EG7EL5	Analog signal processing	Paillol J.		40	**20**	*10*	*10*	***0***	20	**0**		0.17
Total Spec GEII					**704**		**352**	128	172	52	**352**	60	**30**	
Total TC + Spec GEII					**704**		**352**						**30**	

TEACHING UNIT (UE) :

Apprenticeship S7

ECTS : 5

Code UE : EG7AP

SKILLS COVERED BY THE UE :

- Understand the general operation of electrical energy supply or conversion equipment, in order to determine the constraints of service continuity and safety.
- Study specific electrical energy supply or conversion systems, 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.
- Understand the general operation of supervised electrical engineering systems potentially under high voltage, in order to understand the operating and safety constraints.
- Develop control or diagnostic means in line with the expected performances in order to ensure a reliable and safe operation.
- 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, HR, CSR.) in order to promote synergy within the team.
- 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
EG7AP1	Skills developed in the company	0.8	EvalC (entreprise)*0.6 + PA (entreprise)*0.4
EG7AP2	Project: Coporate social responsability	0.2	EvalC (Rap)

EC : Skills developed in the company		EG7AP1	coeff : 0.8
Teacher In Charge : Pécastaing L.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 5 h
			Language Français

INTRODUCTION

During these eight weeks in the company, the apprentice will be confronted with a potentially multidisciplinary project which he will be able to organise and structure. They will also identify the occupational health and safety policy of their host company.

TARGETED SKILLS

- 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 in the team.
- 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 competences.

RESSOURCES

PREREQUISITES

EVALUATION PROCEDURES

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

EC : Project: Coporate social responsability		EG7AP2	coeff : 0.2
Teacher In Charge : Pécastaing L.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

During these eight weeks in the company, the apprentice will again be confronted with new problems related to his activities. He will be able to apprehend new scientific and technical fields, including multidisciplinary ones. He will be led to study and develop new devices in his company's field of activity.

TARGETED SKILLS

- Understand the general operation of electrical energy supply or conversion equipment, in order to determine the constraints of service continuity and safety.
- Study specific electrical energy supply or conversion systems, 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.
- Understand the general operation of supervised electrical engineering systems potentially under high voltage, in order to understand the operating and safety constraints.
- Develop control or diagnostic means in line with the expected performances in order to ensure a reliable and safe operation.

CONTENT

The apprentice submits a written report that assesses the level of competence acquired in the field of corporate social responsibility. The report addresses, among other things, the following themes: societal and environmental concerns and ethical issues at work within the host company. If possible, the apprentice makes the link with his or her activities.
Report of about fifteen pages of information, excluding table of contents, annexes, etc. From the introduction to the conclusion.
The apprentice must check with his/her Apprentice Master that there is no confidential information in the report before it is submitted to the LEA.

RESSOURCES

PREREQUISITES

EVALUATION PROCEDURES

EvalC (Rap)

TEACHING UNIT (UE) :

Language and Culture of the Engineer S7

ECTS : 6

Code UE : EG7LC

SKILLS COVERED BY THE UE :

- Demonstrating the ability to communicate in English in various professional situations
- Deepening the knowledge of a second language
- Demonstrating the knowledge of general business organisation and legal status
- Demonstrating the knowledge of key sustainable development issues
- Understanding issues in ethical risk management for business

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EC7LC1	English	0.33	Niveau intermédiaire : CoO+CoE (EE)x1/4 + CoO+CoE (EE)x1/4 + Cert(TOEIC 1)x1/4 +Cert(TOEIC 2)x1/4 Niveau avancé : ExO (EO)x2/6 + IntO(PA)x1/6 + ExE(EE)x2/6 + CoO/E (EE, 1h30)x1/6
EC7LC2	Second Foreign Language (Spanish/German)	0.23	CoOx1/5 + ExOx1/5 + IntOx1/5 + CoEx1/5 + ExEx1/5
EC7LC3	Ethics - Sustainable Development	0.44	CC(EE, 2h)

EC : English		EC7LC1	coeff : 0.33
Teacher In Charge : Beigbeder S., Grenier A-C.			
CM : 0 h	TD : 30 h	TP : 0 h	Proj : 0 h
			Language Anglais

OVERVIEW

The course covers vocabulary and grammar useful for the business environment and future engineers in particular. It is also aimed at students preparing for the Test of English for International Communication (TOEIC).

TARGET SKILLS

Intermediate level

Students will practise the five skills as described in the Common European Framework of Reference for Languages (CEFR) : Listening, Speaking (including spoken interaction), Reading, and Writing (target level : Vantage/threshold : B2?C1).

Advanced level

Students will increase their knowledge through further practice of the five basic communicative skills : Listening, Speaking (including spoken interaction), Reading, and Writing. The goal is to enable them to communicate and interact fluently in an international business environment (target level : C1).

DESCRIPTION

Intermediate level

General and Business English : Toeic preparation, especially Listening and Reading comprehension. The course includes at least two complete mock Toeic exams and two mini tests.

Advanced level

Oral Business English for independent users : simulations of real?life business situations such as meetings, negotiations, presentations, debates, job interviews, phone calls...
Written expression: students will learn how to write their CV and cover letter, and general business correspondence.

BIBLIOGRAPHY

La Bible Officielle du test Toeic (Cassandra Harvey, Sandra von Barany, Danuta Langner, ETS Global/Hachette, 2018) Grammaire Vocabulaire du test Toeic, Cassandra Harvey et Danuta Langner (ETS Global/Hachette, 2018) Les Tests Officiels corrigés (ETS Global/Hachette, 2018).

REQUIREMENTS

Intermediate: No.
Advanced: 785 points for Toeic score or level CEFR (Common European Framework of Reference for Languages) B2 confirmed.

ASSESSMENT

Niveau intermédiaire : CoO+CoE (EE)x1/4 + CoO+CoE (EE)x1/4 + Cert(TOEIC 1)x1/4 +Cert(TOEIC 2)x1/4 Niveau avancé : ExO (EO)x2/6 + IntO(PA)x1/6 + ExE(EE)x2/6 + CoO/E (EE, 1h30)x1/6

EC : Second Foreign Language (Spanish/German)		EC7LC2	coeff : 0.23
Teacher In Charge : Meunier C., Requena S., Perez Olivia I. / K. Hahn			
CM : 0 h	TD : 20 h	TP : 0 h	Proj : 0 h
		Language Espagnol ou Allemand	

OVERVIEW

Sapnish

El objetivo es mejorar y consolidar las diferentes competencias definidas por el Marco común europeo de referencia para las lenguas.

German

Leveverstehen (Presseartikel)

LEARNING OUTCOMES

Spanish

Nivel A1 o Acceso:

Es capaz de comprender y utilizar expresiones cotidianas de uso muy frecuente así como frases sencillas destinadas a satisfacer necesidades de tipo inmediato. Puede presentarse a sí mismo y a otros, pedir y dar información personal básica sobre su domicilio, sus pertenencias y las personas que conoce. Puede relacionarse de forma elemental siempre que su interlocutor hable despacio y con claridad y esté dispuesto a cooperar.

Nivel A2 o Plataforma:

Es capaz de comprender frases y expresiones de uso frecuente relacionadas con áreas de experiencia que le son especialmente relevantes (información básica sobre sí mismo y su familia, compras, lugares de interés, ocupaciones, etc). Sabe comunicarse a la hora de llevar a cabo tareas simples y cotidianas que no requieran más que intercambios sencillos y directos de información sobre cuestiones que le son conocidas o habituales. Sabe describir en términos sencillos aspectos de su pasado y su entorno así como cuestiones relacionadas con sus necesidades inmediatas.

Nivel B1 o Intermedio:

Es capaz de comprender los puntos principales de textos claros y en lengua estándar si tratan sobre cuestiones que le son conocidas, ya sea en situaciones de trabajo, de estudio o de ocio. Sabe desenvolverse en la mayor parte de las situaciones que pueden surgir durante un viaje por zonas donde

se utiliza la lengua. Es capaz de producir textos sencillos y coherentes sobre temas que le son familiares o en los que tiene un interés personal. Puede describir experiencias, acontecimientos, deseos y aspiraciones, así como justificar brevemente sus opiniones o explicar sus planes.

Nivel B2 o Intermedio alto:
Es capaz de entender las ideas principales de textos complejos que traten de temas tanto concretos como abstractos, incluso si son de carácter técnico siempre que estén dentro de su campo de especialización. Puede relacionarse con hablantes nativos con un grado suficiente de fluidez y naturalidad de modo que la comunicación se realice sin esfuerzo por parte de ninguno de los interlocutores. Puede producir textos claros y detallados sobre temas diversos así como defender un punto de vista sobre temas generales indicando los pros y los contras de las distintas opciones.

Nivel C1 o Dominio operative eficaz:
Es capaz de comprender una amplia variedad de textos extensos y con cierto nivel de exigencia, así como reconocer en ellos sentidos implícitos. Sabe expresarse de forma fluida y espontánea sin muestras muy evidentes de esfuerzo para encontrar la expresión adecuada. Puede hacer un uso flexible y efectivo del idioma para fines sociales, académicos y profesionales. Puede producir textos claros, bien estructurados y detallados sobre temas de cierta complejidad, mostrando un uso correcto de los mecanismos de organización, articulación y cohesión del texto.

German
ODer student sollte in der lage sein, einen kurzen presseartikel zu verstehen, dn inhalt wiederzugeben bzw.fragen zu beantworten and sich kurz zum thema zu aubern.

DESCRIPTION

Sapnish
Variable en función del nivel.
Documentos auténticos de la vida cotidiana y de especialidad.
Documentos audio y video con trabajo de comprensión oral acompañdos de parrillas de comprensión.
Comunicación interna y externa. Interculturalidad.
Escritos profesionales (carta de presentación, CV, noticias, correos, documentos técnicos, informes...)
Trabajo en la red: www.ver-taal.com comprensión oral de reportajes, fragmentos de informaciones televisivas, enriquecimiento del vocabulario
Búsquedas sobre España y América Latina
Búsquedas sobre empresas españolas y latinoamericanas

German
Arbeit mit leichten presseatikeln zu aktuellen themen + grammatik

RECOMMENDED READING

Spanish

Documents fournis indiqués par les enseignantes en fonction du niveau.
Monde du travail :http://www.oficinaempleo.com/content/manualcv1.html
TV : http://www.rtve.es/
Presse: http://elpais.com/
Espagnol : www.ver-taal.com
Plateforme Chamilo de l'UPPA.

German

Website der welle : www.dw.world.de
Zeitschrift Fluter der Bundeszentrale fur politische bildung (kann kostenlos abonniert werden) : www.fluter.de
Grammatik : le memento du germaniste (JP Vasseur)

PREREQUISITE

Spanish

Ninguno para el grupo 1, nivel A2:B1 para el grupo 2, nivel B1/B2 para el grupo 3

German

Deutsch als zweite fremsprache

ASSESSMENT

CoOx1/5 + ExOx1/5 + IntOx1/5 + CoEx1/5 + ExEx1/5

EC : Ethics - Sustainable Development		EC7LC3	coeff : 0.44
Teacher In Charge : Ducousso M., Latour S., Rapin S.			
CM : 36 h	TD : 4 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The goal of this course is to raise awareness about corporate social responsibility, sustainable development and ethics

LEARNING OUTCOMES

S. Latour:

Understanding the corporate social responsibility

M.Ducousso:

Understanding the issues and impacts associated with (the required) use of fossil fuels and renewable energies

S. Rapin:

Understanding the ethics in company

DESCRIPTION

S. Latour:

- Concept of corporate social responsibility and its institutionalization
- New business models

M. Ducousso:

- The origin of resources and consumption (consumers)
- Greenhouse effect and global warming
- Renewable resources (technology and state of places)

S. Rapin:

- Struggle against corruption, fraud, anti-competitive practices and respect for human rights
- Ethical risk management

RECOMMENDED READING

GIEC, 2014 :Changements climatiques 2014 : Rapport de synthèse. Contribution des groupes de travail, I, II et III au cinquième rapport d'évaluation du groupe d'experts intergouvernemental sur l'évolution du climat [sous la direction de l'équipe de rédationc principale, R. K Pachauri et L.A. Meyer], GIEC, Genève, Suisse, 161 p.
"La RSE" théories et pratiques de Lépineux, éditions DUNOD

PREREQUISITE

ASSESSMENT

CC(EE, 2h)

TEACHING UNIT (UE) :

Computer Science for Engineer S7

ECTS : 5

Code UE : EG7II

SKILLS COVERED BY THE UE :

- Understand the features of a free multitasking and multi-user operating system
- Know the basics of programming and know how to synthesize an FPGA circuit.
- Understand the fundamentals of Object-Oriented Programming (Java)

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EG7II1	Linux and Language C	0.52	CC (5 x EE, 15 min) x 0,3 + CC (EE, 1h30, da:C+TD) x 0,7
EG7II2	Object oriented programming	0.48	TP(EM, 1h30)x0,3 + CC(EE,2h)x0,7

EC : Linux and Language C		EG7II1	coeff : 0.52
Teacher In Charge : Rivaletto M.			
CM : 16 h	TD : 24 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The objective of this course is to provide students with a basic knowledge of the features of the Linux operating system and to give them information from the user side. Shell script programming is thorough. An essential partner of Linux, the C language is a reference language in industrial computing. Higher level than the assembler, it allows to write more substantial programs in a more concise way while allowing a fine control over the manipulation of the memory. This second part of the course aims to familiarize students with the design of programs in C Language. The types of variables, functions and pointers, seen on the side of memory usage, are studied in class and put into practice during exercises in front of the computer.

TARGETED SKILLS

- Understand the features of a free multitasking and multi-user operating system.
- Assimilate console mode and shell script programming (batch).
- Understand the interest of a computer language very close to hardware in industrial computing issues.

CONTENT

Linux Courses
1. Overview - File System
2. User commands
3. The command language: the batch shell

Language C Courses
1. Notion of variable and data type
2. Inputs/outputs
3. Functions
4. The notion and manipulations of pointers

5. Tables
6. Character strings
7. Struct data structures

RESSOURCES

PREREQUISITE

First Year Programming
Course (Fortran, VBA) S5 Digital Electronic Course

EVALUATION PROCEDURES

CC (5 x EE, 15 min) x 0,3 + CC (EE, 1h30, da:C+TD) x 0,7

EC : Object oriented programming		EG7II2	coeff : 0.48
Teacher In Charge : Dumas P.			
CM : 12 h	TD : 12 h	TP : 8 h	Proj : 0 h
			Language Français

INTRODUCTION

The purpose of this teaching is to carry out a computer project or not in an object-oriented way. The UML modeling language will be discussed as well as an object-oriented programming language.

TARGETED SKILLS

- Analyze a problem with the notions of objects and classes with their association.
- Easily read UML diagrams.
- Translate easily even with an adaptation in object-oriented computer language.

CONTENT

1. Procedural and object-oriented analysis
2. Notions of objects, classes, associations and inheritance
3. UML modeling language (Bealdiagrams, Structural Diagrams, Different examples are offered)
4. Object-oriented computer language: JAVA, (Instantiation of objects, classes, inheritance, exception handling), Applets.

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

TP(EM, 1h30)x0,3 + CC(EE,2h)x0,7

TEACHING UNIT (UE) :

Electrical energy S7

ECTS : 6

Code UE : EG7EE

SKILLS COVERED BY THE UE :

- Understand the constraints of implementing switched components and structures
- Know the different architectures of static converters and their main uses
- Understand the advantages and disadvantages of different electrical power generation systems
- Understand the principles and technologies related to light sources
- Know how to carry out an analysis or a pre-study of illumination
- Know how to use the CATIA tool for mechanical design and electrical system design

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EG7EE1	Power converters	0.3	CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7
EG7EE2	Electrical power generationtrique	0.18	CC(EE, 2h)
EG7EE3	Lighting	0.16	CC(EE, 2h)
EG7EE4	Mechanical design tools	0.36	TP (Pa)x0.3 + Proj(Or)x0.7

EC : Power converters		EG7EE1	coeff : 0.3
Teacher In Charge : GUSEV A.			
CM : 10 h	TD : 10 h	TP : 8 h	Proj : 0 h
			Language Français

INTRODUCTION

This CE allows students to understand the notions and concepts of static energy conversion and to study most of the converter structures used in industrial environments.

TARGETED SKILLS

- Understand the constraints of implementing modern components and switched structures
- Know the different architectures of static converters and their main uses

CONTENT

1- Introduction to static conversion of electrical energy
2- Components of power electronics
3- Straightening not ordered and ordered
4- Choppers & switching power supplies
5- MLI & resonance inverters

RESSOURCES

PREREQUISITE

MODALITÉS D'ÉVALUATION

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

EC : Electrical power generationtrique		EG7EE2	coeff : 0.18
Teacher In Charge : Ruscassié R.			
CM : 6 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

Energy issues are now an essential aspect of the engineer's culture. This UE aims to inculcate the links between these energy aspects and the consequences they have on the past and future evolution of electrical energy production systems.

TARGETED SKILLS

- Understand the challenges related to changes in energy production
- Understand the advantages and disadvantages of different electrical power generation systems

CONTENT

General information on energies
Past and present energy situation: consequences
Non-renewable power generation systems (thermal & nuclear power plants)
Renewable power generation systems (biomass, hydro, solar, wind)
Conclusions & perspectives

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

CC(EE, 2h)

EC : Lighting		EG7EE3	coeff : 0.16
Teacher In Charge : Ruscassié R.			
CM : 6 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The objective of this course is to provide students with knowledge regarding the wide spectrum of lighting systems potentially available in order to be able to select the most appropriate solutions to be implemented according to the constraints of a given lighting situation.

TARGETED SKILLS

- Understand the principles and technologies related to light sources
- Know how to carry out an analysis or a pre-study of illumination

CONTENT

Principles of photometry and general information on lighting
Light source technologies
Power supplies and associated systems
Lighting principles
Case studies

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

CC(EE, 2h)

EC : Mechanical design tools		EG7EE4	coeff : 0.36
Teacher In Charge : De Ferron A.			
CM : 0 h	TD : 4 h	TP : 12 h	Proj : 20 h
			Language Français

INTRODUCTION

In their future profession, students will have to manage projects requiring multiple skills. One of them is related to the design of products both electronically and ergonomically and therefore mechanically. This module aims to introduce future graduates to one of the many CATIA mechanical design software. Without making them designers, the objective is to give the first notions of creation of parts, assembly and arrangement.

TARGETED SKILLS

- Introduction to reading 2D plans;
- Introduction to the creation of simple parts in extrusion and revolution;
- Introduction to the use of part modification tools (holes, grooves.
- Introduction to the assembly of existing parts;
- Introduction to the creation of 2D plans;
- Development of work independently.

CONTENT

1. Overview ;
2. Presentation of the work environment;
3. Presentation of the tools of manipulations, views, display, organization of work;
4. Presentation of the 2D drawing workshop (drawing, modification, transformation tools.);
5. Presentation of the 3D parts workshop (tools for creation, modification, transformation.);
6- Presentation of the 3D assembly workshop (tools for creation, modification, transformation.);
7- Presentation of the drawing workshop (tools for creation, modification, transformation.);
8- Presentation of some other workshops available on the software (creation of sheets, structural calculation).

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

TP (Pa)x0.3 + Proj(Or)x0.7

TEACHING UNIT (UE) :

Electronic S7

ECTS : 8

Code UE : EG7EL

SKILLS COVERED BY THE UE :

- Understand the general principles and calculation methods of analog filtering
- Acquire basic knowledge of microwave phenomena and technologies
- Understand the principles used for the design and analysis of microwave circuits
- Understand the inner workings of active electronic components (transistors and thyristors).
- Know the methodology and manufacturing steps allowing the realization of electronic components
- Specify a system on the basis of recorded and anticipated needs, in order to establish essential requirements for its design
- Master the tools of analog signal processing.
- Understand the frequency representation of an analog signal and the consequences of processing on this representation.

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EG7EL1	Analog filtering	0.27	CC1 (EE, 1h30, da : 1 feuille A4 recto) x 0,25 + CC2 (EE, 1h30, da : 1 feuille A4 recto verso) x 0,5 + TP (CR) x 0,25
EG7EL2	Microwave circuits	0.28	CC1 (EE, 1h30) x 0,25 + CC2 (EE, 1h30) x 0,5 + TP (CR) x 0,25
EG7EL3	Electronic components	0.14	CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7
EG7EL4	System Specification	0.14	Proj(Rap)x1/2 + Proj(Or)x1/2
EG7EL5	Analog signal processing	0.17	CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7

EC : Analog filtering		EG7EL1	coeff : 0.27
Teacher In Charge : Pécastaing L.			
CM : 10 h	TD : 10 h	TP : 12 h	Proj : 0 h
			Language Français

INTRODUCTION

The aim of circuit synthesis is to provide a circuit that is the realisation of a given impedance. This can be quadrupoles or filters. The objective of this course is to provide students with the necessary tools to synthesize dipoles, quadrupoles and passive filters. The application of these various concepts with the help of mathematical algorithms leads to the development of CAD software for electronic circuits.

COMPÉTENCES VISÉES

- Understand the general principles of analogue filtering
- Acquire the methods of calculating circuits for filtering
- Know how to choose and use the main approximations used in filtering

CONTENT

1- Synthesis of passive dipoles (Synthesis of LC, RC and RL dipoles by Cauer and Foster methods, Synthesis of RLC dipoles by Brune method)
2- Synthesis of passive quadrupoles
3- Synthesis of passive filters (Butterworth's approximation, Chebychev's approximation)

RESSOURCES

PREREQUISITE

Electronics 2 during 1AS5

EVALUATION PROCEDURES

CC1 (EE, 1h30, da : 1 feuille A4 recto) x 0,25 + CC2 (EE, 1h30, da : 1 feuille A4 recto verso) x 0,5 + TP (CR) x 0,25

EC : Microwave circuits		EG7EL2	coeff : 0.28
Teacher In Charge : Pécastaing L.			
CM : 10 h	TD : 10 h	TP : 12 h	Proj : 0 h
			Language Français

INTRODUCTION

This is a course to provide the engineering basis for microwave methods and techniques. The particularity of this frequency range is that the dimensions of the devices are of the order of magnitude of the wavelength.

The objective of this course is to provide students with the knowledge necessary to understand and analyse microwave circuits, in particular transmission lines. The main analysis techniques will be covered such as analytical calculations of reflection phenomena, the table method or the use of the Smith chart.

TARGETED SKILLS

- Acquire the basics necessary for the theoretical evaluation of a microwave circuits
- Know the main techniques for analysing microwave circuits in time and harmonic
- Implement the Smith chart for the analysis of transmission line circuits

CONTENT

1- Introduction to Microwaves
2- Properties of electromagnetic waves
3- Transmission lines with transient anaylsis (description and modelling of a transmission line, various types of lines, relationship to terminations, time domain analysis)
4- Transmission lines with harmonic analysis (“Telegrapher” ’s equations, propagation, attenuation and phase constants, characteristic impedance and reflection coefficient)
5- Use of the Smith chart in microwave (interest, description, examples of use)

RESSOURCES

PREREQUISITE

Electromagnetism during 1AS5

EVALUATION PROCEDURES

CC1 (EE, 1h30) x 0,25 + CC2 (EE, 1h30) x 0,5 + TP (CR) x 0,25

EC : Electronic components		EG7EL3	coeff : 0.14
Teacher In Charge : Ruscassié R.			
CM : 6 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

In the continuity of Semiconductor Physics courses, this course develops the principles of internal operation of the main components used in electronics, with a focus on bipolar transistors and MOS. It also provides an understanding of the techniques used for the manufacture of these microelectronic components in the semiconductor industry.

TARGETED SKILLS

- Understand the inner workings of active electronic components (transistors and thyristors).
- Know the methodology and manufacturing steps allowing the realization of electronic components

CONTENT

1- Homo-structures (Matter and properties of SC, PN junction (recalls), bipolar transistor, thyristor)
2- Hetero-structures (Principles of hetero junctions, Schottky diode, MIS structure, MOS transistor)
3- Process & applications

RESSOURCES

PREREQUISITE

EC Physique des semi-conducteurs

EVALUATION PROCEDURES

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

EC : System Specification		EG7EL4	coeff : 0.14
Teacher In Charge : Rivaletto M.			
CM : 6 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The analysis of the need, the establishment of specifications and the specification of a system are the initial phases of a development cycle. The objective of this course is to allow students to address the use of tools to assist in functional analysis (establishment of functional specifications) and system specification (structured analysis). Then to allow students to acquire mastery of tools to help with the specification.

TARGETED SKILLS

- Understand and analyze the needs of a development or a customer.
- Translate these needs into functions.
- Specify a system on the basis of recorded and anticipated needs, in order to establish essential requirements for its design.

CONTENT

1- Specify, Design, Analysis, Design, Methods, Costs, Quality, Life Cycle
2- Functional Analysis. Functional Specifications
3- Structured Analysis . SA
4- Structured Analysis Timel . SA-RT

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

Proj(Rap)x1/2 + Proj(Or)x1/2

EC : Analog signal processing		EG7EL5	coeff : 0.17
Teacher In Charge : Paillol J.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

This EC will provide students with the necessary tools to understand analog signal processing systems.

TARGETED SKILLS

- Know why process signals
- Know how to analyze deterministic and random signals
- Design linear treatment systems

CONTENT

1. Fourier transform and correlation
2. Linear filtering of deterministic signals
3. Random processes, random variables and random signals
4. Filtering of random signals, noise, adapted and adaptive filtering
5. Modulation of analog signals

RESSOURCES

PREREQUISITE

EC Analog Electronics 1 & 2

EVALUATION PROCEDURES

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

Semestre 8

LIST OF TEACHING UNITS (UE) OF THE SEMESTER

TC, Spe ou Path-ways	Code UE	Entitled UE	ECTS
TC	EC8MA	Mathematics - Computer Sciences S8	6
GP-EN	EC8LI	Languages - Engineering Culture S8	6
EN	EE8AP	Applied Energetics S8	9
EN	EE8SY	System Thermodynamics S8	9
GP	EP8DY	Dynamics – Security S8	11
GP	EP8OU	Thermodynamics - Unit Operations S8	7
GEII	EG8AP	Apprenticeship S8	8
GEII	EG8II	Industrial Computing S8	8
GEII	EG8EE	Electrical energy S8	8

Tronc Commun

2nd Year - Semester 8 - Commun Course														
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
Mathematics - Computer Sciences S8	**EC8MA**	EC8MA1	Scientific Calculus II	**201**	80	**40**	*20*	*0*	*20*	40	**0**	**6**	0.40
		EC8MA2	Optimization Methods		60	**30**	*10*	*20*	***0***	30	**0**		0.30
		EC8MA3	Experimental Design		40	**20**	*14*	*6*	***0***	20	**0**		0.20
		EC8MA4	Introduction to the digital transformation of industrie		21	**8**	*8*	*0*	***0***	13	**10**		0.10
Total TC				**201**		**98**	**52**	**26**	**20**	**103**	**10**	**6**	

TEACHING UNIT (UE) :

Mathematics - Computer Sciences S8

ECTS : 6

Code UE : EC8MA

SKILLS COVERED BY THE UE :

- Demonstrate proficiency in the simulation of coupled mass and heat transfer with numerical solution of partial differential equations
- Demonstrate the ability to formulate and to characterise various optimisation problem types; understand the basics of main resolution algorithms
- Demonstrate the ability to complete a design of experiments
- Master the use of key Industry 4.0 technologies

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EC8MA1	Scientific Calculus II	0.4	CC(EE, 30mn)x1/3 + TP (PA)x1/3 + TP(Prog)x1/3
EC8MA2	Optimization Methods	0.3	CC(EE, 2h, da : tutoriel)
EC8MA3	Experimental Design	0.2	CC(EE, 2h, sd, ca)
EC8MA4	Introduction to the digital transformation of industries	0.1	Proj(Rap)

EC : Scientific Calculus II		EC8MA1	coeff : 0.4
Teacher In Charge : Couture F.			
CM : 20 h	TD : 0 h	TP : 20 h	Proj : 0 h
			Language Français

OVERVIEW

Different methods to solve partial derivative equation are presented on a practical point of view and applied in order to simulate transport phenomena.

LEARNING OUTCOMES

After this course, students should be able to simulate heat and mass transports by solving numerically conservative convection-diffusion equations.

DESCRIPTION

Principles:

Discretisation in time – Discretisation in space – Consistence, stability, convergence.

Discretisation in time:

Finite difference method – Method of fractional time steps.

Discretisation in space:

Finite difference method (1D, 2D, hyperbolic and parabolic equations) - Finite element method (1D, 2D, hyperbolic and parabolic equations) - Finite volume method (1D, 2D, hyperbolic and parabolic equations) TP

Simulation of mass (or heat) transport by solving numerically a partial derivative equation.

RECOMMENDED READING

RAVIART P.A., THOMAS J.M., Introduction à l'analyse des équations aux dérivées partielles, Paris, Masson, 1992.

LASCAUX P., THEODOR R., Analyse numérique matricielle appliquée à l'art de l'ingénieur. 1 Méthodes directes, Paris, Masson, 1993.

DHATT G., TOUZOT G., une présentation de la méthode des éléments finis, Paris, Maloine S.A. éditeur, 1984

PREREQUISITE

Fortran (EC15MI1), Numerical resolution of linear systems (EC15MI2)

ASSESSMENT

CC(EE, 30mn)x1/3 + TP (PA)x1/3 + TP(Prog)x1/3

EC : Optimization Methods		EC8MA2	coeff : 0.3
Teacher In Charge : Reneaume J.M.			
CM : 10 h	TD : 20 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Optimisation is one of the major quantitative tools for decision-making. Acquainting students with the optimisation problem formulation (objective function, optimisation variables and constraints) and solution (algorithms and software tools) is the primary aim of this subject.

LEARNING OUTCOMES

- be able to formulate an optimisation problem
- be able to characterise the formulated problem (LP, NLP, MILP, MINLP) and select an appropriate optimisation algorithm (Simplex, SQP, Branch and Bound, OA/ER)
- have a basic knowledge of the main algorithm
- be able to use the main tools: Excel®, GAMS®

DESCRIPTION

The basic concepts of optimisation and the main algorithms for each class of optimisation problems are presented:
-Unconstrained Optimisation (One-Dimensional Search and Multivariable Optimisation): Golden Section Search, Simplex Method, Genetic Algorithms, Simulated Annealing, Gradient Method, Newton Method ...
-Linear Programming (LP): Simplex Method
-Non Linear Programming (NLP): Quadratic Programming, Successive Linear Programming, Successive Quadratic Programming ...
-Mixed Integer Linear Programming (MILP): Branch and Bound
-Mixed Integer Non Linear Programming (MINLP): Outer Approximation

RECOMMENDED READING

Nonlinear and Mixed-Integer Optimization - Fundamentals and Applications C.A. Floudas Oxford University Press, 1995
Practical Methods of Optimization R. Fletcher Second Edition, Wiley-Interscience Publication,

1996

PREREQUISITE

ASSESSMENT

CC(EE, 2h, da : tutoriel)

EC : Experimental Design		EC8MA3	coeff : 0.2
Teacher In Charge : Tinsson W.			
CM : 14 h	TD : 6 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Industrial experiments are sometimes very complex because they depend on a lot of entry variables (machine tool adjustment, mixture conception, etc...). The purpose of experimental designs is to obtain a maximum of information doing a minima of experiences. This method is of great importance when the experiences are expensive, difficult or time-consuming.

LEARNING OUTCOMES

After this course, students should:

- be able to construct simple classical experimental designs,
- be able to fit an appropriate linear model,
- be able to modelize a mixture problem,
- be able to use the software Nemrod®

DESCRIPTION

1) Experimental designs for models of order 1, (factorial designs, regular fractions of resolution IIi, ...)
2) Experimental designs for interaction models, (factorial designs, regular fractions of resolution V, ...)
3) Experimental designs for response surfaces, (central composite designs, Box and Behnken designs, ...)
4) Experimental designs for mixtures. (simplex centroïd designs, ...)

In a second chapter, different tools are presented in the context of optimization: flowsheeting anvironments, Excel, GAMS...

RECOMMENDED READING

Plans d'expérience : constructions et analyses statistiques (2010) Walter TINSSON

Mathématiques et Applications, volume 67 Springer

PREREQUISITE

Module ”probabilités et statistiques” de première année

ASSESSMENT

CC(EE, 2h, sd, ca)

EC : Introduction to the digital transformation of industries		EC8MA4	coeff : 0.1
Teacher In Charge : Kobayashi M.			
CM : 8 h	TD : 0 h	TP : 0 h	Proj : 10 h
			Language Français

OVERVIEW

LEARNING OUTCOMES

- Master the use of the main Industry 4.0 technologies involved in the digital transformation of industries.
- Be able to identify which technologies to use in new data-driven industrial projects and technological innovation.

DESCRIPTION

1. Industrial Revolutions: from steam power to AI
2. New Technologies Overview: which technologies impact the energy sector the most
3. Industrial Internet of Things
4. Big Data
5. Process Modeling, Process optimization and Digital twin
6. Machine Learning and Artificial Intelligence
7. More cyber technologies : Cloud computing and Cybersecurity
8. The intersection between cyber systems and mechanics: Additive manufacturing, robotics, autonomous robots, drones, AR, and VR
9. Business Intelligence - enabling effective business decisions, Industrial applications and Existing IT tools
10. Agile Software Development
11. Change Management: a personal overview and comparison in terms of people management in different companies
12. How digital transformation impacts our careers as engineers
13. Why digital transformation fails

RECOMMENDED READING

Slides, group exercise on TEAMS and on a free online tool, the connection link will be provided by the teacher during the course.

PREREQUISITE

ASSESSMENT

Proj(Rap)

Tronc Commun GP et EN

2nd Year - Semester 8 - Commun Course EN+GP														
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
Languages - Engineering Culture S8	EC8LI	EC8LI1	Marketing	180	60	**30**	*20*	*10*	***0***	30	**0**	6	0.33
		EC8LI2	Research Project		80	**0**	*0*	*0*	***0***	80	*80*		0.50
		EC8LI3	Engineering Project Management		40	**20**	*10*	*10*	***0***	20	**0**		0.17
Total TC				**180**		**50**	30	20		**130**	80	**6**	

TEACHING UNIT (UE) :

Languages - Engineering Culture S8

ECTS : 6

Code UE : EC8LI

SKILLS COVERED BY THE UE :

- Understand core concepts of marketing
- Demonstrate the ability to develop a scientific approach within the framework of a research project (bibliographic research, overview, analysis, innovation, writing and presentation of research work)
- 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

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EC8LI1	Marketing	0.33	CC(EE, 2h)
EC8LI2	Research Project	0.5	Proj(Rap)x1/2 + Proj(Sout)x1/2
EC8LI3	Engineering Project Management	0.17	CC(EE, 2h)

EC : Marketing		EC8LI1	coeff : 0.33
Teacher In Charge : Elayoubi-Mengi M.			
CM : 20 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Objectives and tools of marketing strategy.

LEARNING OUTCOMES

- Analyzing and understanding the general environment of companies throughout a marketing problematic
- Mastering logics and strategic marketing tools
- Achieving a market survey (quantitative/qualitative)
- Knowledge of the 4 P of the marketing mix.

DESCRIPTION

Perspective of marketing
Diagnostic and marketing survey
Strategy: segmentation, targeting and positioning
Marketing mix: product, price, place, promotion
Focus on international marketing

RECOMMENDED READING

Books :

- Kotler et Keller (2010) Marketing Management, Pearson
- Malaval et Bénaroya (2011) Du marketing industriel au marketing des affaires, Pearson
- Décaudin et Malaval (2015) Pentacom, Pearson Presse spécialisée (et sites Internet correspondants)
- Presse généraliste économique : Capital, Management, Les Echos, etc
- Communication : ”Stratégies” ou www.strategies.fr www.cbnews.fr
- Distribution : ”Libre Service Actualités” (LSA) / ”Points de vente”
- ”Que choisir”, ”60 millions de consommateurs” : magazines de la consommation

- "L'Usine nouvelle" : magazine de l'industrie et du B to B
- www.e-marketing.fr
- Association Française du Marketing : www.afm-marketing.org

PREREQUISITE

General knowledge and curiosity

ASSESSMENT

CC(EE, 2h)

EC : Research Project		EC8LI2	coeff : 0.5
Teacher In Charge : Serra S.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 80 h
			Language Fr et EN

OVERVIEW

The aim of the Project - Research Development Innovation - is to initiate research and to create an open mind for innovation.

LEARNING OUTCOMES

Be able to :

- do a bibliographic research
- give a critical review of the different articles
- find an innovative solution
- write a full paper by observing a template

DESCRIPTION

I. Bibliographic part:
- State of the art on a specific subject
- Use of the online data base
- Critical analysis

II. Development – innovation
- Proposal of a specific development/innovation
- Scientific justification and, depending of the subject, economic and/or societal point of view
- Proposal of a roadmap (software, experimentation, funding plan) and, when possible, partial or full realization

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

Proj(Rap)x1/2 + Proj(Sout)x1/2

EC : Engineering Project Management		EC8LI3	coeff : 0.17
Teacher In Charge : Ricarde M.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

From the beginning of their career, the engineers integrate project teams and can quickly become a project manager. This course aims at preparing them for the managerial tasks, to master the projects on aspects quality, costs and deadlines.
This education leans on concrete examples of industrial projects. Educational platform https: // to elearn.univ-pau.fr/
Used software: MSProject

LEARNING OUTCOMES

- To understand the project organisation: customer / supplier / subcontractor.
- To organise and to conduct a project according to:
  -planning, -cost, -quality.
- To build and to manage a Risk Management Plan
- To track and to report progress

DESCRIPTION

Main phases for industrial project: from design to operating.
Project Management Plan
-Purpose
-Contract
-Budget
-Customer / supplier / subcontractor
-Organization chart
-Risk management
-Communication
-Planning
-Piloting

Planning whith MS Project.

RECOMMENDED READING

Management de la qualité ISO_10006_2003
Présentation générale FD_X50-115 Management par projets FD_X50-116 Gestion des risques FD_X50-117 Management des coûts FD_X50-137 Management des délais FD_X50-138
De l'ingénierie d'affaires au management de projet, Henri Georges Minyem, éditions Eyrolles.
Manager un projet pour la première fois : De l'idée à la réalisation, Alain Asquin, Thierry Picq, éditions Eyrolles.
L'essentiel de la gestion de projet, Roger Aïm, Les Carrés.
Le chef de projet paresseux. mais gagnant !, M Destors, J. Le Bissonnais, Microsoft Press.

PREREQUISITE

None

ASSESSMENT

CC(EE, 2h)

SPECIALITE EN

2nd Year - Semester 8 - 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
Applied Energetics S8	EE8AP	EE8AP1	Carbon Footprint and Life Cycle Analysis	244	36	18	8	10	0	18	0	9	0.11
		EE8AP2	Fluid Networks		28	14	8	6	0	14	0		0.11
		EE8AP3	Electrical conversion		60	30	14	16	0	30	0		0.22
		EE8AP4	Technologies of pumps and turbines		20	10	4	6	0	10	0		0.11
		EE8AP5	Practicals: Applied Energetics		100	50	0	0	50	50	0		0.45
System Thermodynamics S8	EE8SY	EE8SY1	Applied Thermodynamics	260	76	38	12	26	0	38	0	9	0.22
		EE8SY2	Advanced cycles		56	28	14	14	0	28	0		0.22
		EE8SY3	Solid-Liquid Phase Change Heat Transfers		28	14	6	8	0	14	0		0.11
		EE8SY4	Practicals: Systems		100	50	0	0	50	50	0		0.45
Total Spec EN				504		252	66	86	100	252	0	18	
Total TC + Spec EN				885		400						30	

TEACHING UNIT (UE) :

Applied Energetics S8

ECTS : 9

Code UE : EE8AP

SKILLS COVERED BY THE UE :

- Demonstrate the ability to size and to analyse energy systems, in particular in the construction industry and by taking account carbone balance.
- Demonstrate, from both a theoretical and practical standpoint, the knowledge of working principles and performance assessment of main hydraulic and aeraulic machines.

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EE8AP1	Carbon Footprint and Life Cycle Analysis	0.11	CC(EE, 2h, sd, st, ca)
EE8AP2	Fluid Networks	0.11	Proj(Rap)
EE8AP3	Electrical conversion	0.22	CC(EE, 2h, sd, ca)
EE8AP4	Technologies of pumps and turbines	0.11	CC(EE, 1h, sd, st,ca)
EE8AP5	Practicals: Applied Energetics	0.45	moyenne(TP(CR))x1/2 + moyenne(TP(EO, PA))x1/2

EC : Carbon Footprint and Life Cycle Analysis		EE8AP1	coeff : 0.11
Teacher In Charge : Dumergue L.			
CM : 8 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

This lecture is devoted to cycle life analysis of any given process, and in particular to carbon balance.

LEARNING OUTCOMES

- Master basic principles of cycle life analysis.
- Know how to perform such an analysis, especially the carbon balance.

DESCRIPTION

1. Forewords
2. Emissions sources
3. Fundamentals

RECOMMENDED READING

PREREQUISITE

ASSESSMENT

CC(EE, 2h, sd, st, ca)

EC : Fluid Networks		EE8AP2	coeff : 0.11
Teacher In Charge : Kousksou T.			
CM : 8 h	TD : 6 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

To enable students to grasp a hydraulic / ventilation installation to change the Specifications and give it additional functionality.
- Allow students to diagnose hydraulic and ventilation facilities.
- Allow students to dimension and balancing facility (hydraulic / ventilation).

LEARNING OUTCOMES

- Calculating losses in a network (Hydraulic / Aeraulics).
- Size the valves, pumps, fans, expansion tanks, ...
- Association of pumps / fans.
- Balancing a hydraulic / aeraulic network.

DESCRIPTION

Hydraulics
- Calculation of head losses.
- Technologies valves.
- Technologies pumps.
- Operating Point (hydraulic pump / network).
- Cavitation phenomenon.
- Balancing a hydraulic network.
- The expansion vessels.
- Water hammer.

Aeraulics
- Calculation of head losses.
- Technologies fans.
- Characteristics of a fan.

- Point of operation (fan / duct system).
- Balancing a duct system.

RECOMMENDED READING

Hydraulique Industrielle (José Roldan Viloria)
Hydraulique : Machines et composants chez EYROLLES par G. FAYET

PREREQUISITE

Mécanique des fluides 1A

ASSESSMENT

Proj(Rap)

EC : Electrical conversion		EE8AP3	coeff : 0.22
Teacher In Charge : Subileau			
CM : 14 h	TD : 16 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

This second year focuses on the study of converters.

LEARNING OUTCOMES

On completion of this course, students should be able to:

- Choose the right machine for the right purpose
- Perform sizing and connection
- Carry out measurements and associated analyses

DESCRIPTION

1. The different types of electrical machines
2. Basic equations of the perfect DC machine
3. Study of the transformer
4. Alternating machines: Synchronous / Asynchronous / Brushless

RECOMMENDED READING

PREREQUISITE

Previous year's module + Recall booklet (cf 1A)

ASSESSMENT

CC(EE, 2h, sd, ca)

EC : Technologies of pumps and turbines		EE8AP4	coeff : 0.11
Teacher In Charge : Lara Cruz J.			
CM : 4 h	TD : 6 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The course presents the principle of the functioning of machines such as pumps, turbines, propellers and gas compressors. The technology of usual machines is described as well as their procedure of use.

LEARNING OUTCOMES

The student knows the operating principles of hydraulics machines : coupling between the electrical motor/alternator and the hydraulics machine, force, torque and thrust.
The student knows the scaling rules of turbo machines (Combe-Rateau) and can range a machine in regards to its specific speed.

The student is aware of the technology of the following machines and of their procedure of use:
-pumps : axial, centrifuge, volumetric
-turbines : Kaplan, Francis, Pelton
-propellers : marine propellers, Aeolian propellers (Betz formula)
-gas compressors
The conditions of occurrence of cavitation in liquid in turbo machines are discussed.

CONTENT

The course is divided in seven chapters
I – Coupling of an electrical motor/alternator with an hydraulic machine : operating principle of a motor/altenator, rule of torque, principle of action/reaction.
II – Principles of calculation of the flow inside a turbo machine : potential flows, use of momentum balance theorem to compute forces and torque, velocity triangle, stalling
III – Scaling rules of turbo machines (Combe-Rateau) and classification of turbo machines in regard to its specific speed. Caracteristic curve of a turbo machine.
IV – Procedure of operation : series or parallel arrangements, efficiencies (evaluation and measurement), cavitation
V – Technology of pumps : axial, centrifuge, volumetric VI – Technology of turbines : Kaplan,

Francis, Pelton
VII – Technology or propellers : thrust, marine propellers, Aeolian propellers (Betz formula)

RECOMMENDED READING

Ecoulements pour les procédés, M. Mory, Hermès-Lavoisier, 2010.
Fluid Mechanics for chemical engineering, M. Mory, ISTE-J. Wiley, 2011.

PREREQUISITE

The student is able to use the global theorems of fluid mechanics (conservation of energy and momentum).

ASSESSMENT

CC(EE, 1h, sd, st,ca)

EC : Practicals: Applied Energetics		EE8AP5	coeff : 0.45
Teacher In Charge : Gibout S., Lara Cruz J.			
CM : 0 h	TD : 0 h	TP : 50 h	Proj : 0 h
			Language Français

OVERVIEW

These practical working sessions correspond to the study of complete energetic systems.

LEARNING OUTCOMES

- Be able to analyse a complete energetic system starting from measurements
- Be able to choose a technology and to size a complete system

DESCRIPTION

– Air conditioning system
- Gaz combustion
- Radiator
- Hydraulic network
- Thermal energy storage
- Hydraulic regulation and balance

RECOMMENDED READING

PREREQUISITE

TP Thermo/Bilan (EC15TB5) TP Transferts (EC15TM6)

ASSESSMENT

moyenne(TP(CR))x1/2 + moyenne(TP(EO, PA))x1/2

TEACHING UNIT (UE) :

System Thermodynamics S8

ECTS : 9

Code UE : EE8SY

SKILLS COVERED BY THE UE :

- Demonstrate, from both a theoretical and practical standpoint, the ability to apply thermodynamics to main cycles, and especially to engine cycles, so as to size them and assess their performance
- Demonstrate the knowledge of convective heat transfer and complex coupled heat transfer

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EE8SY1	Applied Thermodynamics	0.22	CC(EE, 2h, da:tables des fluides et abaques, ca)
EE8SY2	Advanced cycles	0.22	CC(EE, 1,5h, da:tables des fluides et abaques, ca)x1/2 + CC(EM, 1,5 h)x1/2
EE8SY3	Solid-Liquid Phase Change Heat Transfers	0.11	CC(EE, 2h, da:Cours et TD, ca)
EE8SY4	Practicals: Systems	0.45	moyenne(TP(CR))x1/2 + moyenne(TP(EO, PA))x1/2

EC : Applied Thermodynamics		EE8SY1	coeff : 0.22
Teacher In Charge : Bédécarrats J-P.			
CM : 12 h	TD : 26 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The objectives of this course are:
- to present a thorough treatment of engineering thermodynamics from the classical viewpoint,
- to prepare students to use thermodynamics in engineering practice. This part deals with usually encountered processes in energetic systems.

LEARNING OUTCOMES

After this course the students should:
Be able to correctly size and analyse energetic systems.

DESCRIPTION

•Energy and the First Law of Thermodynamics
•Evaluating Properties
•Control Volume Analysis Using Energy
•The Second Law of Thermodynamics. Using Entropy
•Exergy analysis
•Vapour power systems
•Gas power systems
•Refrigeration and heat pump systems

RECOMMENDED READING

Thermodynamique et optimisation énergétique des systèmes et procédés. M. Feidt (Tec&Doc) ISBN 2-85206-372-7
Fundamentals of engineering thermodynamics (Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Bailey. - 9th ed. - 2018 - Wiley) ISBN-978-1-119-39138-8

PREREQUISITE

Thermodynamique générale (EC15TB2),

ASSESSMENT

CC(EE, 2h, da:tables des fluides et abaques, ca)

EC : Advanced cycles		EE8SY2	coeff : 0.22
Teacher In Charge : Bédécarrats J.P., Brillet C.			
CM : 14 h	TD : 14 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The objective of this course is to address the basic knowledge necessary to understand the operation of turbomachinery. The gas turbine will be more particularly studied, a generic term designating a machine made up of several components (compressor and turbine) and providing power, and its aeronautical applications.
This course will also include advanced system studies using EES the Engineering Equation Solver software.

LEARNING OUTCOMES

After this course, students should be able to master the operation of advanced cycles.

DESCRIPTION

The first part of this course deals with turbomachinery:
1. Presentation of the main types of turbomachinery and associated applications.
2. General aerothermodynamics
3. Blade Aerodynamics
4. Application of aerodynamic concepts
5. Combustion chamber
6. Thermodynamics of cycles

The second part consists of familiarizing oneself with the use of EES software before studying advanced thermodynamic cycles through simulation.

RECOMMENDED READING

Advanced Gas Turbine Cycles - J.H. Horlock, Pergamon, Elsevier Science, Oxford, 2003, ISBN 0-08- 044273-0
Thermodynamics: an engineering approach, eighth edition - Yunus A. Cengel Dr., Michael A. Boles, McGraw-Hill Education, 2015, ISBN 978-0-07-339817-4

PREREQUISITE

Thermodynamique générale (EC15TB2), Thermodynamique appliquée à l'énergétique

ASSESSMENT

CC(EE, 1,5h, da:tables des fluides et abaques, ca)x1/2 + CC(EM, 1,5 h)x1/2

EC : Solid-Liquid Phase Change Heat Transfers		EE8SY3	coeff : 0.11
Teacher In Charge : Bédécarrats J-P.			
CM : 6 h	TD : 8 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The objective of this course is to bring to the students a basic knowledge on the physical mechanisms controlling the liquid-solid phase changes while presenting the most often used methods to characterise the heat transfers. Existing modelling will be presented.

LEARNING OUTCOMES

- Knowledge of physical and thermal mechanisms controlling the liquid-solid phase changes.
- Applications in the field of energy storage and processing.
- Knowledge of the thermal modelling methods.

DESCRIPTION

- Fundamental aspects:

General information (supercooling...), phase change with purely conductive heat transfer, phase-change under forced flow, phase change with combined conduction - free convection, solidification of the multicomponents mixtures.

- System aspects:

Concept of exchange (heat exchange through a wall, heat exchange by direct contact), examples of applications (thermal storage by latent heat, materials of interface, metal deposit, core fusion of a reactor, crystallization in dispersed medium...)

RECOMMENDED READING

Mathematical Modeling of Melting and Freezing Processes, V. Alexiades et A.D. Solomon. Hemisphere Publishing Corporation. 1993
Transferts de chaleur avec changement d'état solide - liquide, A. Bricard et D. Gobin, Techniques de l'ingénieur, traité Génie énergétique. BE 8240
Stockage du froid par chaleur latente, J-P. Dumas, Techniques de l'ingénieur, traité Génie énergétique.

BE 9775

PREREQUISITE

Transfert de chaleur (EC15TM2, EE16MT1, EC15TM4, EC15TM5, EC27TM3

ASSESSMENT

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

EC : Practicals: Systems		EE8SY4	coeff : 0.45
Teacher In Charge : Gibout S., Lara Cruz J.			
CM : 0 h	TD : 0 h	TP : 50 h	Proj : 0 h
			Language Français

OVERVIEW

These practical working sessions correspond to the study of complete systems met in the field of energetic especially those with a thermodynamic cycle.

LEARNING OUTCOMES

- Be able to analyse and understand a complete system.
- Make the energetic balance and perform an efficiency analysis

DESCRIPTION

- Single stage refrigerants machine
- Double stage refrigeration machine
- Solar thermal system
- Stirling engine and Peltier module
- Fuel cell
- Frigodep (software of refrigerating breakdown service)
- Frigodiag (diagnostic software of refrigerating breakdowns of units)

RECOMMENDED READING

PREREQUISITE

TP Thermo/Bilan (EC15TB5) TP Transferts (EC15TM6)

ASSESSMENT

moyenne(TP(CR))x1/2 + moyenne(TP(EO, PA))x1/2

SPECIALITE GP

2nd Year - Semester 8 - GP														
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
Dynamics – Security S8	EP8DY	EP8DY1	Metrology - Sensors in Process Industry	278	28	**14**	*8*	*6*	***0***	14	*0*	11	0.10
		EP8DY2	Security		100	**50**	*26*	*24*	***0***	50	*0*		0.36
		EP8DY3	Unit Operation Modeling		60	**20**	*4*	*16*	***0***	40	*56*		0.22
		EP8DY4	Practicals: Dynamics - Security		90	**60**	*0*	*0*	*60*	30	*0*		0.32
Thermodynamics - Unit Operations S8	EP8OU	EP8OU1	industrial thermodynamics and renewable energy	190	30	**20**	*10*	*10*	***0***	10	*10*	7	0.16
		EP8OU2	Mechanical and Membrane Separations		56	**28**	*16*	*12*	***0***	28	*0*		0.30
		EP8OU3	Innovative Processes		14	**4**	*4*	*0*	***0***	10	*6*		0.07
		EP8OU4	Practicals: Thermodynamics - Unit. Op.		90	**60**	*0*	*0*	*60*	30	**0**		0.47
Total Spec GP				**468**		**256**	68	68	120	**212**	72	**18**	
Total TC + Spec GP				**849**		**404**						**30**	

TEACHING UNIT (UE) :

Dynamics – Security S8

ECTS : 11

Code UE : EP8DY

SKILLS COVERED BY THE UE :

- Demonstrate, from both a theoretical and practical standpoint, the ability to design control loops and to adjust their parameters
- Demonstrate the ability to carry out unit operations under optimum safety conditions
- Know the methods for the risk assessment related to processes

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EP8DY1	Metrology - Sensors in Process Industry	0.1	CC(EE, 1h30')
EP8DY2	Security	0.36	CC(EE, 2h)
EP8DY3	Unit Operation Modeling	0.22	Proj(Rap, Prog, Sout)
EP8DY4	Practicals: Dynamics - Security	0.32	moyenne(TP(EO))

EC : Metrology - Sensors in Process Industry		EP8DY1	coeff : 0.1
Teacher In Charge : Dumas P.			
CM : 8 h	TD : 6 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The two main objectives is firstly to give to the students a sightseeing of metrology that is commonly encountered in industry and in laboratories. A second objective is to give them basic knowledge on control and measurement from the sensor to process monitoring.

LEARNING OUTCOMES

- Know how control and measurement equipment works.
- Be able to establish a process specification.
- Use the GUM method correctly.
- Be able to give a measurement result with the GUM method.

DESCRIPTION

1 – Sensors (temperature, level, flow rate, pressure ...)
2 – Actuators (pumps, valves ...)
3 – Introduction about digital measurement and digital control
4 – Introduction about metrology, GUM method.

RECOMMENDED READING

- R. GICQUEL, ”Systèmes énergétiques” Tome 1 et 2, Presses de l’Ecole des Mines de Paris, 2001
- L. BOREL, D. FAVRAT, ”Thermodynamique et Energétique”, Presses polytechniques et universitaires romandes, 2005
- Techniques de l’ingénieur

PREREQUISITE

Thermodynamique générale

ASSESSMENT

CC(EE, 1h30’)

EC : Security		EP8DY2	coeff : 0.36
Teacher In Charge : Contamine F., Mercadier J., Olivier J., Baron T.			
CM : 29 h	TD : 24 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

Risk analysis in the chemical process industry.

LEARNING OUTCOMES

Students are able to use different ways of carrying out hazard analysis in the process industries. They are able to use hazard identification methods and describe the main hazards associated with chemical industries.

DESCRIPTION

General concepts : Risk, gravity, probability

Accidents and risk analysis ;
Examples of Mexico and Bhopal

Elements of a risk management program

Making decisions in matters of process safety
Hazard identification – estimation of consequences and of the frequency
Hazard identification techniques
Safety check list
Fault tree analysis
Hazop

Explosions
Deflagration detonation
Vapors and dust explosion
Risk reduction
Vent design

Runaways reactions

RECOMMENDED READING

Basic Principles of Membrane Technology , J. Mulder, Springer; 1996
Membrane Technology and Applications , Richard W. Baker , Wiley; 2004
Ecoulements pour les procédés, M. Mory, Hermès-Lavoisier, 2010.
Fluid Mechanics for chemical engineering, M. Mory, ISTE-J. Wiley, 2011

PREREQUISITE

Mécanique des fluides I et II

ASSESSMENT

CC(EE, 2h)

EC : Unit Operation Modeling		EP8DY3	coeff : 0.22
Teacher In Charge : Reneaume JM.			
CM : 4 h	TD : 16 h	TP : 0 h	Proj : 56 h
			Language Français

INTRODUCTION

This course is the continuation of the one proposed during the previous semester: Thermodynamic Modelling I (EP27OU3). Here, we focus on Differential and Algebraic Equation systems (DAE). Numerical methods (Gear) are also presented.
During a project, the students have to formulate a Unit Operation Model and to develop a FORTRAN code in order to solve it. They also have to use a library containing the solver to be used.
A typical project is a multicomponent Rayleigh (Batch) Distillation using NRTL thermodynamic model and DISCO®as an EDA solver.

LEARNING OUTCOMES

- be able to formulate the model: variables (state variables/parameters) and equations (constitutive equations, balances, constraints. . .)
- be able to write a general and structured FORTRAN code in order to solve a complex problem, using a solver library

DESCRIPTION

Students must solve a problem suggested by the teacher. The main stages of the project are as follows:
• Formulate hypotheses
• Write the equations of the model: balances, constraints, constitutive equations.
Make sure to write only independent equations.
• Proceed to the analysis of the degrees of freedom: variables / parameters
• Define the code flow diagram
• Program the code (including the solver library)
• Analyze the results, the influences of the parameters (sensitivity analysis), of the hypotheses

RECOMMENDED READING

Bases de données Science Direct, Techniques de l'ingénieur, Scopus, . : accès via l'ENT de l'UPPA

PREREQUISITE

L'étudiant doit avoir suivi les cours d'opérations unitaires classiques (extraction liquide- liquide, extraction solide-liquide, absorption, adsorption, transfert de matière et transfert de chaleur)

ASSESSMENT

Proj(Rap, Prog, Sout)

EC : Practicals: Dynamics - Security		EP8DY4	coeff : 0.32
Teacher In Charge : Cezac P., Contamine F.			
CM : 0 h	TD : 0 h	TP : 60 h	Proj : 0 h
			Language Français

OVERVIEW

Pre industrial-scale experiments in the practical ENSGTI laboratory give students a practical experience of operating principles and familiarize the students with practical problems encountered in chemical engineering.

LEARNING OUTCOMES

After this course, students should be able to have the knowledge required to analyse and solve problems relating to practical chemical engineering.

DESCRIPTION

Separation processes (distillation, extraction, absorption)
Cristallisation
Chemical Reaction Engineering
Heterogeneous Kinetics
Residence time distribution
Heat exchangers
Evaporator
Regulation
Drying
Filtration

RECOMMENDED READING

PREREQUISITE

Basic notions in process

ASSESSMENT

moyenne(TP(EO))

TEACHING UNIT (UE) :

Thermodynamics - Unit Operations S8

ECTS : 7

Code UE : EP8OU

SKILLS COVERED BY THE UE :

- Demonstrate, from both a theoretical and practical standpoint, the ability to design control loops and to adjust their parameters
- Demonstrate the ability to carry out unit operations under optimum safety conditions

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EP8OU1	industrial thermodynamics and renewable energy	0.16	CC(EE, 2h, da : tables thermodynamiques,ca)x4/5 + Proj(Rap)x1/5
EP8OU2	Mechanical and Membrane Separations	0.3	CC (EE, 1h, da:cours, ca)x1/2 + CC(EE, 1h, da:cours, ca)x1/2
EP8OU3	Innovative Processes	0.07	CC(EE, 1h)x1/2 + Proj(Rap)x1/2
EP8OU4	Practicals: Thermodynamics - Unit. Op.	0.47	moyenne(TP(EO))

EC : industrial thermodynamics and renewable energy		EP8OU1	coeff : 0.16
Teacher In Charge : Olivier J.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 10 h
			Language Français

OVERVIEW

The aim of this subject is to present and evaluate the energetic efficiency of the thermodynamics power cycles and refrigeration cycles.

LEARNING OUTCOMES

- know the main schemes of gas turbines, steam turbines, refrigeration cycles...
- analyse an industrial power or refrigeration process
- calculate the thermal efficiency of a power cycle and the coefficient of performance of a refrigeration cycle
- calculate the steam needs for an evaporation concentration process

DESCRIPTION

Part I: History...

The main dates of thermodynamics history

Part II: Power cycle

Gas turbines, steam turbines, combined cycle, cogeneration

Part III: Refrigeration cycles

Vapor compression cycle, absorption refrigeration cycle, heat pump, trigeneration, the reversed Brayton cycle, cryogenic cycles

RECOMMENDED READING

-R. GICQUEL, "Systèmes énergétiques Tome 1 et 2", Presses de l'Ecole des Mines de Paris, 2001
-L. BOREL, D. FAVRAT, "Thermodynamique et Energétique", Presses polytechniques et universitaires romandes, 2005

-Techniques de l'ingénieur

PREREQUISITE

General thermodynamics

ASSESSMENT

CC(EE, 2h, da : tables thermodynamiques,ca)x4/5 + Proj(Rap)x1/5

EC : Mechanical and Membrane Separations		EP8OU2	coeff : 0.3
Teacher In Charge : Alexandrova S., Ducousso M.			
CM : 16 h	TD : 12 h	TP : 0 h	Proj : 0 h
			Language Français

OVERVIEW

The course describes the basic tools for mechanical and membrane separation of particles from fluids. Three mechanical processes are treated specifically: Filtration and membranes, centrifugal separation, fluidisation.

LEARNING OUTCOMES

The student knows the processes governing the motion of a particle in a mechanical separation process (gravitational settling, suspension, fluidization, action of centrifugal forces, mechanisms driving filtration). He can apply this knowledge to scale an apparatus for filtration, centrifugal separation and fluidisation and he is aware of the relevant parameters governing their dynamics. He can therefore recommend or not recommend the choice of an apparatus for a given requirement.
The course enables the student to acquire an understanding of the principles, function, practice and application of membrane processes in the industry.

DESCRIPTION

Part I : Mechanical separation (M. Ducousso)
I – Description of a granular medium
II - The settling of particle by the effect of gravity
III – Suspension of fluid particles by the action of agitation
IV - Fluidisation
V - Centrifugation in a rotating fluid

Part II : Membrane separation (S. Alexandrova)
I. Membrane and Membrane Materials
II. Transport mechanisms in solution.
III. Transport phenomena in membranes.
IV. Membrane separation processes : Liquid membranes, Osmosis and Reverse Osmosis, Ultrafiltration and Microfiltration, Gas Permeation, Pervaporation, Dialysis, Electrodialysis

RECOMMENDED READING

Basic Principles of Membrane Technology , J. Mulder, Springer; 1996
Membrane Technology and Applications , Richard W. Baker , Wiley; 2004
Les séparations par membrane dans les procédés de l'industrie alimentaire, Daufin G., F. René, P. Aimar, Tec et Doc, Lavoisier, 1998

PREREQUISITE

Basic knowledge in Fluid Mechanics

ASSESSMENT

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

EC : Innovative Processes		EP8OU3	coeff : 0.07
Teacher In Charge : Alexandrova S.			
CM : 4 h	TD : 0 h	TP : 0 h	Proj : 6 h
			Language Français

OVERVIEW

The aim of this lectures is:
- to educate students to an innovative approach and intensification
- to provide the basic knowledge of existing innovative processes
- to provide the calculation basis for some advanced processes

LEARNING OUTCOMES

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

- Analyze a unit operation and to determine the limiting phenomena
- Propose enhancements to existing process
- Propose technological solutions for process intensification (mass and/or heat transfers and/or coupled processes)

DESCRIPTION

- Process intensification,
- Existing technologies: transfer intensification and coupled processes
- Miniaturization of existing contactors (scale down)
- Process intensification : microwave assisted extraction, supercritical extraction, reactive distillation ...
- Coupled process : membrane bioreactors, extraction-adsorption,...

RECOMMENDED READING

Scientific databases : Techniques de l'Ingénieur, Science Direct,Scopus, ...: available via the ENT of UPPA

PREREQUISITE

Good knowledge concerning basic unit operations: liquid-liquid and solid-liquid extraction, absorption, adsorption, mass transfer and heat transfer)

ASSESSMENT

CC(EE, 1h)x1/2 + Proj(Rap)x1/2

EC : Practicals: Thermodynamics - Unit. Op.		EP8OU4	coeff : 0.47
Teacher In Charge : Cezac P., Contamine F.			
CM : 0 h	TD : 0 h	TP : 60 h	Proj : 0 h
			Language Français

OVERVIEW

Pre industrial-scale experiments in the practical ENSGTI laboratory give students a practical experience of operating principles and familiarize the students with practical problems encountered in chemical engineering.

LEARNING OUTCOMES

After this course, students should be able to have the knowledge required to analyse and solve problems relating to practical chemical engineering.

DESCRIPTION

Separation processes (distillation, extraction, absorption)
Cristallisation
Chemical Reaction Engineering
Heterogeneous Kinetics
Residence time distribution
Heat exchangers
Evaporator
Regulation
Filtration

RECOMMENDED READING

PREREQUISITE

Theorical basis in chemical engineering

ASSESSMENT

moyenne(TP(EO))

SPECIALITE GEII

2nd Year - Semester 8 - GEII															
UE Name	Code UE	Code EC	EC Name	Hours (h) Tot UE	Tot EC	Tot Prés.	CM	TD	TP	TA	Proj.	ECTS / Coef. ECTS UE	Coef. EC
Apprenticeship S8	EG8AP	EG8AP1	Skills developed in the company	0	0	**0**	*0*	*0*	***0***	**0**	**5**	8	0.50
		EG8AP2	Mission in the company		0	**0**	*0*	*0*	***0***	**0**	**0**		0.25
		EG8AP3	Tools and quality management		0	**0**	*0*	*0*	***0***	**0**	**0**		0.25
Industrial Computing S8	EG8II	EG8II1	Industrial automation	238	28	**18**	*6*	*0*	*12*	10	**0**	8	0.10
		EG8II2	microControllers and interfacing		48	**32**	*6*	*10*	*16*	16	**0**		0.28
		EG8II3	Programmable Electronics and Codesign and FPG		50	**20**	*0*	*0*	*20*	30	20		0.14
		EG8II4	Real-time systems		72	**36**	*16*	*20*	*0*	36	*0*		0.31
		EG8II5	System Design		40	**10**	*6*	*4*	*0*	30	*20*		0.17
Electrical energy S8	EG8EE	EG8EE1	Electrical diagnostic tools	224	28	**14**	*8*	*6*	*0*	14	0	8	0.13
		EG8EE2	Acquisition and sensors		40	**20**	*10*	*10*	*0*	20	0		0.18
		EG8EE3	Design of electrical machines		32	**16**	*6*	*10*	*0*	16	0		0.14
		EG8EE4	TP Conversion machines		64	**32**	*0*	*0*	*32*	32	0		0.28
		EG8EE5	Optimization of electrical energy systems		60	**20**	*10*	*10*	*0*	40	*20*		0.27
Total Spec GEII				462		218	68	70	80	244	65	24	
Total TC + Spec GEII				663		316						30	

TEACHING UNIT (UE) :

Apprenticeship S8

ECTS : 8

Code UE : EG8AP

SKILLS COVERED BY THE UE :

- Validate previously designed and manufactured devices in order to certify compliance with all the requirements of the specifications.
- 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, HR, 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
EG8AP1	Skills developed in the company	0.5	EvalC (entreprise)*0.6 + PA (entreprise)*0.4
EG8AP2	Mission in the company	0.25	EvalC (Rap*0.5+ soutenance*0.5)
EG8AP3	Tools and quality management	0.25	EvalC (Rap)

EC : Skills developed in the company		EG8AP1	coeff : 0.5
Teacher In Charge : Pécastaing L.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 5 h
			Language Français

INTRODUCTION

During this twenty-week period in a company, including a long period of seventeen weeks (five of which are during the 3AS9), the apprentice will be confronted with a potentially multidisciplinary project which he will be able to organise and structure. He will also identify the functioning of governance and the management of ethics within his host company.

TARGETED SKILLS

- To 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 competences.

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

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

EC : Mission in the company		EG8AP2	coeff : 0.25
Teacher In Charge : Pécastaing L.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

During this twenty-week period in the company, including a long period of seventeen weeks (five of which are during the 3AS9), the apprentice will be confronted with a potentially multidisciplinary project which he will be able to organise and structure. He will certainly be confronted with the validation of his choices and will have written reports linked to his design and validation activities. He/she will be able to apprehend new scientific and technical fields, including multidisciplinary ones.

TARGETED SKILLS

- Validate previously designed and manufactured devices in order to certify compliance with all the requirements of the specifications.
- Write design and validation reports to ensure traceability, which is essential for a continuous improvement process.

CONTENT

The apprentice will submit a written report which will allow the level of competence acquired in the specific technical area of the company to be judged. As far as possible, this report will be devoted to validation activities in relation to the stated specifications.
The report will also address, among other things, the theme: Governance and management of ethics in the company and, if possible, will make a link with his/her own activities.

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

EvalC (Rap*0.5+ soutenance*0.5)

EC : Tools and quality management		EG8AP3	coeff : 0.25
Teacher In Charge : Pécastaing L.			
CM : 0 h	TD : 0 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

During this twenty-week period in the company, including a long period of seventeen weeks (five of which are during the 3AS9), the apprentice will be confronted with a project in which traceability or quality plays a significant part.

TARGETED SKILLS

- Write design and validation reports to ensure traceability, which is essential for a continuous improvement process.

CONTENT

The apprentice will submit a written report which will allow the assessment of the level of competence acquired in the field of quality management in his/her activities or at least in his/her company and on the continuous improvement processes put in place.

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

EvalC (Rap)

TEACHING UNIT (UE) :

Industrial Computing S8

ECTS : 8

Code UE : EG8II

SKILLS COVERED BY THE UE :

- Master the various principles and programming languages of industrial PLCs
- Understand the principles and programming of microcontrollers
- Master microcontroller communication with various devices
- Systematically approach the realization of digital or Codesign systems by programming a programmable electronics component
- Assimilate the basics of VHDL or Verilog languages, as well as their use via FPGA programming.
- Provide students with a basic knowledge of time-constrained computerized multitasking embedded systems.
- Design a system based on requirements from the specification.

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EG8II1	Industrial automation	0.1	CC(EE,1h30)
EG8II2	microControllers and interfacing	0.28	TP (CR)*0.3 + CC (EE, 1h30)*0.7
EG8II3	Programmable Electronics and Codesign and FPGA	0.14	TP (CR)x0,7+ Proj(Rap, sout)x0,3
EG8II4	Real-time systems	0.31	CC (3 x EE, 20 min) x 0.3 + CC (EE, 1h30, da:tous) x 0.7
EG8II5	System Design	0.17	Proj(Rap)x1/2 + Proj(Or)x1/2

EC : Industrial automation		EG8II1	coeff : 0.1
Teacher In Charge : Dumas P.			
CM : 6 h	TD : 0 h	TP : 12 h	Proj : 0 h
			Language Français

INTRODUCTION

The purpose of this course is to study different methods of analysis used to describe automated systems.

TARGETED SKILLS

- Master different methods of analysis of automated systems and choose the most suitable

CONTENT

Notion de SCADA, ERP, GEMMA
Grafcet Analysis, Finite Etas Diagram, Petri Network, Colored Petri Network
Standardized Languages
Illustration with different examples and application on API and SIEMENS Supervision

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

CC(EE,1h30)

EC : microControllers and interfacing		EG8II2	coeff : 0.28
Teacher In Charge : Dumas P.			
CM : 6 h	TD : 10 h	TP : 16 h	Proj : 0 h
			Language Français

INTRODUCTION

The purpose of this course is to understand the software-hardware interaction in microprocessor or microcontroller systems. The study of the main families of peripheral circuits will be made to carry out various process control operations.

TARGETED SKILLS

- Be able to design the architecture of a CPU board based on microprocessor, memory and peripheral circuits.
- Know how to control peripheral circuits thanks to a programming language using hierarchical methods.

CONTENT

General study of a CENTRAL UNIT card, static and dynamic memories
Microprocessor signals, read-write chronograms, VHDL decoding logic
Interrupts, interrupt controller, interrupt program installation
Peripheral functions; TOR, series, Timer, interrupt, communication I2C
Several TD and TP allow to implement the different concepts.

RESSOURCES

PREREQUISITE

Knowledge of Language C
S5 Digital Electronic Course

EVALUATION PROCEDURES

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

EC : Programmable Electronics and Codesign and FPGA		EG8II3	coeff : 0.14
Teacher In Charge : Dumas P.			
CM : 0 h	TD : 0 h	TP : 20 h	Proj : 20 h
			Language Français

INTRODUCTION

This course proposes to realize mixed digital-processor electronic systems (CODESIGN) for embedded systems through programmable digital electronics (FPGA).

TARGETED SKILLS

- Systematically approach the realization of digital or Codesign systems by programming a programmable electronics component.
- No longer apprehend digital electronics by discrete components but by an electronic description language (VHDL, Verilog).
- Introduction of processors in the FPGA and make a multiprocessor measurement system driven in C Language

CONTENT

- Synthesizable VHDL language
- Applications counters, encoders, state machine, memory
- Set up a microcontroller with different devices
- Exchange of information between state machine and microcontroller
- Multiprocessor

RESSOURCES

PREREQUISITE

S5 Digital Electronic Course
Language C, Finite State Machine, Processor.

EVALUATION PROCEDURES

TP (CR)x0,7+ Proj(Rap, sout)x0,3

EC : Real-time systems		EG8II4	coeff : 0.31
Teacher In Charge : Rivaletto M.			
CM : 16 h	TD : 20 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The objective of this course is to provide students with a basic knowledge of time-constrained multitasking computerized embedded systems.
The VRTX32 and μC-OS-II real-time kernels serve as functional support for the course. The second serves as a practical support for some TDs.

TARGETED SKILLS

- Master the notions of real-time embedded programming. Using an industrial real-time core

CONTENU

Control system - Parallelism - Time constraints
Real-time systems (General - Definitions, Real-time systems - Tasks)
Scheduling of tasks (Scheduling, Obtaining scheduling feasibility tests, Inclusion of aperiodic processes, Conclusion, Specificities of VRTX32 and μCOS-II, Management of material tasks (interruptions))
Communication between tasks (General, Communication by messages, Communication by common area of data)
Synchronization between tasks (Introduction, Appointments, Events, Resource Sharing - Critical Sections - Mutual Exclusion)

RESSOURCES

PREREQUISITE

C Language Basics

EVALUATION PROCEDURES

CC (3 x EE, 20 min) x 0.3 + CC (EE, 1h30, da:tous) x 0.7

EC : System Design		EG8II5	coeff : 0.17
Teacher In Charge : Rivaletto M.			
CM : 6 h	TD : 4 h	TP : 0 h	Proj : 20 h
			Language Français

INTRODUCTION

A logical continuation of the S7 specification course, this design course explains how to rely on the specification (especially SART type) to build a structural and then detailed design. We will show how on a simple example we can finalize this structured design by writing a pseudo code.

TARGETED SKILLS

- Design a system based on requirements from the specification.

CONTENT

Preliminary Design (Structural)
Structured Design, SD
Problem-based learning (PD) complements this course. It also builds on the S7's course System Specification

RESSOURCES

PREREQUISITE

S7 System Specification Course

EVALUATION PROCEDURES

Proj(Rap)x1/2 + Proj(Or)x1/2

TEACHING UNIT (UE) :

Electrical energy S8

ECTS : 8

Code UE : EG8EE

SKILLS COVERED BY THE UE :

- Learn the various functionalities of electrical metrology devices in the time and frequency domain
- Learn how to choose a dedicated measuring device based on the application.
- Take into account measurement error parameters and corrections during an electrical measurement
- Know how to implement a measuring bench or an acquisition chain adapted to a process
- Understand the principles necessary to understand the sizing methods of electrical machines
- Develop a practical understanding, with effective implementation of converter associations with their load.
- Develop a capacity to analyze industrial systems and their constraints of use
- Analyze and synthesize a wide range of technical and non-technical information related to energy systems.
- Establish conclusions and recommendations for optimizations for electrical energy systems.

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

CODE EC	INTILTLED EC	COEF	EVALUATION
EG8EE1	Electrical diagnostic tools	0.13	CC (EE, 1h30)
EG8EE2	Acquisition and sensors	0.18	CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7
EG8EE3	Design of electrical machines	0.14	CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7
EG8EE4	TP Conversion machines	0.28	TP(CR)*0.3 + TP (EM, 2h)*0.7
EG8EE5	Optimization of electrical energy systems	0.27	Proj (Rap)*0.25 + Proj (Or)*0.25 + CC (EE, 1h30)*0.5

EC : Electrical diagnostic tools		EG8EE1	coeff : 0.13
Teacher In Charge : Pécastaing L.			
CM : 8 h	TD : 6 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The oscilloscope and network analyser are the basic tools in electrical metrology. The measurements made can easily be subject to error if the user does not take into account the performance of the measurement tool used in relation to the expected measurement specifications.
The objective of this course is to explain to the students the operation, the main functionalities of these devices, to evaluate the potential errors and to give them all the tools to make the most relevant choice according to the measurement to be made.

TARGETED SKILLS

- Know the operation and functions of the main devices used in electrical measurements (oscilloscope, network analyser)
- Know how to carry out and interpret an electrical measurement
- Know how to evaluate the veracity of an electrical measurement
- Have a critical eye on the most relevant choice of the apparatus to be used according to the expected specifications

CONTENT

1- The oscilloscope (Basic principle, Operation, Sampling methods (direct and sequential), Acquisition modes (Sample, DRT, Stop acquisition, Peak detect, High resolution (Hi-Res), Envelope, Averaging, Smoothing, Fastframe, InstaVuTM)
2- The network analyser, Description of a network analyser, S-parameters, Types of measurements, Error parameters and corrections, Time domain reflectometry

RESSOURCES

PREREQUISITE

Electromagntism during 1AS5 and Microwave Circuits during 2AS7

EVALUATION PROCEDURES

CC (EE, 1h30)

EC : Acquisition and sensors		EG8EE2	coeff : 0.18
Teacher In Charge : Rivaletto M.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

The objective of this course is to provide students with the basics of the acquisition of measurements seen from the electronic aspect. Describe the principles of the most common measurement sensors in industry.

TARGETED SKILLS

- Implement a measuring bench or chain of custody
- Know how to instrument a process.
- Choose of acquisition system

CONTENT

Introduction to data acquisition systems
Analog digital conversion
Digital analog conversion
Sensors
Wiring and signal conditioning
Additional functions
Implementation of an acquisition chain

RESSOURCES

PREREQUISITE

Digital electronics (S5)

EVALUATION PROCEDURES

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

EC : Design of electrical machines		EG8EE3	coeff : 0.14
Teacher In Charge : Ruscassié R.			
CM : 6 h	TD : 10 h	TP : 0 h	Proj : 0 h
			Language Français

INTRODUCTION

This course aims to present the different aspects and methodology to be taken into consideration when sizing electrical machines. It allows students to understand the principles related to sizing, but also to have an overview of the constraints related to the implementation of high-performance electrical machines.

TARGETED SKILLS

- Understand the principles necessary to understand the sizing methods of electrical machines
- Understand the technological constraints related to the optimization of modern electrical machines.

CONTENT

Machinery constitution (ME reminders, structures & principles, constituents, technologies, selection criteria)
Design (electromagnetic, electrostatic, thermal, and advanced (CAD))
Power & control (power principles, modelling, control principles, ”modern electric drives”, case studies).

RESSOURCES

PREREQUISITE

Transformers & Electrical Machines

EVALUATION PROCEDURES

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

EC : TP Conversion machines		EG8EE4	coeff : 0.28
Teacher In Charge : Ruscassié R.			
CM : 0 h	TD : 0 h	TP : 32 h	Proj : 0 h
			Language Français

INTRODUCTION

The objective of this EC is to train students in the practical implementation of industrial electrotechnical systems including both converters and rotating machines.

TARGETED SKILLS

- Develop a practical understanding, with effective implementation of converter associations with their load.
- Develop a capacity to analyze industrial systems and their constraints of use
- Putting electrical safety rules into practice
- Interpret experimental results live

CONTENU

Continuous-to-continuous conversion: Discharge and recharge of batteries.
Continuous-continuous conversion: Application of a 4Q chopper to the control of an MCC.
Ac-continuous conversion: Three-phase rectifier and assisted inverter.
Continuous-to-AC conversion: Three-phase inverters.
Synchronous machine: Synchronous compensation.
Asynchronous machine: Direct power supply and speed variation.
Urban lighting: Energy quality.
Renewable energies: MPPT & uses

RESSOURCES

PREREQUISITE

Transformers & Electrical Machines
Power converters

EVALUATION PROCEDURES

TP(CR)*0.3 + TP (EM, 2h)*0.7

EC : Optimization of electrical energy systems		EG8EE5	coeff : 0.27
Teacher In Charge : Ruscassié R.			
CM : 10 h	TD : 10 h	TP : 0 h	Proj : 20 h
			Language Français

INTRODUCTION

This module aims to provide broad knowledge on the current issues related to energy systems, the various constraints that result from them, and to present the tools under development to take these constraints into account, all in order to better understand the potential avenues for optimizing electrical energy systems that exist in different sectors of activity. Particular emphasis is placed on the transport sector and EVs, as well as storage systems and smart grids.
Following the provision of these tools, students must carry out a multi-criteria study on systems and, following a work of research, critical analysis and synthesis, propose reasoned optimization solutions.

TARGETED SKILLS

- Understand energy issues in the broad sense.
- Analyze and synthesize a wide range of technical and non-technical information related to energy systems.
- Parallel multi-criteria analyses.
- Establish conclusions and recommendations for optimizations for electrical energy systems.

CONTENU

Challenges (Evolution of energy needs, different future scenarios, potential of non-renewable and renewable energy production systems).
The new rules of the game in a finite world (”Goodbye growth”, behind the scenes of dematerialization, the life cycle: from the mine to the trash).
Current tools (Emission (and consumption) reductions, Control of energy demand and rebound effect, Emission factor, carbon footprint and offset).
Ways to optimize energy systems (Transport & EV, Storage & smart grids, Building & food production).

RESSOURCES

PREREQUISITE

EVALUATION PROCEDURES

Proj (Rap)*0.25 + Proj (Or)*0.25 + CC (EE, 1h30)*0.5