Teaching program

Maîtrise des Energies

Academic year 2023-2024

Ecole polytechnique de Nantes Université

November 13, 2023

Contents

Part I

Tables of teaching units

Semester 5 - unit *MDE 3*

Sciences for electricity 1 — ECTS : 4

Manager : GREINER Yoan

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electricity 1	9	11	4			14	*2*
• Electromagnetism	13	15	4			20	*2*
TOTAL	22	26	8	0	0	34	

Sciences for Thermal and Energy 1 — ECTS : 6

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Mechanics	18	20	4			15	*3*
• Photometry	2	2	4				*0*
• Thermodynamics	18	22				30	*3*
TOTAL	38	44	8	0	0	45	

Humanités S5 — ECTS : 4

Manager : OILI Luc

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Practis analysis S5		2					*0*
• ESE S5		4				2	*0*
• PSI S5		8				2	*0.2*
• Applied Social Sciences to the Workplace S5		28				10	*0.5*
• Toeic & Professional English		22.5				10	*0.15*
• Economy		20					*0.15*
TOTAL	0	84.5	0	0	0	24	

Mathematical tools for engineers 1 — ECTS : 6

Manager : SOURISSE Arnaud

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Algorithmic	6	8	16			5	*1.5*
• Mathematics 1	16.5	18.5				20	*3*
• Mathematics project		2		20		4	*1.5*
TOTAL	22.5	28.5	16	20	0	29	

Company S5 ECTS : 10

Manager : GREINER Yoan

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Alternation report S5							*0*
TOTAL	0	0	0	0	0	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	82.5	183	32	20	0	132	30
Face-to-face sum	317.5						

Semester 6 - unit *MDE 3*

Company S6 ECTS : 10

Manager : GREINER Yoan

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Business skills S6							*0*
• Alternation report S6							*0*
TOTAL	0	0	0	0	0	0	

Sciences pour la thermique et l'énergétique 2 à traduire ECTS : 8

Manager : GADOIN Emilie

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Thermodynamics Cycles	12	14	8			15	*2*
• Flow Dynamics	18	20	8			20	*3*
• Hydraulic Networks	10	12	4	4		10	*2*
• Strength of materials	8	10				15	*1*
TOTAL	48	56	20	4	0	60	

Humanity S6 ECTS : 4

Manager : OILI Luc

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Practice analysis S6		4					*0*
• Social issues and businesses S6		16				6	*0.25*
• PSI S6		8				2	*0*
• Applied Social Sciences to the Workplace S6		21				12.5	*0.25*
• Toeic & public speaking		22.5				10	*0.25*
• Accounting business game + Biodiversity fresco		35					*0.25*
TOTAL	0	106.5	0	0	0	30.5	

Sciences pour l'électricité 2 ECTS : 5

Manager : MIEGEVILLE Laurence

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electrical Distribution	22.25	25.75	14			32	*4*
• Electricity 2	5.25	6.75				3	*1*
TOTAL	27.5	32.5	14	0	0	35	

Athematical tools for engineers ECTS : 3

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• CAD			16			4	*1.5*
• Matlab	3	3	6			4	*1.5*
TOTAL	3	3	22	0	0	8	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	78.5	198	56	4	0	133.5	30
Face-to-face sum	336.5						

Semester 7 - unit *MDE 4*

Control and regulation of energy process — ECTS : 4

Manager : AIT-AHMED Nadia

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Industrial Automation 1	6	7				12	*1*
• Control 1	13.5	15.5				20	*1.5*
• TP Pilotage 1			28			8	*1*
TOTAL	19.5	22.5	28	0	0	40	

Company S7 — ECTS : 12

Manager : AIT-AHMED Nadia

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Alternation report S7							*0*
• Business skills S7		2					*0*
TOTAL	0	2	0	0	0	0	

Conversion of electrical energy 1 — ECTS : 4

Manager : BENKHORIS Mohamed-Fouad

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Power Electronics 1	14.5	17.5				12	*2*
• Electrical Machines 1	13	15				17	*2*
• Practical works in Electrical Engineering 1			16			8	*1*
TOTAL	27.5	32.5	16	0	0	37	

Humanity S7 — ECTS : 4

Manager : AIT-AHMED Nadia

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Analyse de la pratique S7		2					*0*
• Enjeux de Société et d'Entreprise S7		8					*0*
• PSI S7		4				20	*0.15*
• Applied Social Sciences of the Workplace S7		28				10	*0.35*
• Corporate culture		15				16	*0.125*
• Toeic		15					*0.125*
• Business economy		16					*0.25*
TOTAL	0	88	0	0	0	46	

Heat transfers

ECTS : 6

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Conduction	10	11				10	*1*
• Convection	10	11				10	*1*
• Radiance	10	11				10	*1*
• Practical works in Thermic			28			14	*1*
TOTAL	30	33	28	0	0	44	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	77	178	72	0	0	167	30
Face-to-face sum	327						

Semester 8 - unit *MDE 4*

Company S8 — ECTS : 12

Manager : AIT-AHMED Nadia

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Business skills S8		5					*0*
• Alternation report S8							*0*
TOTAL	0	5	0	0	0	0	

Conversion of electrical energy 2 — ECTS : 5

Manager : BENKHORIS Mohamed-Fouad

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Power Electronics 2	12	15				13	*1.5*
• Electrical Machines 2	14	16				15	*1.5*
• Practical works in electrical engineering 2			16			8	*2*
TOTAL	26	31	16	0	0	36	

Humanity S8 — ECTS : 4

Manager : KINGSTON John

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Practice analysis S8		4					*0*
• Social issues and businesses S8		12				10	*0.4*
• Applied Social Sciences of the Workplace S8		21				40	*0.35*
• Corporate culture		15				8	*0.25*
TOTAL	0	52	0	0	0	58	

Energy — ECTS : 5

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Combustion	6	8				5	*1.5*
• Echangeurs	4	5					*1*
• Technology of refrigerating plant	10	12				8	*2*
• Turbo-machines	6	8				5	*1.5*
TOTAL	26	33	0	0	0	18	

Pilotage et régulation de process d'énergie 2 ECTS : 4

Manager : DAKHOUCHE Kada

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Automatisme 2	6	7					*1*
• Régulation 2	6	7				6	*0.5*
• TP Pilotage 2			24			8	*2*
TOTAL	12	14	24	0	0	14	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	64	135	40	0	0	126	30
Face-to-face sum	239						

Semester 9 - unit *MDE 5*

Company S9 — ECTS : 15

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Business Skills S9							*0*
• Alternation report S9							*0*
TOTAL	0	0	0	0	0	0	

Renewable energies — ECTS : 4

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Multi-sources	2	2					*0*
• Project renenewable energy				20			*2.5*
• Storage	9	10				3	*1.5*
• Seminars about renewable energy	22.5	14.5					*0*
TOTAL	33.5	26.5	0	20	0	3	

Metrology — ECTS : 4

Manager : GUELED Ahmed

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Thermal metrology	8	8	20			10	*1.5*
• Electrical metrology	6	8	8			10	*1.5*
• Statistical	7	9	6			4	*1*
TOTAL	21	25	34	0	0	24	

Humanity S9 — ECTS : 4

Manager : KINGSTON John

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Applied Social Sciences of the Workplace S9		28				20	*0.3*
• Business management - negotiation		36					*0.4*
• Quality Security Environment		20					*0.3*
TOTAL	0	84	0	0	0	20	

Generation and transportation of energy — ECTS : 3

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Eolien	3	3					*0*
• Electrical energy	12	14				10	*2.5*
• Production nucléaire	3.5	4					*1*
• Réseaux de chaleurs	4	4				10	*0*
• Solar thermal	9.5	10.5					*1*
• Conception de projet photovoltaique	1	1					*0*
TOTAL	33	36.5	0	0	0	20	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	87.5	172	34	20	0	67	30
Face-to-face sum	313.5						

Semester 10 - unit *MDE 5*

Humanity S10 — ECTS : 3

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Applied Social Sciences of the Workplace S10		28				40	*0.8*
• Business law and economic intelligence		21					*0.2*
TOTAL	0	49	0	0	0	40	

Company S10 — ECTS : 16

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• PFE defence		12				80	*1*
TOTAL	0	12	0	0	0	80	

Energies mastery — ECTS : 5

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Marchés publics	4	4					*0*
• Project energy optimization	2	2		48		20	*4*
• Project energy economies and polities	8	8		20		15	*2*
TOTAL	14	14	0	68	0	35	

Process control — ECTS : 3

Manager : BARAKAT Abdallah

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Acoustic	1.5	1.5		4			*1*
• Engeenering of process	4.5	5.5		16		10	*2*
TOTAL	6	7	0	20	0	10	

HVAC engineering — ECTS : 3

Manager : JOSSET Christophe

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Building energetics	7	7	8			4	*1.5*
• Air conditionning	13.5	16.5				8	*1.5*
TOTAL	20.5	23.5	8	0	0	12	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	40.5	105.5	8	88	0	177	30
Face-to-face sum	242						

Part II

Sheets of courses

Accounting business game + Biodiversity fresco

Hours

Lect	Tut	PW	Proj	WP	Asst
	35				

Evaluation

One evaluation : *Oral*

Manager : Chrystèle GONCALVES

Acoustic

Hours

Lect	Tut	PW	Proj	WP	Asst
1.5	1.5		4		

Evaluation

One evaluation : *Projet*

Bibliography

SOUTIF, M. "Vibrations, propagation, diffusion", Dunod: 1985
BRUNEAU, M. "Manuel d'acoustique fondamentale", Hermès: 1998

Learning outcomes

Learning outcomes	N	A	M	E	O
• Calculer le niveau sonore du à plusieurs sources	·	·	✓	·	·
• Déterminer le temps de réverbération d'une salle	·	·	✓	·	·

Manager : Hervé GRAU

Air conditionning

Hours

Lect	Tut	PW	Proj	WP	Asst
13.5	16.5				8

Evaluation

One evaluation : *Examen écrit*

Outline

1- Humid air
2- Air traitement - Evolution in the psychrometric chart;
3- Air handling units
4- HVAC systems

Goals

This technical course relies on global knowledge of thermodynamics and energetics. It deals about the humid air evolutions (heating, cooling, humidification) and links HVAC systems with bulding requirements. For each process, energy saving is valued (free-cooling).

Bibliography

- J. Bouteloup, M. le Gay, J. Ligen ; « Conditionnement d'air : tome 1 Traitement de l'air » ; « Conditionnement d'air : tome 2 Production de chaud et de froid» ; «Conditionnement d'air : tome 4 Les systèmes » EDIPA, 1998

- Hermann Recknagel, Eberhard Sprenger, E.-R. Schramek ; « Le Recknagel - Manuel pratique du génie climatique » PYC Editions, 1995

- AICVF; « Guide Thématique n10 "Conception des installations de climatisation et de conditionnement de l'air" » ; Les éditions parisiennes, 1999

Prerequisites

Applied thermodynamics and energetics
Fluid mechanics

Learning outcomes

Learning outcomes	N	A	M	E	O
• to choose a scenario of HVAC and to define the evolution of the air in the psychrometric chart	·	·	✓	·	·
• to caracterise the components of the choosen HVAC system	·	·	✓	·	·
• to know the different HVAC technologies and to be able to propose energy saving systems	·	·	✓	·	·

Manager : Ludovic PLOUZENNEC

Algorithmic

Hours

Lect	Tut	PW	Proj	WP	Asst
6	8	16			5

Evaluation

2 evaluations :

- *Examen écrit*
- *TP*

Outline

1 - reminders on objects and elementary actions
2 - Background on control structures
3 - functions
4 - sorting methods
5 - data structures for dynamic variables
6 - Formal computing

Goals

Mastering the basic mechanisms of structured programming

Bibliography

Sedgewick R., "Algorithmes en langage C - Cours et exercices", Dunod, 2001
Horowitz E., Sahni S., Anderson-Freed S., "L'essentiel des structures de données en C", Dunod, 1993

Learning outcomes

Learning outcomes	N	A	M	E	O
• Acquire the basic mechanisms of algorithms, including the representation and manipulation of dynamic data	✓	·	·	·	·
• Mastering the concepts of C language C: variables, control structures, functions	✓	·	·	·	·

Manager : Arnaud SOURISSE

Alternation report S5

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

One evaluation : *Casuel*

Alternation report S6

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

One evaluation : *Casuel*

Alternation report S7

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

One evaluation : *Casuel*

Alternation report S8

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

One evaluation : *Casuel S8*

Alternation report S9

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

One evaluation : *Casuel*

Applied Social Sciences of the Workplace S10

Hours

Lect	Tut	PW	Proj	WP	Asst
	28				40

Evaluation

2 evaluations :

- *Dossier*
- *Soutenance*

Goals

Setting up and mastering a rational process, based on a strong questioning. Setting up and carrying out a field research, based on strong questioning. Acquiring knowledge about humanity, work and workplace. Matching theories and concrete situations. Transfer theoretical knowledge to practical and professional skills

Prerequisites

Advanced level in french reading and writing, plus stong skills in documents analysis.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Setting up and mastering a rational process, based on a strong questioning, on humanity at workplace.	·	·	✓	·	·
• Setting up and carrying out a field research, based on strong questioning	·	·	✓	·	·
• Acquiring knowledge about humanity, work and workplace	·	·	✓	·	·
• Matching theories and concrete situations	·	·	✓	·	·
• Transfer theoretical knowledge to practical and professional skills	·	·	✓	·	·

Manager : Hervé GRAU

Applied Social Sciences of the Workplace S7

Hours

Lect	Tut	PW	Proj	WP	Asst
	28				10

Evaluation

One evaluation : *Dossier*

Outline

Laws and social phenomena applied to economics.
Team working.

Goals

Setting up and mastering a rational process, based on a strong questioning. Setting up and carrying out a field research, based on strong questioning. Acquiring knowledge about humanity, work and workplace. Matching theories and concrete situations. Transfer theoretical knowledge to practical and professional skills

Prerequisites

Advanced level in french reading and writing, plus stong skills in documents analysis.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Setting up and mastering a rational process, based on a strong questioning, on humanity at workplace.	·	·	✓	·	·
• Setting up and carrying out a field research, based on strong questioning	·	·	✓	·	·
• Acquiring knowledge about humanity, work and workplace	·	·	✓	·	·
• Matching theories and concrete situations	·	·	✓	·	·
• Transfer theoretical knowledge to practical and professional skills	·	·	✓	·	·

Manager : John KINGSTON

Applied Social Sciences of the Workplace S8

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				40

Evaluation

2 evaluations :

- *Dossier*
- *Soutenance*

Goals

Setting up and mastering a rational process, based on a strong questioning. Setting up and carrying out a field research, based on strong questioning. Acquiring knowledge about humanity, work and workplace. Matching theories and concrete situations. Transfer theoretical knowledge to practical and professional skills

Prerequisites

Advanced level in french reading and writing, plus stong skills in documents analysis.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Setting up and mastering a rational process, based on a strong questioning, on humanity at workplace.	·	·	✓	·	·
• Setting up and carrying out a field research, based on strong questioning	·	·	✓	·	·
• Acquiring knowledge about humanity, work and workplace	·	·	✓	·	·
• Matching theories and concrete situations	·	·	✓	·	·
• Transfer theoretical knowledge to practical and professional skills	·	·	✓	·	·

Manager : Nadia AIT-AHMED

Applied Social Sciences of the Workplace S9

Hours

Lect	Tut	PW	Proj	WP	Asst
	28				20

Evaluation

One evaluation : *Dossier*

Goals

Setting up and mastering a rational process, based on a strong questioning. Setting up and carrying out a field research, based on strong questioning. Acquiring knowledge about humanity, work and workplace. Matching theories and concrete situations. Transfer theoretical knowledge to practical and professional skills

Prerequisites

Advanced level in french reading and writing, plus stong skills in documents analysis.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Setting up and mastering a rational process, based on a strong questioning, on humanity at workplace.	·	·	✓	·	·
• Setting up and carrying out a field research, based on strong questioning	·	·	✓	·	·
• Acquiring knowledge about humanity, work and workplace	·	·	✓	·	·
• Matching theories and concrete situations	·	·	✓	·	·
• Transfer theoretical knowledge to practical and professional skills	·	·	✓	·	·

Manager : Hervé GRAU

Applied Social Sciences to the Workplace S5

Hours

Lect	Tut	PW	Proj	WP	Asst
	28				10

Evaluation

One evaluation : *Dossier*

Presentation

Applied social sciences to the workplace

Goals

Setting up and mastering a rational process, based on a strong questioning. Setting up and carrying out a field research, based on strong questioning. Acquiring knowledge about humanity, work and workplace. Matching theories and concrete situations. Transfer theoretical knowledge to practical and professional skills.

Prerequisites

Advanced level in french reading and writing, plus stong skills in documents analysis.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Setting up and mastering a rational process, based on a strong questioning, on humanity at workplace.	·	·	✓	·	·
• Setting up and carrying out a field research, based on strong questioning	·	·	✓	·	·
• Acquiring knowledge about humanity, work and workplace	·	·	✓	·	·
• Matching theories and concrete situations	·	·	✓	·	·
• Transfer theoretical knowledge to practical and professional skills	·	·	✓	·	·

Manager : Yoan GREINER

Applied Social Sciences to the Workplace S6

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				12.5

Evaluation

2 evaluations :

- *Dossier*
- *Fiche de lecture*

Presentation

Social sciences applied to the workplace

Goals

Setting up and mastering a rational process, based on a strong questioning. Setting up and carrying out a field research, based on strong questioning. Acquiring knowledge about humanity, work and workplace. Matching theories and concrete situations

Transfer theoretical knowledge to practical and professional skills

Prerequisites

Advanced level in french reading and writing, plus stong skills in documents analysis.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Setting up and mastering a rational process, based on a strong questioning, on humanity at workplace.	·	·	✓	·	·
• Setting up and carrying out a field research, based on strong questioning	·	·	✓	·	·
• Acquiring knowledge about humanity, work and workplace	·	·	✓	·	·
• Matching theories and concrete situations	·	·	✓	·	·
• Transfer theoretical knowledge to practical and professional skills	·	·	✓	·	·

Manager : Yoan GREINER

Automatisme 2

Hours

Lect	Tut	PW	Proj	WP	Asst
6	7				

Evaluation

One evaluation : *Examen*

Outline

-Definition of a technical system

-Functional analysis of a sytème: using elements of the APTE, FAST and SADT methods,

-Structure of an automated system

-Study of control part: strucure, languages (ladder, SFC, List, Scl, flowcharts)

-Study of operating modes and stops (GEMMA).

-Study of Industrial Automation: structure, organization software, PLC cycle, response time (SCHNEIDER, SIEMENS).

-Study on the industrial Supervision.'

Goals

Study of automated technical systems using the tools of functional analysis, knowledge of electrical, pneumatic and hydraulic action chains , the use of Siemens and Schneider Industrial Automation with ladder language, grafcet, list, flowcharts , .. Supervision on console is used during sessions of practical projects for the realization of a complete application.

Bibliography

Bossy J.C " Le GRAFCET" ,Casteilla

Reeb B. " Le développement des grafcets" ,Ellipses

Learning outcomes

Learning outcomes	N	A	M	E	O
• Ability to apply tools of functional analysis for the study of technical systems	·	✓	·	·	·
• Knowledge of the structure of an automated technical systems	·	✓	·	·	·
• Know the structure of electrical action chains (contactors, actuators) pneumatic action (distributors, verrins) and the acquisition chain (inductive, capacitive, photoelectric, ..	·	✓	·	·	·
• Know the structure of PLCs and industrial use: SIEMENS SCHNEIDER	·	·	✓	·	·
• Programming with languages ??for automata with contacts, grafcet	·	·	✓	·	·

Manager : Kada DAKHOUCHE

Building energetics

Hours

Lect	Tut	PW	Proj	WP	Asst
7	7	8			4

Evaluation

One evaluation : *Projet STD*

Outline

1. Heat transfert
   2. Human thermal comfort
   3. Air exchange
   4. heating loads
   5. cooling loads
   6. Energy bulding legislation
   7. building application

Goals

Application of heat transfer and energy knowledge in the fields of building energy. Estimate the heat and mass balance of a building interacting with its environment and its occupants is the starting point of design of the HVAC facility, also for thermal requirements for a manufacturing process. The evolution of french legislation is studied since 1974 and specially the so called RT2012, French energy legislation.

Bibliography

- Hermann Recknagel, Eberhard Sprenger, E.-R. Schramek ; « Le Recknagel - Manuel pratique du génie climatique » PYC Editions, 1995

Prerequisites

Heat transfer

Learning outcomes

Learning outcomes	N	A	M	E	O
• to establish the thermal and mass balances of a building	·	·	✓	·	·
• To optimize the elements of bulding construction and energy systems to meet the requirements of the thermal legislation	·	·	✓	·	·

Manager : Christophe JOSSET

Business Skills S9

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Business economy

Hours

Lect	Tut	PW	Proj	WP	Asst
	16				

Evaluation

One evaluation : *Devoir sur table*

Manager : Chrystèle GONCALVES

Business law and economic intelligence

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				

Evaluation

One evaluation : *Contrôle continu*

Manager : Gwenael THOREL

Business management - negotiation

Hours

Lect	Tut	PW	Proj	WP	Asst
	36				

Evaluation

One evaluation : *Contrôle continu*

Manager : John KINGSTON

Business skills S6

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

One evaluation : *Casuel*

Business skills S7

Hours

Lect	Tut	PW	Proj	WP	Asst
	2				

Evaluation

One evaluation : *Casuel*

Business skills S8

Hours

Lect	Tut	PW	Proj	WP	Asst
	5				

Evaluation

One evaluation : *Casuel S8*

CAD

Hours

Lect	Tut	PW	Proj	WP	Asst
		16			4

Evaluation

One evaluation : *Dossier*

Goals

Get acquainted with tools of drawing by computer used in companies

Learning outcomes

Learning outcomes	N	A	M	E	O
• Discover CAD	✓	·	·	·	·
• Be able to propose presentation of autocad drawing	·	✓	·	·	·
• Be able to modify and read an autocad drawing	·	·	✓	·	·

Manager : Valérie HOORELBECK

Combustion

Hours

Lect	Tut	PW	Proj	WP	Asst
6	8				5

Evaluation

One evaluation : *Examen écrit*

Bibliography

L. Borel et D. Favrat, Thermodynamique et Energétique, PPUR, 2005 - Van Wylen, Sonntag et Desrochers, Thermodynamique Appliquée, Ed. Renouveau Pédagogique, 1992 - M.J. Moran et H.N. Shapiro, Engineering Thermodynamics, Wiley, 2004 - Michel Pluviose, Machines à Fluides: Principe et fonctionnement, Ellipses, 2002

Learning outcomes

Learning outcomes	N	A	M	E	O
• Mastering the design of combustion installations	·	·	✓	·	·
• Energy balance of the combustion	·	·	✓	·	·
• Acquire notions on the physical chemistry of pollutants	✓	·	·	·	·

Manager : Dominique TARLET

Conduction

Hours

Lect	Tut	PW	Proj	WP	Asst
10	11				10

Evaluation

One evaluation : *Examen écrit*

Bibliography

Taine J et Petit J-P "Transferts thermiques", Edition Dunod 1998

Necati Osisik "Heat transfert, a basic aapproach" Mac Graw-Hill Int. Editions

Frank P. Incropera, David P. DeWitt "Introduction to heat transfer", 3rd edition John Wiley en Sons edition

Jean-Luc Battaglia, Andrzej Kusiak, Jean-Rodolphe Puiggali. INTRODUCTION AUX TRANSFERTS THERMIQUES, cours et exercices. Dunod, Paris, 2010

Kau-Fui Vincent Wong, Intermediate Heat Transfer, Marcel Dekker, Inc. 270 Madison Avenue, New York, NY 10016

Amimul Ahsan, CONVECTION AND CONDUCTION HEAT TRANSFER, Janeza Trdine 9, 51000 Rijeka, Croatia

Learning outcomes

Learning outcomes	N	A	M	E	O
• Be able to	·	✓	·	·	·
• To use	·	✓	·	·	·
• Quanti	·	·	✓	·	·
• Realize a thermal balance	·	·	✓	·	·
• Analyze	·	✓	·	·	·
• Check	·	·	✓	·	·

Manager : Walid BLEL

Control 1

Hours

Lect	Tut	PW	Proj	WP	Asst
13.5	15.5				20

Evaluation

One evaluation : *Examen écrit*

Outline

- Introduction to automatic control - Modeling, temporal and frequency domain representation of linear system

- Bloc diagram, Mason rule - Representation of basic systems (first and second order, integrator, delay)

- PID controller synthesis

Goals

At the end of this course, students should have acquired the ability to synthesize of traditional PID controllers. It must appear, that the fundamental problem of control is essential, to manage a compromise between performance, stability, actuators stresses, sensitivity to noise

Bibliography

- M. Rivoire, J.L Ferrier, J. Groleau, « Cours d'automatique : Signaux et systèmes (tome1,tome 2) », Edition Eyrolles.

- Y. Granjon, « Automatique : systèmes linéaires, non linéaires, à temps continu, à temps discret, représentation d'état », Edition Dunod.

- C. Sueur, P. Vanheeghe, P. Borne, "Automatique des systèmes continus : Eléments de cours et exercices résolus", Collection sciences et technologies, Ed : Technip

Prerequisites

Mathematical course: complex numbers, ordinary differential equations

Learning outcomes

Learning outcomes	N	A	M	E	O
• Modéliser les systèmes linéaires (Fonction de transfert, équation différentielle)	·	✓	·	·	·
• Analyser les systèmes linéaires (réponses temporelles et fréquentielles) des systèmes linéaires	·	✓	·	·	·
• Synthétiser les régulateurs de base	·	·	✓	·	·

Manager : Nadia AIT-AHMED

Convection

Hours

Lect	Tut	PW	Proj	WP	Asst
10	11				10

Evaluation

One evaluation : *Examen écrit*

Bibliography

Taine J et Petit J-P "Transferts thermiques", Edition Dunod 1998

Necati Osisik "Heat transfert, a basic aapproach" Mac Graw-Hill Int. Editions

Frank P. Incropera, David P. DeWitt "Introduction to heat transfer", 3rd edition John Wiley en Sons edition

Learning outcomes

Learning outcomes	N	A	M	E	O
• Différencier les modes de transfert de chaleur	·	·	✓	·	·
• Simplification justifiée de la problématique	·	·	✓	·	·
• Maîtrise des outils introduits en cours	·	·	✓	·	·
• Bilans thermiques	·	✓	·	·	·
• Quantifier les transfert lorsqu'ils sont couplés	·	✓	·	·	·
• Pouvoir modifier un système dans un but d'optimisation des transferts	·	✓	·	·	·

Manager : El-Khider SI-AHMED

Corporate culture

Hours

Lect	Tut	PW	Proj	WP	Asst
	15				8

Evaluation

2 evaluations :

- *CC*
- *DS*

Corporate culture

Hours

Lect	Tut	PW	Proj	WP	Asst
	15				16

Evaluation

2 evaluations :

- *CC*
- *DS*

Echangeurs

Hours

Lect	Tut	PW	Proj	WP	Asst
4	5				

Evaluation

One evaluation : *Examen écrit*

Outline

Heat exchangers and their design

Goals

This course is substantially based about industrial heat exchangers

Prerequisites

Course of heat transfer, combustion, turbo-Machines and energetic

Learning outcomes

Learning outcomes	N	A	M	E	O
• Be able to design heat exchangers and a heat distribution network	✓	·	·	·	·

Manager : Marc LENOIR

Economy

Hours

Lect	Tut	PW	Proj	WP	Asst
	20				

Evaluation

One evaluation : *Devoir sur table*

Manager : Chrystèle GONCALVES

Electrical Distribution

Hours

Lect	Tut	PW	Proj	WP	Asst
22.25	25.75	14			32

Evaluation

3 evaluations :

- *Examen écrit 1*
- *Examen écrit 2*
- *TP*

Outline

1. About the dangers associated with electricity and the role of earthing arrangements
   - direct & indirect-contact hazards, detailed review of the usual earthing schemes
   2. The fundamentals of electrical engineering
   - use and application of phasors and complex algebra in 3-phase sinusoidal balanced systems, impedance concept, electrical powers
   3. Typical layout of the electrical distribution system
   - national power grid structure (design characteristics / functional aspects)
   4. Introduction to the magnetic systems of power transformers
   - coil with iron core, manufacturing technologies, roles of air gaps, behaviour modelling
   5. Role and uses of power transformers
   - operating rules, Kapp's model, performance characteristics, three-phase coil arrangements, turns ratio, phase shift, parallel operation and special transformers

Goals

Understand the operation of electrical machines (induction motors, generators and compensation synchronous machines), based on the electromagnetic induction theory. Basic concepts to carry out the analysis of the ideal transformer, and to study real transformers. Earthing connections for the protection of persons against electrical faults. Role and operational principles of power transformers in supplying the electrical distribution system.

Bibliography

CEI 60479, Effets du courant passant par le corps humain - Partie 2 : aspects particuliers.

B. LACROIX, R. CALVAS, Les schémas des liaisons à la terre en BT, Cahier technique no. 172, Schneider Electric, édition mai 2001.

M. LAMBERT, Les régimes de neutres et les schémas de liaison à la terre, Collection technique & Ingénierie, Dunod, 2011.

B. HOCHART, Le transformateur de puissance, Lavoisier, Tech. & Doc., 1998.

R.P. BOUCHARD, G. OLIVIER, Electrotechnique, Presses internationales Polytechnique (Montréal), 1999, 2ème édition.

Prerequisites

Background in electromagnetic induction, basic circuit and electrical system theories

Learning outcomes

Learning outcomes	N	A	M	E	O
• Be aware of the dangers of indirect contact hazards and master the analysis approach for calculation of insulation faults in the TT, TN and IT systems	·	·	✓	·	·
• Know how to determine the rating of protective devices (breaking capacity in accordance with the current earthing scheme, fuse size ratings, ...)	·	·	✓	·	·
• Understand the role of a 3-phase distribution transformer in the whole electric power system and master its operating rules under load & no-load conditions	·	·	✓	·	·
• Be able to model a steady-state transformer for the purpose of simulation and sizing (equivalent circuit and calculation of its typical values)	·	·	·	✓	·
• Know how to estimate the main characteristics of real-world transformers (i.e. voltage regulation, copper and iron losses, ratio of the 3-phase input voltage to the 3-phase output voltage, phase shift feature, efficiency, ...)	·	·	✓	·	·

Manager : Laurence MIEGEVILLE

Electrical Machines 1

Hours

Lect	Tut	PW	Proj	WP	Asst
13	15				17

Evaluation

One evaluation : *Examen écrit*

Outline

I. Electromagnetism for electrical machines

- Magnetic field and flux density/ Magnetic characteristic/ Iron losses/ Ampere's law/ Magnetic energy/ Flux/Faraday's law/ Self and mutual inductances/ Permanent magnets

II. DC current machine

- Technology and applications/ Fondamental equations/ Excitation mode/ Supply and control (torque or speed)

Goals

Knowing the laws of electromagnetism

Knowing the principle and the technology of electrical machines

Knowing how to model DC machines considering different assumptions

Understanding the different kind of supply and how to control torque or speed of DC machines

Bibliography

Lavabre (Cours TD électrotechnique)

« Electronique de puissance, conversion d'énergie. Cours et exercices résolus, DUT-BTS, écoles d'ingénieurs », 2000, collection Capliez

Prerequisites

How to solve electrical circuits (complex and phasor diagram)

How to calculate electrical powers in sinusoïdal supply

How to use laws in magnetism

Learning outcomes

Learning outcomes	N	A	M	E	O
• Being able to choose a machine considering an application	·	·	·	✓	·
• Knowing the electrical model of DC machines	·	·	✓	·	·
• Knowing the technology of the DC machines	·	·	✓	·	·
• Knowing the control of the DC machines (torque and speed)	·	·	✓	·	·

Manager : Nicolas BERNARD

Electrical Machines 2

Hours

Lect	Tut	PW	Proj	WP	Asst
14	16				15

Evaluation

One evaluation : *Examen écrit*

Outline

I. Magnetic rotating fields
- Principle/technology

II. Synchronous Machine
- Principle/ Technology and applications/ Torque calculation and stability/ Current and voltage supply, control

III. Asynchronous Machine
- Principle/ Technology and applications/ Modeling (Steinmetz model)/ Torque calculation/ Operation at variable speed

Goals

Knowing the principle of electrical AC machines
Knowing the technology of electrical AC machines
Knowing how to model electrical AC machines considering different assumptions
Understanding the different kind of supply and how to control torque or speed of AC machines

Bibliography

Lavabre (Cours TD électrotechnique)
« Electronique de puissance, conversion d'énergie. Cours et exercices résolus, DUT-BTS, écoles d'ingénieurs », 2000, collection Capliez

Prerequisites

How to solve electrical circuits (complex and phasor diagram)
How to calculate electrical powers in sinusoïdal supply
How to use laws in magnetism

Learning outcomes

Learning outcomes	N	A	M	E	O
• Being able to choose a machine considering an application	·	·	·	✓	·
• Knowing the electrical model of AC machines	·	·	✓	·	·
• Knowing the technology of the AC machines	·	·	✓	·	·
• Knowing the control of the AC machines (torque and speed)	·	·	✓	·	·

Manager : Nicolas BERNARD

Electrical energy

Hours

Lect	Tut	PW	Proj	WP	Asst
12	14				10

Evaluation

2 evaluations :

- *Examen RTE*
- *Examen distribution*

Presentation

This course focuses on the entire power conversion and transmission chain from producers to consumers. This overview provides the basics of electricity network operation, and allows to master the major concepts of these structures.

Outline

1. Electric Power Generation: Energy Sources & Introduction to the Economic Context of the Electricity Market

2. Power grids: History & Operating fundamentals of AC-DC grids

3. The major transport network:

3.1 Functionality, organization, structures; power system safety

3.2 Illustration of the "supply/demand balance" problem around major incidents

4. The distribution network: Features, organization, architectures; role and use of the three-phase transformer

5. Study of specific concepts for the characterization of the behavior of a network: Calculation of power transits; voltage and frequency regulation; modeling and study methods.

Goals

Develop the technical aspects of the operation of our electrical networks. Starting from generation centres with a growing number of local sources, the power system is made up of transmission and distribution networks constituted of a heterogeneous association of electrical structures whose operation is a determining factor in the behaviour of the system itself.

Bibliography

- RTE, Memento de la sûreté du système électrique, 2004.

- SCHNEIDER ELECTRIC, Guide de la distribution électrique basse tension et HTA, 2009.

- L. LASNE, Electrotechnique, Dunod, 2008.

- T. WILDI, G. SYBILLE, Electrotechnique, DeBoeck, 4ème édition, 2005.

- R.P. BOUCHARD, G. OLIVIER, Electrotechnique, Presses internationales Polytechnique (Montréal), 2ème édition, 1999.

Prerequisites

- Knowledge of electrical machines

- Knowledge of single-phase and three-phase electricity methods

- Mathematical tools for electrical circuits, differential equations

Learning outcomes

Learning outcomes	N	A	M	E	O
• Develop a basic understanding of electricity and know how the nation-wide electrical power system works	·	✓	·	·	·
• Have an extensive knowledge of electrical power generation, transmission and distribution	·	·	✓	·	·
• Master the fundamental physics that rule the functioning of the whole electric power system	·	·	✓	·	·
• Know the safety rules and be able to tackle safety issues	·	·	✓	·	·
• Be able to perform electric circuit calculations and analyse the power system behaviour from specific and suitable modeling tools	·	·	·	✓	·

Manager : Salvy BOURGUET

Electrical metrology

Hours

Lect	Tut	PW	Proj	WP	Asst
6	8	8			10

Evaluation

2 evaluations :

- *Examen écrit*
- *Rapport TP*

Outline

I. Introduction

Potentials (ground and earth ground), electronic amplifiers, common mode and differential mode.

II. Operational Amp. : circuits and caracteristics

Equivalent circuit, open-loop and closed-loop on operationel amplifier circuits, calculations on circuits using operationel amplifiers.

III. Instrumentation Amplifier

Necessity of an instrumentation amplifier in a measurement system, caracteristics, main designs of instrumentation amplifier.

Goals

Knowing how to implement a measurement associating a sensor and the electronic amplifier

Knowing the main technologies of sensors

Knowing the electronic circuits using Operational Amplifier (Op Amp)

Knowing the basics of metrology (uncertainty of a measurement)

Bibliography

Traité de l'électronique Analogique et numérique, Vol. 1 et 2.

Paul Horowitz et Winfield Hill, Ed. Elektor, ISBN : 2-86661-070-9 et 2-86661-071-7

Amplifiers for Signal Conditioning

Walt Kester, http://www.analog.com/index.html

Prerequisites

How to solve electrical circuits (Ohm's law and phasor diagram...)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing when it is necessary to use an instrumentation amplifier (IA)	·	·	✓	·	·
• Knowing the caracteristics of simple amplifier and instrumention amplifier	·	·	✓	·	·
• Knowing how to calculate the electronic circuits using operationel amplifiers	·	·	✓	·	·
• Knowing the different imperfections of operationel amplifiers.	✓	·	·	·	·

Manager : Yoan GREINER

Electricity 1

Hours

Lect	Tut	PW	Proj	WP	Asst
9	11	4			14

Evaluation

2 evaluations :

- *Examen écrit 1*
- *Rapport TP*

Outline

Electricity in continuous:
- Presentation of basic laws
- Using systematic methods for solving electrical circuits
- Presentation of the Thevenin and Norton sources. Using Thevenin-Norton equivalencies to simplify and solve electrical circuits

Electricity in sinusoidal:
- Representation of complex sources and impedances
- Calculation of modules and phase

Goals

Master the main theorems of electricity and how to apply them to electrical circuit (in continuous and sinusoidal). Calculate power and energy balance.

Bibliography

Tahar Neffati: Électricité Générale, analyse et synthèse des circuits, 2ème éditionDUNOD

Yves Granjon: Électricité Générale,Rappels de cours,méthodes, exercices et problèmes avec corrigés détaillés, 3ème édition DUNOD

Luc Lasne: Exercices et problèmes d'électrotechnique, notions de base, réseaux et machine électriques, 2ème édition DUNOD

Pierre Mayé: Aide-mémoire électrotechnique, DUNOD

Prerequisites

Basic knowledge in physics and mathematics (integrals, derivatives, complex numbers)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Acquire the basic laws of electricity	·	·	✓	·	·
• Master the operation of electrical circuits in steady state	·	·	✓	·	·
• Master the operation of electrical circuits in sinusoidal	·	·	✓	·	·
• Calculate the transfert function of filters	·	✓	·	·	·
• Take stock of power and energy	✓	·	·	·	·

Manager : Yoan GREINER

Electricity 2

Hours

Lect	Tut	PW	Proj	WP	Asst
5.25	6.75				3

Evaluation

One evaluation : *Examen écrit*

Bibliography

-LUC LASNE, Exercices et problèmes en électrotechnique, notions de base et machines électrique
édition Dunod
-CHRISTOPHE PALERMO, Précis d'électrotechnique, l'essentiel du cours ,exercices et problèmes corrigés.
édition Dunod
-BERTRAND NOGAREDE, Électrodynamique appliquée Bases et principes physiques de l'électrotechnique
édition Dunod
-PIERRE MAYE, Aide-mémoire électrotechnique
édition Dunod
- Max Marty, Daniel Dixneuf, Dephine Garcia Gilabert, Principes d'électrotechniques
édition Dunod

Learning outcomes

Learning outcomes	N	A	M	E	O
• Acquire	·	·	✓	·	·
• behaviour	·	·	✓	·	·
• perform a balance of power on three-phase electrical installations	✓	·	·	·	·

Manager : Yoan GREINER

Electromagnetism

Hours

Lect	Tut	PW	Proj	WP	Asst
13	15	4			20

Evaluation

2 evaluations :

- *Examen écrit*
- *Rapport TP*

Bibliography

DURAND E ; Electrostatique T1 : Les distributions ; Masson, 1997

DURAND E ; Electrostatique T2 : Problèmes généraux ; Masson, 1966

FOURNET G; Electromagnétisme à partir des équations locales ; Masson, 1985

PEREZ J, CARLES R, FLECKINGER R ; Electromagnétisme, Fondement et applications; Masson, 1997

Learning outcomes

Learning outcomes	N	A	M	E	O
• Acquérir les concepts de base de l'électromagnétisme	·	·	✓	·	·
• Connaître les propriétés caractéristiques (électriques et magnétiques) des différents type de matériaux	·	·	·	✓	·
• Maîtriser à partir des lois électromagnétiques le calcul des caractéristiques électrique des principaux éléments de circuits (inductance, condensateur, résistances)	·	·	✓	·	·
• Connaître les principes de base des perturbations électromagnétiques	✓	·	·	·	·

Manager : Didier TRICHET

Engeenering of process

Hours

Lect	Tut	PW	Proj	WP	Asst
4.5	5.5		16		10

Evaluation

2 evaluations :

- *Examen*
- *Compte rendu*

Bibliography

Laporte Bernard "Machines électriques tournantes : Conception, dimensionnement, fonctionnement" Paris, Ellipses, 2007

Jean-Paul LOUIS, Bernard MULTON, Yvan BONNASSIEUX, Michel LAVABRE, "Commande des machines à courant continu (mcc) à vitesse variable", D3610, Technique de l'ingénieur, 2002,

Learning outcomes

Learning outcomes	N	A	M	E	O
• Analyze	·	·	·	✓	·
• Proposer un ensemble convertisseur-machine-commande répondant à un cahier de charges	·	·	✓	·	·
• modéliser, simuler et valider un système complexe composé des machines, convertisseurs et régulateurs	·	·	✓	·	·

Manager : Abdallah BARAKAT

Enjeux de Société et d'Entreprise S7

Hours

Lect	Tut	PW	Proj	WP	Asst
	8				

Evaluation

One evaluation : *Présentation*

Manager : Nadia AIT-AHMED

Eolien

Hours

Lect	Tut	PW	Proj	WP	Asst
3	3				

Evaluation

One evaluation : *QCM*

Manager : Hervé GRAU

Flow Dynamics

Hours

Lect	Tut	PW	Proj	WP	Asst
18	20	8			20

Evaluation

3 evaluations :

- *Examen écrit*
- *Contrôle continu*
- *TP*

Bibliography

S. Candel, Mécanique des fluides, Dunod
P. Chassaing, Mécanique des fluides, éléments d'un premier parcours, Cépaduès Editions
E. Guyon, J.P. Hulin, L. Petit, Hydrodynamique Physique, EDP Sciences
I. Ryhming, Dynamique des fluides, PPUR
F.M. White, Fluid Mechanics, McGraw-Hill

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know Navier-Stokes equations and basic flows : Couette and Poiseuille	·	·	✓	·	·
• Be able to calculate forces acting on an obstacle by a flowing fluid	·	·	✓	·	·
• Know Eulerian and Lagrangian descriptions, notions of continuous media, of behavior, viscosity, of boundary layer, of similarity, of turbulence	·	✓	·	·	·
• Savoir résoudre les équations de Navier-Stokes dans des cas simples	·	·	✓	·	·
• Avoir des notions sur le milieu continu, la viscosité, la couche limite, les similitudes, la turbulence.	·	✓	·	·	·

Manager : Emilie GADOIN

Hydraulic Networks

Hours

Lect	Tut	PW	Proj	WP	Asst
10	12	4	4		10

Evaluation

3 evaluations :

- *Examen écrit*
- *Projet*
- *Contrôle Continu*

Bibliography

J.P. Beaudry et J.C. Rolland, Mécanique des fluides appliquées, Berger
R. Comolet, Mécanique expérimentale des fluides, Masson
R. Ouziaux et J. Perrier, Mécanique des fluides appliquées, Dunod
H. Lumbroso, Problèmes résolus de mécanique des fluides, Dunod Université
F.M. White, Fluid Mechanics, McGraw-Hill

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know how to measure rate flow	·	·	✓	·	·
• Be able to calculate pressure forces acting on an abstacle by a fluid at rest	·	·	✓	·	·
• Be able to calculate mass flow rate and pressure drop for pipe and network flow	·	·	✓	·	·
• Connaître le smoyens de mesure classique; débitmétrie par Venturi ou diaphragme, tube de Pitot	·	✓	·	·	·

Manager : Emilie GADOIN

Industrial Automation 1

Hours

Lect	Tut	PW	Proj	WP	Asst
6	7				12

Evaluation

One evaluation : *Examen écrit*

Outline

-Definition of a technical system

-Functional analysis of a sytème: using elements of the APTE, FAST and SADT methods,

-Structure of an automated system

-Study of control part: strucure, languages (ladder, SFC, List, Scl, flowcharts)

-Study of operating modes and stops (GEMMA).

-Study of Industrial Automation: structure, organization software, PLC cycle, response time (SCHNEIDER, SIEMENS).

-Study on the industrial Supervision.'

Goals

Study of automated technical systems using the tools of functional analysis, knowledge of electrical, pneumatic and hydraulic action chains , the use of Siemens and Schneider Industrial Automation with ladder language, grafcet, list, flowcharts , .. Supervision on console is used during sessions of practical projects for the realization of a complete application.

Bibliography

Bossy J.C " Le GRAFCET" ,Casteilla

Reeb B. " Le développement des grafcets" ,Ellipses

Learning outcomes

Learning outcomes	N	A	M	E	O
• Ability to apply tools of functional analysis for the study of technical systems	·	✓	·	·	·
• Knowledge of the structure of an automated technical systems	·	✓	·	·	·
• Know the structure of electrical action chains (contactors, actuators) pneumatic action (distributors, verrins) and the acquisition chain (inductive, capacitive, photoelectric, ..	·	✓	·	·	·
• Know the structure of PLCs and industrial use: SIEMENS SCHNEIDER	·	·	✓	·	·
• Programming with languages ??for automata with contacts, grafcet	·	·	✓	·	·

Manager : Kada DAKHOUCHE

Mathematics 1

Hours

Lect	Tut	PW	Proj	WP	Asst
16.5	18.5				20

Evaluation

2 evaluations :

- *Examen écrit 1*
- *Examen écrit 2*

Outline

1. Matrix calculation and systems of linear equations, 2. Differential and integral calculus, 3. Vector analysis

Goals

This course will focus on the tools of matrix calculation, vector analysis, differential equations, operational calculus (Laplace and Fourier transforms) usefull to solve problems in energy management.

Bibliography

Soum, Jagut, Dubouix, techniques mathématiques pour la physique, travaux dirigés, volumes 1 et 2, Hachette supérieur, 1995

Kaddour NAJIM, Enso IKONEN, Outils mathématiques pour le génie des procédés, cours et exercices corrigés, Dunod, 1999.

François LIRET, Maths en pratique à l'usage des étudiants, cours et exercices , Dunod, 2006

Prerequisites

Have L2 level in sciences

Learning outcomes

Learning outcomes	N	A	M	E	O
• Exhibit a proficiency in the topics covered in the course	·	·	✓	·	·
• To have the ability to interprete and analyse given information by translating them into mathematical statements and to check the solutions	·	✓	·	·	·

Manager : Arnaud SOURISSE

Mathematics project

Hours

Lect	Tut	PW	Proj	WP	Asst
	2		20		4

Evaluation

One evaluation : *Examen*

Manager : Arnaud SOURISSE

Matlab

Hours

Lect	Tut	PW	Proj	WP	Asst
3	3	6			4

Evaluation

One evaluation : *Évaluation*

Outline

Introduction
- Matlab/Simulink basics and toolboxes
- Methods of work
- Examples :
- Solving a system of linear equations
- Solving of an electrical circuit
- Responses of a linear system
- Highlighting of experimental results

Goals

MATLAB/SIMULINK Initiation

Bibliography

1- Aflio QUARTERONI, Fautso SALERI, Paolo. GERVSIO, « Calcul scientifique : cours , exercices corrigés et illustrations en Matlab et Octave », Edition Springer.

2- Christophe SALZMANN, « cours introduction Matlab » , EPFL.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Programming and using the basics functions of MATLAB	·	✓	·	·	·
• Initiation Simulink and Toolboxes	·	✓	·	·	·

Manager : Nadia AIT-AHMED

Mechanics

Hours

Lect	Tut	PW	Proj	WP	Asst
18	20	4			15

Evaluation

2 evaluations :

- *Examen écrit*
- *TP*

Presentation

Mechanic for non mechanical engineers based upon the six principles with Newton's laws.

Outline

1. Vectorial calculus, screws algebra;
2. Statics of solids
3. Kinematics
4. Particles dynamic
5. Geometry of masses, solid dynamic, energy

Goals

Provide the main knowledge for the modelling and resolution of problems of systems of solids dynamics in order to be able to evaluate internal efforts, dimension systems and predict their time evolution.

Bibliography

PEREZ, J.P. "Mécanique: fondements et applications", Duond, 2014.
BEER, F.B. JOHNSTON, E.R.: "Mécanique pour ingénieur" 2 volumes, de boeck, 2009.

Prerequisites

Basic knowledge in mechanics (forces, velocity, acceleration, equilibrium), and associated mathematics.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowledge of basic principles of the modelling of systems of solids in mechanics	·	·	✓	·	·
• Know how to perform the balance unknowns / equations in a mechanical problem	·	·	✓	·	·
• Know how to write and solve the equations of a simple solid dynamics problem	·	✓	·	·	·

Manager : Hervé GRAU

Multi-sources

Hours

Lect	Tut	PW	Proj	WP	Asst
2	2				

Learning outcomes

Learning outcomes	N	A	M	E	O
• ? Connaître les moyens de production d'électrité et leurs contraintes techniques	·	✓	·	·	·
• Connaître le concept SmartGrid	✓	·	·	·	·

Manager : Hervé GRAU

PFE defence

Hours

Lect	Tut	PW	Proj	WP	Asst
	12				80

Evaluation

2 evaluations :

- *Soutenance PFE*
- *Mémoire PFE*

Manager : Hervé GRAU

PSI S5

Hours

Lect	Tut	PW	Proj	WP	Asst
	8				2

Bibliography

-Mythologies, ROLAND BARTHES
-La construction des identités au travail, NORBERT ALTER ET JEAN-LOUIS LAVILLE
-Raconter son histoire, MICHEL LEGRAND
-Capital culturel et reproduction scolaire, GERARD MAUGER
-La mobilité comme « capital », SYLVAIN ALLEMAND
-Entre l'intérêt et le don, SYLVAIN ALLEMAND
-La société malade de gestion, VINCENT DE GAULEJAC

Learning outcomes

Learning outcomes	N	A	M	E	O
• Préparer et effectuer un séjour à l'étranger dans une entreprise	·	·	✓	·	·
• Avoir une vision élargie du travail et de la culture	·	·	✓	·	·

Manager : Yoan GREINER

PSI S6

Hours

Lect	Tut	PW	Proj	WP	Asst
	8				2

Evaluation

One evaluation : *Évaluation*

Bibliography

-Mythologies, ROLAND BARTHES
-La construction des identités au travail, NORBERT ALTER ET JEAN-LOUIS LAVILLE
-Raconter son histoire, MICHEL LEGRAND
-Capital culturel et reproduction scolaire, GERARD MAUGER
-La mobilité comme « capital », SYLVAIN ALLEMAND
-Entre l'intérêt et le don, SYLVAIN ALLEMAND
-La société malade de gestion, VINCENT DE GAULEJAC

Learning outcomes

Learning outcomes	N	A	M	E	O
• Préparer et effectuer un séjour à l'étranger dans une entreprise	·	·	✓	·	·
• Avoir une vision élargie du travail et de la culture	·	·	✓	·	·

Manager : Yoan GREINER

PSI S7

Hours

Lect	Tut	PW	Proj	WP	Asst
	4				20

Evaluation

One evaluation : *Rapport*

Bibliography

-Mythologies, ROLAND BARTHES
-La construction des identités au travail, NORBERT ALTER ET JEAN-LOUIS LAVILLE
-Raconter son histoire, MICHEL LEGRAND
-Capital culturel et reproduction scolaire, GERARD MAUGER
-La mobilité comme « capital », SYLVAIN ALLEMAND
-Entre l'intérêt et le don, SYLVAIN ALLEMAND
-La société malade de gestion, VINCENT DE GAULEJAC

Learning outcomes

Learning outcomes	N	A	M	E	O
• Préparer et effectuer un séjour à l'étranger dans une entreprise	·	·	✓	·	·
• Avoir une vision élargie du travail et de la culture	·	·	✓	·	·

Manager : Nadia AIT-AHMED

Power Electronics 1

Hours

Lect	Tut	PW	Proj	WP	Asst
14.5	17.5				12

Evaluation

2 evaluations :

- *Examen écrit 1*
- *Examen écrit 2*

Outline

1. Introduction
   1.1. Characteristics of semi-conductors components
   1.2. Functions of power electronics
   2. Signals and methods of study power electronics
   3. Rectifiers (AC-DC converters)
   3.1. Single phase rectifier (not controlled and controlled)
   3.2. Redresseurs triphasés (not controlled and controlled)
   4. Dimmers
   4.1 Single phase dimmer
   4.2 Three phase dimmer

Goals

Describe the functions of the power electronics and provide the theoretical basis for the study and analysis of operation of static power converters based on semiconductor components. In this first course we focus on the study of steady powered by AC mains converters and their impact on the supply network

Bibliography

- Mohan, Underland, Robins : "Power Electronics, converters, applications and design" John Willey and Sons, inc, 1989 - Seguier G., : "les convertisseurs d'électronique de puissance, volume 1 conversion alternatif-continu" Tech doc. Lavoisier - P. Delarue, C. Rombaut, Seguier G. : "les convertisseurs d'électronique de puissance,voulume 2 conversion alternatif-alternatif" Tech doc. Lavoisier - Rachid. M.H. "Power Electronics, circuits, devices and applications." Prentice hall 1988, second edition

Prerequisites

Electrical circuits, Analysis

Learning outcomes

Learning outcomes	N	A	M	E	O
• Analyze and study the functioning of a static converter of power electronics (AC/DC and AC/AC conversions)	·	·	✓	·	·
• Choose the topology of a converter according to the application	·	·	✓	·	·
• Size a static converter of power electronics	·	·	✓	·	·
• Integrate a static converter into a chain of energy conversion	·	·	✓	·	·

Manager : Mohamed-Fouad BENKHORIS

Power Electronics 2

Hours

Lect	Tut	PW	Proj	WP	Asst
12	15				13

Evaluation

2 evaluations :

- *Examen écrit 1*
- *Examen écrit 2*

Outline

1.Choppers DC-DC converters (Buck, boost, interlaced,reversible)
2.Non-isolated switched-mode power supplies
3.Isolated switched-mode power supplies
4. Single phase inverter
5. Three-phase inverter
6. Forced commutation

Goals

This course follows the electronic power during semester 7. Its aim is to study the steady-state of continuously DC powered converters. DC-DC converters and DC-AC converters are studied

Bibliography

- Mohan, Underland, Robins : "Power Electronics, converters, applications and design" John Willey and Sons, inc, 1989

- Bausière R. Labrique F. G. Seguier G., : "les convertisseurs d'électronique de puissance, volume 3 conversion continu-continu" Tech doc. Lavoisier

- Labrique F, Seguier G., Bausière R.. : "les convertisseurs d'électronique de puissance,volume 4 conversion continu-alternatif" Tech doc. Lavoisier

- Ferrieux J.P., Forest F., Alimentations à découpage convertisseurs à résonance, Dunod, 3ème édition, 1999, Techniques de l'ingénieur, traité de Génie Electrique, D 3152, D 3164, D 3165, D 3166, D 3167

- Bausière R. Labrique F. G. Seguier G., : "les convertisseurs d'électronique de puissance, volume 3 conversion continu-continu" Tech doc. Lavoisier

- Labrique F, Seguier G., Bausière R.. : "les convertisseurs d'électronique de puissance,volume 4 conversion continu-alternatif" Tech doc. Lavoisier

- Rachid. M.H. "Power Electronics, circuits, devices and applications." Prentice hall 1988, secon edition-

Prerequisites

Electrical circuits
Analysis

Learning outcomes

Learning outcomes	N	A	M	E	O
• Analyser et étudier le fonctionnement d'un convertisseur statique d'électronique de puissance (conversions DC/DC et DC/AC)	·	·	✓	·	·
• Choisir la topologie d'un convertisseur en fonction de l'application	·	·	✓	·	·
• Dimensionner un convertisseur statique d'électronique de puissance	·	·	✓	·	·
• Intégrer un convertisseur statique dans une chaîne de conversion d'énergie	·	·	✓	·	·

Manager : Mohamed-Fouad BENKHORIS

Practical works in Electrical Engineering 1

Hours

Lect	Tut	PW	Proj	WP	Asst
		16			8

Evaluation

2 evaluations :

- *Rapport machines*
- *Rapport EP*

Outline

TP1. Electromechanical characteristics of a DC machine
TP2. DC motor with separate excitation: Energy balance & performance
TP3. No commanded rectifiers: single & three phase rectifier
TP4. Controlled rectifiers : comparison between Graetz bridge thyristor and composite bridges

Goals

Understand and implement devices of DC electromechanical energy converters and high current power rectifiers controlled and non-controlled. Learn how to manipulate with autonomy, and developing a rigorous analytical and synthesis of physical principles observed. Strengthen and expand the knowledge base introduced in progress and tutorials.

Prerequisites

Electrognametism, electric circuits,DC machines, power rectifiers

Learning outcomes

Learning outcomes	N	A	M	E	O
• Make a practical instrumented mountage, using DC machine, or power rectifiers	·	·	✓	·	·
• Conduct tests to modelize a DC machine and characterize its woking	·	·	✓	·	·
• Conduct tests to characterize working of rectifiers	·	·	✓	·	·
• Know and apply appropriate measurement technics	·	·	✓	·	·
• Synthesize knowledge in a reportshowing the scientific approach and a critical analysis of experimental results.	·	·	✓	·	·

Manager : Kada DAKHOUCHE

Practical works in Thermic

Hours

Lect	Tut	PW	Proj	WP	Asst
		28			14

Evaluation

2 evaluations :

- *Examen final de TP*
- *Six rapports de TP*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Etre capable d'appréhender la dimension énergétique d'une nouvelle installation et de réaliser le bilan des flux de chaleur	·	✓	·	·	·
• Etre capable de proposer des solutions techniques appropriées à une utilisation optimale de l'énergie	·	✓	·	·	·
• Etre capable d'identifier les trois modes de transfert de chaleur (convection, conduction, rayonnement) et de vérifier les relations fondamentales étudiées en cours	·	·	✓	·	·

Manager : Matthieu FRAPPART

Practical works in electrical engineering 2

Hours

Lect	Tut	PW	Proj	WP	Asst
		16			8

Evaluation

2 evaluations :

- *Rapport machines*
- *Rapport EP*

Outline

TP1. Synchronous machine
TP2. Asynchronous machie
TP3. Chopper
TP4. Inverter

Goals

Understand and implement devices of AC electromechanical energy converters and power converters (DC/DC, DC/AC). Learn how to manipulate with autonomy, and developing a rigorous analytical and synthesis of physical principles observed. Strengthen and expand the knowledge base introduced in progress and tutorials on the subject of AC machines and power converters(DC/DC, DC/AC).

Prerequisites

Electromagnetism, AC machines, choppers and inverters

Learning outcomes

Learning outcomes	N	A	M	E	O
• Make a practical instrumented mountage, using Ac machine, or power converters (DC/DC and DC/AC)	·	·	✓	·	·
• Conduct tests to modelize a AC machine and characterize its working	·	·	✓	·	·
• Conduct tests to characterize working of power converters (DC/DC and DC/AC)	·	·	✓	·	·
• Know and apply appropriate measurement technics	·	·	✓	·	·
• Synthesize knowledge in a reportshowing the scientific approach and a critical analysis of experimental results.	·	·	✓	·	·

Manager : Kada DAKHOUCHE

Production nucléaire

Hours

Lect	Tut	PW	Proj	WP	Asst
3.5	4				

Evaluation

One evaluation : *Examen*

Bibliography

CHARLES, P. "Energie nucléaire, fission et fusion", Ellipses: Paris, 2007.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Etablir l'énergie libérée par une fission ou une fusion	·	✓	·	·	·

Manager : Hervé GRAU

Project energy economies and polities

Hours

Lect	Tut	PW	Proj	WP	Asst
8	8		20		15

Evaluation

2 evaluations :

- *Soutenance*
- *Rapport*

Presentation

Economic expertise of the energy

Outline

1. A world energy outlook
   1.1. Energy mix analysis,
   1.2. Energy issues and stakes,
   1.3. Energy and economics: basic notions,
   2. Finite energy sectors: an economic analysis,
   2.1. Oil market (including non conventional),
   2.2.Gas market (inculding shale gas),
   3. Electricity sector: an economic analysis:
   3.1. Nuclear power,
   3.2. Renewable energy,
   4. Renewable energy: public policy issues:
   4.1. A world outlook through international, national and local levels,
   4.2. Focus : Feed-in tariffs, green, black and white certificates.

Goals

Provide the necessary knowledge for the economic expertise of the energy sector at different macroeconomic levels (international, European and French). Teach economic analysis in the energy sectors through an economic, political, societal and environmental approach.

Bibliography

AIE: "World Energy Outlook"; (publication annuelle).
BP: "BP Statistical Review" ; (publication annuelle).
JL.Bobin: "L'énergie de demain"; 2005, édition EDP Sciences, 634 pages.
J.Percebois: "Énergie: économie et politiques"; 2011, édition De Boeck, 810 pages.

Prerequisites

Economics and politics energy basics required
Advanced writing skills

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the economic and political environment of the energy sector at the different macroeconomic levels	·	·	✓	·	·
• Understand the energy sectors analysis by means of a multicritera approach (economy, politic, society, governance)	·	·	✓	·	·
• Develop good drafting skills, accuracy and synthesizing ability through dissertation writing	·	·	✓	·	·
• Apply the writing codes in economics (bibliography, sources, writing skills...)	·	·	✓	·	·

Manager : Luc OILI

Project energy optimization

Hours

Lect	Tut	PW	Proj	WP	Asst
2	2		48		20

Evaluation

2 evaluations :

- *Projet*
- *Dossier d'audit*

Outline

Main stages of the project

1- Acknowledge the project and more particularly the application of optimization
2- Establishment of working groups and implementaion of strategy for project management
3- Site audit surveys to data from construction and operation
4- Modeling of energy consumption and comparing the results to the actual invoices
5- Searching for optimization solutions
6- Estimating of solutions prices and determining the time of return on investment (ROI)

Goals

This project is locative at the end of engineer training and can apply the knowledge gained in the fields of thermal, electricity and project management to bring the complete energy analysis of an actual installation.

Bibliography

"Entreprises : optimisez vos consommations énergétiques " - Editions ADEME - Octobre 2003
"Transformateurs de distribution et économies d'énergies " - Editions ADEME - Juin 2012

Prerequisites

Building energetics, HVAC, producting and transporting thermal energy
Management project
Electrical energy, control command, producting and transmissing electrical energy

Learning outcomes

Learning outcomes	N	A	M	E	O
• To conduct a study to optimize energy systems and building envelopes	·	·	✓	·	·
• To perform the energy diagnosis of an installation from the site audit up to recommandations with time of return on investment (ROI)	·	·	✓	·	·

Manager : Hervé GRAU

Project renenewable energy

Hours

Lect	Tut	PW	Proj	WP	Asst
			20		

Evaluation

One evaluation : *Présentation*

Presentation

Studying in group a project about renewable energies in expermental or concerte cases and giving an oral presentation with a promotional material

Outline

Each group chooses a subject of interest to them which will be validated by the science teacher. They research the question and do a Powerpoint to illustrate their thesis.

Goals

Giving an oral presentation concerning renewable energy in groups of 2 until 4 apprentices.

Prerequisites

Seminars about renewable energy

Learning outcomes

Learning outcomes	N	A	M	E	O
• Making a presentation	·	·	·	✓	·
• Speaking spontaneously and interactively	·	·	·	✓	·
• Create a promotional material	·	·	·	✓	·

Manager : Hervé GRAU

Quality Security Environment

Hours

Lect	Tut	PW	Proj	WP	Asst
	20				

Evaluation

One evaluation : *QCM + exercices*

Manager : John KINGSTON

Radiance

Hours

Lect	Tut	PW	Proj	WP	Asst
10	11				10

Evaluation

One evaluation : *Examen écrit*

Presentation

Principles of radiance's modelisation

Outline

1. Radiance particularities
   2. Radiance's laws
   3. Black body shifts
   4. Radiance's modelisation
   5. Radiance's balance sheets

Goals

Modelize a radiance problem.

Bibliography

TAINE, J. PETIT, J.P. "Transferts thermiques", Dunod, 1998.

Prerequisites

Thermodynamics (energy balance sheets, thermal capacities)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Radiance's balance sheets	·	✓	·	·	·

Manager : Hervé GRAU

Régulation 2

Hours

Lect	Tut	PW	Proj	WP	Asst
6	7				6

Evaluation

One evaluation : *Controle*

Outline

Introduction to digital control and discret signals - Z transform - Sampling of signals and Shannon theorem - Representation and stability of discret systems (conversion continuous to discret) - Transposition of continuous control methods to the discrete case - Approximation of continuous regulators - Methods specific to the discrete case and implementation of digital controllers

Industrial Communication part :

- PLC network : network design, communication protocols (Modbus, Jbus, Unitelway,) - Supervision systems : supervision structures, communication interfaces, application examples, practical learning on Siemens and Schneider devices.

Goals

Introduce the fundamentals of signals and discrete-time systems. Transpose for the sampled systems, methods acquired during the control of continuous systems. presentation of methods specific to the discrete case

Industrial Communication part : Know networks, industrial bus and flexible systems. Discover supervision through an industrial software

Bibliography

Y. GRANJON, ?Automatique : Systèmes linéaires, non linéaires, à temps discrets, à temps continu, représentation d'état ', cours et exercices corrigés, Edition Dunod, 2003.

M. Rivoire, J.L Ferrier, J. Groleau, « Cours d'automatique : Signaux et systèmes (tome3) », Edition Eyrolles.

W. Aström, 'Computer-controlled systems: theory and design', Prentice Hall.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Acquire the mathematical tools necessary for the study and control of sampled systems	·	✓	·	·	·
• Discretize analog controllers: transposition of continuous control to the discrete case	·	✓	·	·	·
• Implementation of digital controllers	·	✓	·	·	·

Manager : Nadia AIT-AHMED

Réseaux de chaleurs

Hours

Lect	Tut	PW	Proj	WP	Asst
4	4				10

Evaluation

One evaluation : *QCM*

Prerequisites

Thermodynamique, machine thermique, transfert thermique, économie, gestion de projet

Learning outcomes

Learning outcomes	N	A	M	E	O
• Maîtriser les contraintes et opportunités de développement d'un réseau de chaleur.	·	·	✓	·	·
• Savoir appréhender dans quels cas il est possible de raccorder un bâtiment à un réseau de chaleur.	·	·	✓	·	·

Manager : Hervé GRAU

Seminars about renewable energy

Hours

Lect	Tut	PW	Proj	WP	Asst
22.5	14.5				

Presentation

Conferences about renewable energy.

Outline

- Solar (PV and Thermal)
  - Hydrogène and Fuel cells
  - Marine energies
  - Biomass
  - Methanisation
  - New gaz systems
  - Hydrogen

Goals

These conferences are given by researchers, industrials and members of institutions. They give to the students a global view regarding renewable energies. General conference explains the Sustainable development context. Specific conference give detailed information nregarding technology, economics and enviromnetal aspect for each kind of renewable energy.

Manager : Yoan GREINER

Social issues and businesses S6

Hours

Lect	Tut	PW	Proj	WP	Asst
	16				6

Evaluation

One evaluation : *Dossier*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Mobiliser les ressources des sciences sociales	·	·	✓	·	·
• Pratiquer une démarche scientifique d'analyse du fonctionnement et des évolutions des entreprises : questionnement, recueil et analyse de données	·	·	✓	·	·
• Travailler en équipe sur un temps long et gérer de l'autonomie dans la formation	·	·	✓	·	·
• Prendre en compte les enjeux de société	·	·	✓	·	·
• Prendre en compte les enjeux professionnels	·	·	✓	·	·
• Travailler de manière pluridisciplinaire	·	·	✓	·	·

Manager : Yoan GREINER

Social issues and businesses S8

Hours

Lect	Tut	PW	Proj	WP	Asst
	12				10

Evaluation

One evaluation : *Présentation*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Mobiliser les ressources des sciences sociales	·	·	✓	·	·
• Pratiquer une démarche scientifique d'analyse du fonctionnement et des évolutions des entreprises : questionnement, recueil et analyse de données	·	·	✓	·	·
• Travailler en équipe sur un temps long et gérer de l'autonomie dans la formation	·	·	✓	·	·
• Prendre en compte les enjeux de société	·	·	✓	·	·
• Prendre en compte les enjeux professionnels	·	·	✓	·	·
• Travailler de manière pluridisciplinaire	·	·	✓	·	·

Manager : Nadia AIT-AHMED

Solar thermal

Hours

Lect	Tut	PW	Proj	WP	Asst
9.5	10.5				

Evaluation

One evaluation : *Examen*

Statistical

Hours

Lect	Tut	PW	Proj	WP	Asst
7	9	6			4

Evaluation

2 evaluations :

- *Examen écrit*
- *Examen TP*

Outline

1. The role of statistics and probability as an information and communication tool
   - introduction to the purposes of the statistics in the data collection, analysis and interpretation (pie charts, bar graphs, line graphs, scatter plots, tables, numerical features)
   2. Univariate and bivariate statistical distributions
   - general overview, use of the basic concepts in statistics and probability (occurrences, marginal, joint & conditional frequencies, probability distributions, ...)
   3. Statistical dependence and curve fit models
   - introduction to the correlation and regression analysis, characteristics & calculation procedures (covariance, correlation coefficient, generalised least squares method, ...)
   4. Introduction to the time-series for modelling and prediction purposes

Goals

Deal with the theory of probability and statistics as a deductive discipline. Connections between content and applications will be systematically emphasized in order to enhance the students' learning and to aid in the solution of practical problems regarding data analysis and decision-making.

Bibliography

DELMAS B., Statistique descriptive, Nathan Université, 2ème édition, Paris 2000.
DROESBECKE J.J, Eléments de statistiques, 3e édition, Ellipse, 1997.
MASSONI A., Initiation aux Statistiques descriptives avec Excel, Vuibert, Septembre 2002.
VENTSEL H., Théorie des Probabilités, 1ère édition - MIR Moscou, 1973.
VEYSSEYRE R., Statistique et probabilités pour l'ingénieur, L'Usine Nouvelle, Dunod, Paris 2001.

Prerequisites

Applied mathematics

Learning outcomes

Learning outcomes	N	A	M	E	O
• Be able to describe, analyse and interpret a collection of data from the descriptive statistics tools.	·	·	✓	·	·
• Know how to write a non-deterministic issue from a given context in the language of probability.	·	✓	·	·	·
• Master the basic concepts of a probabilistic modelling : i.e. statistical parameters assessement and probability-based calculations.	·	·	✓	·	·
• Be able to identify a curve fit model and characterise its good matching with historical data	·	·	✓	·	·

Manager : Laurence MIEGEVILLE

Storage

Hours

Lect	Tut	PW	Proj	WP	Asst
9	10				3

Evaluation

One evaluation : *Examen écrit*

Presentation

Electricity storage in batteries ans supercondensators

Manager : Hervé GRAU

Strength of materials

Hours

Lect	Tut	PW	Proj	WP	Asst
8	10				15

Evaluation

One evaluation : *Examen écrit*

Presentation

Modelisation of vibrations and strenght of materials for non mechanical engineers.

Outline

1 dof systems : amortized or not amortized free oscillations systems, forced periodic oscillations, pulses.
Structures studies
Strength of materials

Goals

The objective of this course is to provide a basic knowledge of the mechanical response of a dynamic mechanical systems, when submitted to various types of loading and to give principles of strenght of materials.

Bibliography

PEREZ, J.P. "Mécanique: fondements et applications", Dunod, 2014.
VENIZELOS, G. "Résistance des matériaux", Ellipses, 2011.

Prerequisites

General Mechanics

Learning outcomes

Learning outcomes	N	A	M	E	O
• Be able to determine the mechanical response of a 1 dof systems for different types of loading	·	·	✓	·	·
• Know the concept of eigen frequencies and eigen modes for a discrete system with several degrees of freedom.	·	✓	·	·	·
• Be able to solve numerically a vibration problem	·	✓	·	·	·
• Determine internal strenghts in a simple structure	·	·	✓	·	·
• Calculate elements of a structure	·	✓	·	·	·

Manager : Hervé GRAU

TP Pilotage 1

Hours

Lect	Tut	PW	Proj	WP	Asst
		28			8

Evaluation

2 evaluations :

- *Rapport Régulation*
- *Rapport automatisme*

Presentation

Practice of the knowledge base introduced in class and tutorials

Outline

Part 1: Analog
TP 1- MATLAB / SIMULINK initiation
TP2- Speed control of a DC motor via the Zeigler Nichols method
TP3 and TP4 - Real-time identification and control of a DC motor

Goals

To Learn to handle with autonomy, and by developing a rigorous spirit of analysis and synthesis of the physical principles observed.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Study of linear systems in simulation via MATLAB SIMULINK	·	·	✓	·	·
• Analysis and synthesis of simulation results	·	·	✓	·	·

Manager : Nadia AIT-AHMED

TP Pilotage 2

Hours

Lect	Tut	PW	Proj	WP	Asst
		24			8

Evaluation

One evaluation : *Compte rendu TP*

Manager : Nadia AIT-AHMED

Technology of refrigerating plant

Hours

Lect	Tut	PW	Proj	WP	Asst
10	12				8

Evaluation

One evaluation : *Examen écrit*

Outline

1. Technology
   - The basic refrigeration cycles
   - Technology of compressors (reciprocating, centrifugal ,screw, scroll...)
   - Lubrification and refrigeration oils
   - Refrigerants (context and usage constraints, legislation)
   - The expansion systems
   - Technology of evaporators and condensers
   2. cold balance
   3. Study of various refrigeration cycles (single and two- stage, full and partial injection)
   -4-New cooling tendencies (second refrigerants, COé)

Goals

The aim is to understand the energy issues and environmental constraints encountered during the design and the building of a refrigerating plant. After a presentation of the different elements of a refrigerating system, the dimensioning and selection criteria of different cycles are presented, in order to evaluate their energetic efficiency with respect to the specifications of the refrigeration factories.

Bibliography

"- W. Maake, H.J.Eckert et J.L.Cauchepin ; « le Pohlmann »
- PJ Rapin et P Jacquard ; « Installations Frigorifiques » ; PYC Editions
- HUGO NOACK et Rolf Seidel ; « Pratique des installations frigorifiques » ; PYC Editions
- « la Revue Générale du Froid » ; AFF
- « la Revue Pratique du Froid »"

Prerequisites

psychrometry, , thermodynamics

Learning outcomes

Learning outcomes	N	A	M	E	O
• To know the different cooling basic cycles and to compare their performances	·	·	✓	·	·
• To know the current legislation concerning workinf fluids and their applications	·	·	✓	·	·
• To determine the cooling power	·	✓	·	·	·
• To design control equipments	·	✓	·	·	·
• To design a commercial refrigerating plant	·	✓	·	·	·

Manager : Victorin CHEGNIMONHAN

Thermal metrology

Hours

Lect	Tut	PW	Proj	WP	Asst
8	8	20			10

Evaluation

One evaluation : *Soutenance TP*

Outline

1. Experimental methods in Fluid mechanics: Measurement of pressure, flow rate and velocity
   1.1. Global measurement of pressure, flow rate and velocity
   1.2. local measurement of velocity (Pitot tube, PIV, LDA, CTA)
   1.3. flow visualization
   2. Experimental methods in Heat transfer: Temperature qand heat flux measurements
   2.1. thermometric phenomena
   2.2. Seebeck effect: pricipal and applications (thermocouples)
   2.3. Systematic errur model on temperature measurements
   2.4. Radiative temperature measurement methods

Goals

Give students the basic knowledge on the different physical phenomena and errors encountered when measuring temperature, heat flow, as well as the velocity field, pressure and concentration in flows. In each case the conventional tools of information processing will be mentioned with the quantities and characteristics obtained as well as the constraints imposed by the quality of the signal to be processed

Prerequisites

Heat Transfer
Fluid Mechanics

Learning outcomes

Learning outcomes	N	A	M	E	O
• Designing a thermal or fluid mechanics instrumentation system	·	✓	·	·	·
• Carrying out a thermal or fluid mechanics instrumentation system	·	✓	·	·	·
• Evaluating errors on measured data	·	·	✓	·	·

Manager : Ahmed GUELED

Thermodynamics

Hours

Lect	Tut	PW	Proj	WP	Asst
18	22				30

Evaluation

2 evaluations :

- *Examen écrit 1*
- *Examen écrit 2*

Presentation

Thermodynamics and thermal machines

Outline

1. Pressure, temperature
2. Heat, work
3. First principle: energy balance
4. Transformation of ideal gases
5. Liquids and steams
6. Cycles and second principle
7. Entropy and second principle
8. Energetics functions
9. Thermics devices

Goals

To bring a knowledge on the essential, general basic concepts of the thermodynamics to understand (include) the systems of conversion and transformation (processing) of heat energy. Apply these fundamental to calculate the performances of the main thermal machines.

Bibliography

CENGEL, Y. BOLES, M. "Thermodynamique, une approche pragmatique", de boeck, 2014.
PEREZ, J.P. "Thermodynamique: fondements et applications", Dunod, 2001.

Prerequisites

Basic knowledge in mechanics and associated mathematics.

Learning outcomes

Learning outcomes	N	A	M	E	O
• To know the first thermodynamic principle and to know how to apply to heat machines.	·	·	·	✓	·
• To know principal heat engines, receiving and generating of work and to know how to trace their cycle in a thermodynamical diagram.	·	·	✓	·	·
• To know how to extract main characteristics of a fluid to calculate the performance of the associated heat machine.	·	·	✓	·	·

Manager : Hervé GRAU

Thermodynamics Cycles

Hours

Lect	Tut	PW	Proj	WP	Asst
12	14	8			15

Evaluation

2 evaluations :

- *Examen écrit*
- *Rapport TP*

Outline

I - Generalities - Cycles engine - Inverse Cycles - Efficiency II - Motor cycles: Gas Cycles, Steam Cycles III - Combined Cycles - Cogeneration IV - Inverse Cycles: Vapor compression cycles, Vapor absorption cycles

Goals

Familiarize students with the main thermodynamic cycles (engine and reverse) - Pass from the theoretical cycle to the "real" cycle Present ways to improve the energy performance of major cycles

Bibliography

L. Borel et D. Favrat, Thermodynamique et Energétique, PPUR, 2005 - Van Wylen, Sonntag et Desrochers, Thermodynamique Appliquée, Ed. Renouveau Pédagogique, 1992 - M.J. Moran et H.N. Shapiro, Engineering Thermodynamics, Wiley, 2004

Prerequisites

Thermodynamics L3 Level Applied thermodynamics L3 level

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the main dithermes thermal machines	·	·	✓	·	·
• Being able to establish a comprehensive energy balance of an industrial thermic engine	·	·	✓	·	·

Manager : Philippe GUILLEMET

Toeic

Hours

Lect	Tut	PW	Proj	WP	Asst
	15				

Evaluation

2 evaluations :

- *CC*
- *DS*

Toeic & Professional English

Hours

Lect	Tut	PW	Proj	WP	Asst
	22.5				10

Evaluation

2 evaluations :

- *CC*
- *DS*

Toeic & public speaking

Hours

Lect	Tut	PW	Proj	WP	Asst
	22.5				10

Evaluation

2 evaluations :

- *CC*
- *DS*

Turbo-machines

Hours

Lect	Tut	PW	Proj	WP	Asst
6	8				5

Evaluation

One evaluation : *Examen écrit*

Bibliography

L. Borel et D. Favrat, Thermodynamique et Energétique, PPUR, 2005 Van Wylen, Sonntag et Desrochers, Thermodynamique Appliquée, Ed. Renouveau Pédagogique, 1992 M.J. Moran et H.N. Shapiro, Engineering Thermodynamics, Wiley, 2004 Michel Pluviose, Machines à Fluides: Principe et fonctionnement, Ellipses, 2002

Learning outcomes

Learning outcomes	N	A	M	E	O
• Etre capable de déterminer le point de fonctionnement d'une turbo-machine sur un circuit	·	·	✓	·	·

Manager : Bruno AUVITY