

Teaching program
Maîtrise des Energies

Academic year 2019-2020

Ecole polytechnique de l'université de Nantes

October 3, 2019

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Part I

Tables of teaching units

Semester 5 - unit *MDE 3*

Basic sciences for electricity 1

ECTS : 7

Manager : GREINER Yoan

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Electricity 1	10	10	8			14	3.5
• Electromagnetism	16	16				20	3.5
TOTAL	26	26	8	0	0	34	

Basic Sciences for Thermal and Energy 1

ECTS : 7

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Mechanics	12	12	4			15	3
• Thermodynamics	20	20				30	4
• Lighting	2	2	4				0
TOTAL	34	34	8	0	0	45	

Humanity 1

ECTS : 5

Manager : OILI Luc

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• English 1		15				10	2
• General Economy	8	8				10	1.5
• Business Function	19	19				15	1.5
TOTAL	27	42	0	0	0	35	

Socle commun de l'alternance 1 à traduire

ECTS : 4

Manager : GREINER Yoan

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• PSI 1	4	4					1
• SSAT 1	10.5	10.5					3
• Analyse de la pratique à traduire 1	1	1					1
TOTAL	15.5	15.5	0	0	0	0	

athematical tools for engineers

ECTS : 7

Manager : BOURGUET Salvy

Course	Lect	Tut	PW	Proj	WP	Asst	<i>Coef</i>
• Algorithmic	7	7	16			5	<i>3</i>
• Mathematics	10	10				20	<i>3</i>
• à traduire			16				<i>1</i>
TOTAL	17	17	32	0	0	25	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	119.5	134.5	48	0	0	139	30
Face-to-face sum	302						

Semester 6 - unit *MDE 3*

Company 1

ECTS : 6

Manager : GREINER Yoan

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Industrial tutoring 1							3
• Teaching tutoring 1							3
TOTAL	0	0	0	0	0	0	

Sciences pour la thermique et l'énergétique 2 à traduire ECTS : 6

Manager : GADOIN Emilie

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Flow Dynamics	21	21	8			20	2
• Hydraulic Networks	11	11	4			10	2
• Vibrations and strength of materials	16	16				15	2
TOTAL	48	48	12	0	0	45	

Humanity 2

ECTS : 5

Manager : OILI Luc

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• English		30				10	2
• Finance Accounting Managment	18	18				15	2.5
• Quality Safety Environment	3.5	3.5				5	0.5
TOTAL	21.5	51.5	0	0	0	30	

Sciences pour l'électricité 2

ECTS : 4

Manager : MIEGEVILLE Laurence

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Electrical Distribution	24	24	14			32	3
• Electricity 2	6	6					1
TOTAL	30	30	14	0	0	32	

à traduire

ECTS : 6

Manager : GREINER Yoan

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Practice analysis		4					0
• Enjeux de société et entreprise 1 à traduire		20					1
• PSI 2		8					2
• Management		28				12.5	3
TOTAL	0	60	0	0	0	12.5	

Athematical tools for engineers

ECTS : 3

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• CAD			16			4	2
• Mathematics 2	3.5	3.5					1
• Matlab			6				1
TOTAL	3.5	3.5	22	0	0	4	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	103	193	48	0	0	123.5	30
Face-to-face sum	344						

Semester 7 - unit *MDE 4*

Control and regulation of energy process

ECTS : 6

Manager : AIT-AHMED Nadia

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Industrial Automation	6.5	6.5	12			12	2.5
• Control	14.5	14.5	16			20	3.5
TOTAL	21	21	28	0	0	32	

Company 2

ECTS : 4

Manager : AIT-AHMED Nadia

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Industrial tutoring 2							1
• Teaching Tutoring 2							1
TOTAL	0	0	0	0	0	0	

Conversion of electrical energy 1

ECTS : 7

Manager : BENKHORIS Mohamed-Fouad

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Power Electronics 1	14.5	14.5				12	2.5
• Electrical Machines 1	16	16				17	3
• Practical works in Electrical Engineering 1			16			8	1.5
TOTAL	30.5	30.5	16	0	0	37	

Socle commun de l'aternance 3 à traduire

ECTS : 5

Manager : AIT-AHMED Nadia

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• English		32				16	2
• Issues	3						0
• Management and organisation	3	3					0
• PSI 3		14					2
• SSAT 3	12	12					1
TOTAL	18	61	0	0	0	16	

Heat transfers

ECTS : 6

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Conduction	10.5	10.5				10	2
• Convection	10.5	10.5				10	2
• Practical works in Thermic			28			14	2
TOTAL	21	21	28	0	0	34	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	90.5	133.5	72	0	0	119	28
Face-to-face sum	296						

Semester 8 - unit *MDE 4*

Applied Mechanics

ECTS : 5

Manager : AUVITY Bruno

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Turbo-machines	7	7				5	2
• Vibrations and strength of materials	16	16				15	3
TOTAL	23	23	0	0	0	20	

Company 3

ECTS : 6

Manager : AIT-AHMED Nadia

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Teaching tutoring 3							3
• Industrial tutoring 3							3
TOTAL	0	0	0	0	0	0	

Conversion of electrical energy 2

ECTS : 6

Manager : BENKHORIS Mohamed-Fouad

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Power Electronics 2	13.5	13.5				13	2.5
• Electrical Machines 2	15	15				15	2.5
• Practical works in electrical engineering 2			16			8	1
TOTAL	28.5	28.5	16	0	0	36	

Social and normative environment of the engineer

ECTS : 4

Manager : MOREAU Jacques

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• English 4		15				8	2
• Issues Mde 2		8					0
• Standards and Reglementation	15	15				15	2
TOTAL	15	38	0	0	0	23	

Energy

ECTS : 6

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Combustion	7	7				5	1
• Thermodynamics Cycles	14	14	8			15	3
• Radiance	10.5	10.5				10	2
TOTAL	31.5	31.5	8	0	0	30	

à traduire

ECTS : 3

Manager : AIT-AHMED Nadia

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Practice analysis 2			6				0
• Enjeux de société et entreprise 2 à traduire		20					1
• SSAT 4	12.5	12.5				40	2
TOTAL	12.5	32.5	6	0	0	40	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	110.5	153.5	30	0	0	149	30
Face-to-face sum	294						

Semester 9 - unit *MDE 5*

Company 4

ECTS : 6

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Industrial tutoring 4							3
• Teaching tutoring 4							3
TOTAL	0	0	0	0	0	0	

Renewable energies

ECTS : 7

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Multi-sources	2	2					0
• Project renewable energy			16				4
• Storage	9.5	6.5				3	3
• Seminars about renewable energy	22.5	11.5					0
TOTAL	34	20	16	0	0	3	

Metrology

ECTS : 6

Manager : GUELED Ahmed

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Electrical Metrology	8	8	8			10	2
• Thermal Metrology	8	8	20			10	2
• Statistical	8	8	6				2
TOTAL	24	24	34	0	0	20	

Management 1

ECTS : 6

Manager : OILI Luc

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Business and Project Management	28.5	28.5				20	3
• Social sciences about work 5	14	14					3
TOTAL	42.5	42.5	0	0	0	20	

Generation and transportation of energy

ECTS : 5

Manager : GRAU Hervé

Course	Lect	Tut	PW	Proj	WP	Asst	<i>Coef</i>
• Thermal energy	11.5	8.5				10	<i>2.5</i>
• Electrical energy	16	16				10	<i>2.5</i>
TOTAL	27.5	24.5	0	0	0	20	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	128	111	50	0	0	63	30
Face-to-face sum	289						

Semester 10 - unit *MDE 5*

Humanity 5

ECTS : 3

Manager : *OILI Luc*

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Issues Mde 3		6					0
• PFE defence		8				20	0
• Social sciences about work 6	14	14				100	3
TOTAL	14	28	0	0	0	120	

Company 5

ECTS : 20

Manager : *GRAU Hervé*

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• PFE							12
• Industrial tutoring 5							4
• Teaching tutoring 5							4
TOTAL	0	0	0	0	0	0	

Energies mastery

ECTS : 3

Manager : *GRAU Hervé*

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Energy economies and politics	10	10	20			15	2
• Energy optimization			56			20	4
TOTAL	10	10	76	0	0	35	

Process control

ECTS : 2

Manager : *AIT-AHMED Nadia*

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Automatism	6	6	12			10	1
• Engeneering of process	5	5	16			10	0.5
• Industrial regulators	7	7	12			10	0.5
TOTAL	18	18	40	0	0	30	

HVAC engineering

ECTS : 2

Manager : *JOSSET Christophe*

Course	Lect	Tut	PW	Proj	WP	Asst	Coef
• Technology of refrigerating plant	11	11				8	1.5
• Building energetics	7	7	8			4	1
• Air conditioning	15	15				8	1.5
TOTAL	33	33	8	0	0	20	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	75	89	124	0	0	205	30
Face-to-face sum	288						

Part II

Sheets of courses

Air conditionning

Hours

Lect	Tut	PW	Proj	WP	Asst
15	15				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 caractériser the components of the choosen HVAC system	•	•	✓	•	•
• to know the different HVAC technologies and to be able to propose energy saving systems	•	•	✓	•	•

Manager : Hervé GRAU

Algorithmic

Hours

Lect	Tut	PW	Proj	WP	Asst
7	7	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 : Salvy BOURGUET

Automatism

Hours

Lect	Tut	PW	Proj	WP	Asst
6	6	12			10

Evaluation

2 evaluations :

- *Soutenance*
- *Travail*

Outline

-Definition of a technical system

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

-Structure of an automated system

-Study of control part: structure, 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 grafquets" ,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 : *Rapport*

Manager : Christophe JOSSET

Business Function

Hours

Lect	Tut	PW	Proj	WP	Asst
19	19				15

Evaluation

2 evaluations :

- *Examen écrit*
- *Dossier*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Connaître les enjeux et les missions des différentes fonctions de l'entreprise	✓
• Mesurer l'importance de la communication inter-fonctions et du système d'information	✓
• Appréhender les enjeux et les contraintes de l'ingénieur, en relation avec ces différentes fonctions	.	✓	.	.	.

Manager : Luc OILI

Business and Project Management

Hours

Lect	Tut	PW	Proj	WP	Asst
28.5	28.5				20

Evaluation

3 evaluations :

- *ICD*
- *Examen Négociation*
- *Business Game*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Comprendre les enjeux d'une négociation et savoir s'y préparer.	·	✓	·	·	·
• Connaître les outils de la gestion organisationnelle et financière d'un projet	·	✓	·	·	·
• Connaître les principes de la qualité et les principales normes et réglementation.	·	✓	·	·	·
• Connaître les enjeux et principes de l'action commerciale.	✓	·	·	·	·

Manager : Jacques MOREAU

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 : Hervé GRAU

Combustion

Hours

Lect	Tut	PW	Proj	WP	Asst
7	7				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
10.5	10.5				10

Evaluation

One evaluation : *Examen écrit*

Manager : Hervé GRAU

Control

Hours

Lect	Tut	PW	Proj	WP	Asst
14.5	14.5	16			20

Evaluation

3 evaluations :

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

Outline

Introduction to automatic control Modeling, temporal and frequential 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, 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
10.5	10.5				10

Evaluation

One evaluation : *Examen écrit*

Bibliography

Taine J et Petit J-P "Transferts thermiques", Edition Dunod 1998 Necati Osisik "Heat transfert, a basic approach" 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 : Hervé GRAU

Electrical Distribution

Hours

Lect	Tut	PW	Proj	WP	Asst
24	24	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
16	16				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/ Fundamental 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 sinusoidal 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 : Daniel DUBOIS

Electrical Machines 2

Hours

Lect	Tut	PW	Proj	WP	Asst
15	15				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 sinusoidal 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 : Yoan GREINER

Electrical Metrology

Hours

Lect	Tut	PW	Proj	WP	Asst
8	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 characteristics

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

III. Instrumentation Amplifier

Necessity of an instrumentation amplifier in a measurement system, characteristics, 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 characteristics of simple amplifier and instrumentation amplifier	.	.	✓	.	.
• Knowing how to calculate the electronic circuits using operational amplifiers	.	.	✓	.	.
• Knowing the different imperfections of operational amplifiers.	✓

Manager : Daniel DUBOIS

Electrical energy

Hours

Lect	Tut	PW	Proj	WP	Asst
16	16				10

Evaluation

3 evaluations :

- *Examen RTE*
- *Examen éolien*
- *Examen distribution*

Manager : Laurence MIEGEVILLE

Electricity 1

Hours

Lect	Tut	PW	Proj	WP	Asst
10	10	8			14

Evaluation

2 evaluations :

- *Examen écrit 1*
- *Examen écrit 2*

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
- Resolution of circuits in sinusoidal mode using the methods developed in continuous
- Concept of transfer function, gain and frequency. Calculation of passive filters

Goals

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

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
6	6				

Evaluation

One evaluation : *Examen écrit*

Manager : Yoan GREINER

Electromagnetism

Hours

Lect	Tut	PW	Proj	WP	Asst
16	16				20

Evaluation

2 evaluations :

- *Examen écrit 1*
- *Examen écrit 2*

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

Energy economies and politics

Hours

Lect	Tut	PW	Proj	WP	Asst
10	10	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 (including 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 multicriteria 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

Energy optimization

Hours

Lect	Tut	PW	Proj	WP	Asst
		56			20

Evaluation

One evaluation : *Soutenance*

Outline

Main stages of the project

- 1- Acknowledge the project and more particularly the application of optimization
- 2- Establishment of working groups and implementation 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 located 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, producing and transporting thermal energy

Management project

Electrical energy, control command, producing and transmitting 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 recommendations with time of return on investment (ROI)	·	·	✓	·	·

Manager : *Hervé GRAU*

Engeneering of process

Hours

Lect	Tut	PW	Proj	WP	Asst
5	5	16			10

Evaluation

2 evaluations :

- *Rapport TP*
- *Examen*

Manager : Mohamed-Fouad BENKHORIS

English

Hours

Lect	Tut	PW	Proj	WP	Asst
	30				10

Evaluation

2 evaluations :

- *Examen écrit*
- *Examen oral*

Outline

1. Revision of important grammar points for the TOEIC test
2. Listening (dialogues and videos in American English)
3. Reading comprehension (press clippings, various texts)
4. Speaking in public (learning to speak with video documents, study of specific language for speaking in public, etc.).
5. CV and cover letter

Goals

This course prepares students for the TOEIC test. An introduction to speaking in public is proposed, as well as further work on CV writing and cover letters, as well as meetings in English.

Bibliography

- Service Langues, livret Polygram, livret Polyvoc ; B.U.
- ?Preparation Series for the Toeic Test : More Practice Tests? (débutant) ; Longman, B.U.
- ?Building skills for the Toeic test (débutant) ; Longman, B.U.
- ?Official Test-Preparation Guide? (débutant) ; Peterson's Thomson Learning, B.U.
- ?Preparation series for the Toeic test? : Advanced course (confirmé) ; Longman, B.U
- ?Tell Me More? en ligne (via Madoc)

Prerequisites

1. Revision of important grammar points for the TOEIC
2. Meetings
3. Professional telephone communication
4. Elements of phonology
5. Resume writing and cover letter

Learning outcomes

Learning outcomes	N	A	M	E	O
• Utiliser les principaux outils grammaticaux de l'anglais	·	✓	·	·	·
• Gérer et participer à une réunion ou un débat en anglais	·	·	✓	·	·
• S'exprimer en continu pour une présentation en anglais	·	✓	·	·	·
• S'exprimer spontanément en interactivité en anglais (réunions, débats, entretiens)	·	✓	·	·	·
• Rédiger un CV et une lettre de motivation en anglais	·	·	✓	·	·

Manager : Pascale SIMON-LLOBREGAT

English

Hours

Lect	Tut	PW	Proj	WP	Asst
	32				16

Evaluation

2 evaluations :

- *Examen écrit*
- *Présentation*

Outline

1. Revision of important grammar points for the TOEIC test
2. Listening (dialogues and videos in American English)
3. Speaking in public (learning to speak with video documents, study of specific language for speaking in public, etc.).

Goals

This course prepares students for the TOEIC test. Further work on speaking in public is also proposed.

Bibliography

- . Département Langues, livret Polygram, livret Polyvoc ; B.U.
- . ?Preparation Series for the Toeic Test : More Practice Tests? (débutant) ; Longman, B.U.
- . ?Building skills for the Toeic test (débutant) ; Longman, B.U.
- . ?Official Test-Preparation Guide? (débutant) ; Peterson's Thomson Learning, B.U.
- . ?Preparation series for the Toeic test? : Advanced course (confirmé) ; Longman, B.U
- . ?Tell Me More? en ligne (via Madoc)

Prerequisites

1. Revision of important grammar points for the TOEIC test - 2. Listening (dialogues and videos in American English) - 3. Reading comprehension (press clippings, various texts) - 4. Speaking in public (learning to speak with video documents, study of specific language for speaking in public, etc.). - 5. CV and cover letter

Learning outcomes

Learning outcomes	N	A	M	E	O
• Using basic grammatical tools in English	.	.	✓	.	.
• Managing and participating in a meeting or discussion in English	.	.	✓	.	.
• Making a presentation in English	.	✓	.	.	.
• Speaking spontaneously and interactively in English (meetings, debates, interviews)	.	.	✓	.	.

Manager : Eric FALC'HER-POYROUX

English 1

Hours

Lect	Tut	PW	Proj	WP	Asst
	15				10

Evaluation

One evaluation : *Examen 1*

Outline

1. Revision of important grammar points for the TOEIC
2. Meetings
3. Professional telephone communication
4. Elements of phonology
5. Resume writing and cover letter

Goals

This module includes the first approach to Business communication in English, especially concerned with the holding of meetings and telephone communications. It also includes a refresher course in grammar and oral communication. A basic approach to résumé writing in English is also provided.

Bibliography

- Service Langues, livret Polygram, livret Polyvoc ; B.U.
- Michael Swann, L'Anglais de A à Z, Hatier ; BU.
- Presse anglophone (Time Magazine, Newsweek, presse quotidienne accessible sur Internet : The Times, The Guardian, The New York Times, ?)
- Culture populaire anglophone (musique, cinéma, TV?)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Utiliser les principaux outils grammaticaux de l'anglais	·	✓	·	·	·
• Soutenir une conversation téléphonique à caractère professionnel en anglais	·	✓	·	·	·
• Gérer et participer à une réunion ou un débat en anglais	·	✓	·	·	·
• Différencier et utiliser les phonèmes (sons) anglophones	·	✓	·	·	·
• Décrire des données chiffrées et statistiques en anglais	·	✓	·	·	·
• Rédiger un CV et une lettre de motivation en anglais	·	✓	·	·	·

Manager : *Pascale SIMON-LLOBREGAT*

English 4

Hours

Lect	Tut	PW	Proj	WP	Asst
	15				8

Evaluation

One evaluation : *Présentation*

Outline

1. Revision of important grammar points for the TOEIC test
2. Listening (dialogues and videos in American English)
3. Speaking in public (learning to speak with video documents, study of specific language for speaking in public, etc.).

Goals

This course prepares students for the TOEIC test. Further work on speaking in public is also proposed.

Bibliography

- . Département Langues, livret Polygram, livret Polyvoc ; B.U.
- . ?Preparation Series for the Toeic Test : More Practice Tests? (débutant) ; Longman, B.U.
- . ?Building skills for the Toeic test (débutant) ; Longman, B.U.
- . ?Official Test-Preparation Guide? (débutant) ; Peterson's Thomson Learning, B.U.
- . ?Preparation series for the Toeic test? : Advanced course (confirmé) ; Longman, B.U
- . ?Tell Me More? en ligne (via Madoc)

Prerequisites

(Semester 7)

1. Revision of important grammar points for the TOEIC test
2. Listening (dialogues and videos in American English)
3. Reading comprehension (press clippings, various texts)
4. Speaking in public (learning to speak with video documents, study of specific language for speaking in public, etc.).

Learning outcomes

Learning outcomes	N	A	M	E	O
• Managing and participating in a meeting or discussion in English	.	.	✓	.	.
• Making a presentation in English	.	.	✓	.	.
• Speaking spontaneously and interactively in English (meetings, debates, interviews)	.	.	✓	.	.

Manager : *Eric FALC'HER-POYROUX*

Enjeux de société et entreprise 1 à traduire

Hours

Lect	Tut	PW	Proj	WP	Asst
	20				

Evaluation

One evaluation : *Dossier*

Outline

Each trainee chooses a general culture theme in 1st year and works in teams of 2/3 to research and present their chosen project. The teams work on their own in allotted time slots to prepare the restitution of their project results.

Goals

Master the steps of documenting a research topic (theory and field research)

Prerequisites

Interest in exploring general culture issues and in analyzing work related problematics, good team worker.

Manager : Yoan GREINER

Enjeux de société et entreprise 2 à traduire

Hours

Lect	Tut	PW	Proj	WP	Asst
	20				

Evaluation

One evaluation : *Présentation*

Outline

In 2nd year the questions are individual and teams are formed by meta-analyzing the questions to extract a common problematic. The teams work on their own in allotted time slots to prepare the restitution of their project results.

Goals

Develop the capacity to meta-analyse several questions to find a common problematic, develop the capacity to work in a team on a research project.

Manager : Nadia AIT-AHMED

Finance Accounting Managment

Hours

Lect	Tut	PW	Proj	WP	Asst
18	18				15

Evaluation

2 evaluations :

- *Examen écrit*
- *TP Jeu*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Connaître les notions fondamentales de la comptabilité générale	✓
• Maîtriser quelques outils de la comptabilité de gestion : calcul de coûts, analyse de la performance et de la situation financière de l'entreprise	✓
• Prendre des décisions pertinentes concernant la production et la commercialisation, en évaluant leur impact financier, dans le cadre d'une simulation de gestion.	.	✓	.	.	.

Manager : Luc OILI

Flow Dynamics

Hours

Lect	Tut	PW	Proj	WP	Asst
21	21	8			20

Evaluation

2 evaluations :

- *Examen écrit*
- *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	·	✓	·	·	·

Manager : Emilie GADOIN

General Economy

Hours

Lect	Tut	PW	Proj	WP	Asst
8	8				10

Evaluation

One evaluation : *Examen écrit*

Bibliography

Porter (différents ouvrages), Strategor et Mercator essentiellement

Learning outcomes

Learning outcomes	N	A	M	E	O
• Connaître les différents acteurs d'un marché et les caractéristiques marché	✓	·	·	·	·
• Savoir analyser la situation d'une entreprise sur un marché	·	✓	·	·	·
• Avoir des notions de ce qu'on appelle une étude de marché	✓	·	·	·	·
• Etre en mesure de mener une analyse stratégique d'une entreprise sur un marché	·	✓	·	·	·

Manager : Luc OILI

Hydraulic Networks

Hours

Lect	Tut	PW	Proj	WP	Asst
11	11	4			10

Evaluation

One evaluation : *Examen écrit*

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
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	·	·	✓	·	·

Manager : Emilie GADOIN

Industrial Automation

Hours

Lect	Tut	PW	Proj	WP	Asst
6.5	6.5	12			12

Evaluation

2 evaluations :

- *Examen écrit coef(1)*
- *Rapport TP*

Outline

-Definition of a technical system

- Functional analysis of a système: using elements of the APTE, FAST and SADT methods,
- Structure of an automated system
- Study of control part: structure, 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 grafquets" ,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

Industrial regulators

Hours

Lect	Tut	PW	Proj	WP	Asst
7	7	12			10

Evaluation

2 evaluations :

- *Rapport TP*
- *Examen*

Manager : Nadia AIT-AHMED

Industrial tutoring 1

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Industrial tutoring 2

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Industrial tutoring 3

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Industrial tutoring 4

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Industrial tutoring 5

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Management

Hours

Lect	Tut	PW	Proj	WP	Asst
	28				12.5

Evaluation

One evaluation : *Dossier*

Outline

MdE3, semestre 5 : overview ; management as a function ; building rational questioning ; field research basics. MdE3, semestre 6 : corporate economics ; organization theories ; innovation & change applied to the workplace ; practical interviewing

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 strong 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

Management and organisation

Hours

Lect	Tut	PW	Proj	WP	Asst
3	3				

Evaluation

One evaluation : *Examen 1*

Manager : Isabelle PIQUET

Mathematics

Hours

Lect	Tut	PW	Proj	WP	Asst
10	10				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 : Annaig COTONNEC

Mechanics

Hours

Lect	Tut	PW	Proj	WP	Asst
12	12	4			15

Evaluation

3 evaluations :

- *Examen écrit 1*
- *Examen écrit 2*
- *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. Geometry of masses and dynamics

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.

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

PFE

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Présentation*

Manager : Hervé GRAU

PSI 1

Hours

Lect	Tut	PW	Proj	WP	Asst
4	4				

Evaluation

One evaluation : *Dossier*

Manager : Daniel DUBOIS

PSI 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	8				

Evaluation

One evaluation : *Dossier*

Manager : Yoan GREINER

PSI 3

Hours

Lect	Tut	PW	Proj	WP	Asst
	14				

Evaluation

One evaluation : *Présentation*

Manager : Nadia AIT-AHMED

Power Electronics 1

Hours

Lect	Tut	PW	Proj	WP	Asst
14.5	14.5				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 - Segulier G., : "les convertisseurs d'électronique de puissance, volume 1 conversion alternatif-continu" Tech doc. Lavoisier - P. Delarue, C. Rombaut, Segulier G. : "les convertisseurs d'électronique de puissance,volume 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
13.5	13.5				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. Segquier G., : "les convertisseurs d'électronique de puissance, volume 3 conversion continu-continu" Tech doc. Lavoisier
 - Labrique F, Segquier 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. Segquier G., : "les convertisseurs d'électronique de puissance, volume 3 conversion continu-continu" Tech doc. Lavoisier
 - Labrique F, Segquier 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, second 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

One evaluation : *Rapport TP*

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

Electromagnetism, electric circuits, DC machines, power rectifiers

Learning outcomes

Learning outcomes	N	A	M	E	O
• Make a practical instrumented moutage, 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 : Daniel DUBOIS

Practical works in Thermic

Hours

Lect	Tut	PW	Proj	WP	Asst
		28			14

Evaluation

One evaluation : *Rapport 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 : Hervé GRAU

Practical works in electrical engineering 2

Hours

Lect	Tut	PW	Proj	WP	Asst
		16			8

Evaluation

One evaluation : *Rapport TP*

Outline

- TP1. Synchronous machine
- TP2. Asynchronous machine
- 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 moutage, 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 : Yoan GREINER

Project renewable energy

Hours

Lect	Tut	PW	Proj	WP	Asst
		16			

Evaluation

2 evaluations :

- *Présentation*
- *Plaquette*

Presentation

Studying in group a project about renewable energies in experimental or concrete 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 Safety Environment

Hours

Lect	Tut	PW	Proj	WP	Asst
3.5	3.5				5

Evaluation

One evaluation : *Examen écrit*

Manager : Luc OILI

Radiance

Hours

Lect	Tut	PW	Proj	WP	Asst
10.5	10.5				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 et Petit J-P "Transferts thermiques", Edition 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

SSAT 1

Hours

Lect	Tut	PW	Proj	WP	Asst
10.5	10.5				

Evaluation

One evaluation : *Dossier*

Manager : Yoan GREINER

SSAT 3

Hours

Lect	Tut	PW	Proj	WP	Asst
12	12				

Evaluation

One evaluation : *Dossier*

Manager : Nadia AIT-AHMED

SSAT 4

Hours

Lect	Tut	PW	Proj	WP	Asst
12.5	12.5				40

Evaluation

One evaluation : *Dossier*

Outline

MdE4, semestre 7 : Laws and social phenomena applied to economics ; team working. MdE4, semestre 8 : Leading a team meeting ; communications technologies and work ; work, check and benchmark ; advanced training in french,

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 strong 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

Seminars about renewable energy

Hours

Lect	Tut	PW	Proj	WP	Asst
22.5	11.5				

Presentation

Conferences about renewable energy.

Outline

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

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 : Hervé GRAU

Social sciences about work 5

Hours

Lect	Tut	PW	Proj	WP	Asst
14	14				

Evaluation

One evaluation : *Dossier*

Manager : Hervé GRAU

Social sciences about work 6

Hours

Lect	Tut	PW	Proj	WP	Asst
14	14				100

Evaluation

3 evaluations :

- *Dossier*
- *Soutenance*
- *Dossier 2*

Outline

MdE5, semestre 9 :Setting up and leading a one-off training ; welfare management ; advanced training in french. MdE5, semestre 10 : Cross-cultural management ; global and worldwide economics overview ; speach training.

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

Standards and Reglementation

Hours

Lect	Tut	PW	Proj	WP	Asst
15	15				15

Evaluation

One evaluation : *Examen écrit*

Bibliography

PME PMI : LA DEMARCHE QUALITE (AFNOR 2ème édition) Assurer la qualité dans les organismes de formation la certification ISO 9001 (AFNOR)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Connaître les concepts et le vocabulaire de la qualité	·	·	✓	·	·
• Connaître les fondamentaux des normes ISO 9001, ISO 14001, BS 8800, OHSAS 18001	✓	·	·	·	·
• Connaître les objectifs d'un système de management de la qualité option QSE	·	·	✓	·	·
• Comprendre quelques outils de la qualité : diagramme d'Ishikawa, Poka Yoké, QQQQCPC, SIX SIGMA, AMDEC, HACCP, 5S...	·	✓	·	·	·
• Proposer et auditer la ou les normes à respecter	·	✓	·	·	·

Manager : Nadia AIT-AHMED

Statistical

Hours

Lect	Tut	PW	Proj	WP	Asst
8	8	6			

Evaluation

One evaluation : *Examen écrit*

Storage

Hours

Lect	Tut	PW	Proj	WP	Asst
9.5	6.5				3

Evaluation

One evaluation : *Examen écrit*

Presentation

Electricity storage in batteries and supercondensators

Manager : Hervé GRAU

Teaching Tutoring 2

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Teaching tutoring 1

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Teaching tutoring 3

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Teaching tutoring 4

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Teaching tutoring 5

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Casuel*

Technology of refrigerating plant

Hours

Lect	Tut	PW	Proj	WP	Asst
11	11				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, CO₂)

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 : Hervé GRAU

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 and heat flux measurements
 - 2.1. thermometric phenomena
 - 2.2. Seebeck effect: principal and applications (thermocouples)
 - 2.3. Systematic error 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

Thermal energy

Hours

Lect	Tut	PW	Proj	WP	Asst
11.5	8.5				10

Evaluation

2 evaluations :

- *Examen échangeurs*
- *Examen chaudières*

Outline

- Domestic and industrial boilers, combustibles and current regulation
 - Heat exchangers and their design
 - Heating networks
 - The nuclear fuel and nuclear energy

Goals

This course is substantially based about conferences majority of engineers, experts in their field and deal with industrial systems of thermal energy production and with the transport.

Prerequisites

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

Learning outcomes

Learning outcomes	N	A	M	E	O
• Be able to make the choice of a system of thermal power generation based on existing resources, needs and environmental and regulatory context	.	✓	.	.	.
• Be able to design heat exchangers and a heat distribution network	.	✓	.	.	.

Manager : Hervé GRAU

Thermodynamics

Hours

Lect	Tut	PW	Proj	WP	Asst
20	20				30

Evaluation

2 evaluations :

- *Examen écrit 1*
- *Examen écrit 2*

Presentation

Thermodynamic and thermal machines

Outline

1. General thermodynamics:
 - 1.1 Notion of fluids
 - 1.2 Thermodynamic systems and variables
 - 1.3 Work
 - 1.4 Heat
 - 1.5 First principle of the thermodynamics
 - 1.6 Second principle of the thermodynamics
2. Thermodynamics applied to the thermal machines:
 - 2.1 Généralités about machines : 1er principe in open system - Diagrams thermodynamics - Efficiency
 - 2.2 Receiving machines : heat pumps and chillers
 - 2.3 Generating machines : Stirling engine - Internal combustion engines - Elements about steam turbines and gas turbines.

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

Lucien Borel, Din Lan Nguyen ; « Thermodynamique et énergétique, Problèmes résolus et exercices » ; Presses polytechniques romandes.

R. Kling ; « Thermodynamique générale et applications » ; Editions Technip.

R. Giquel ; « <http://www.thermoptim.org/sections/bases-thermodynamique/notions-fondamentales>.

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
14	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 : Bruno AUVITY

Turbo-machines

Hours

Lect	Tut	PW	Proj	WP	Asst
7	7				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

Vibrations and strength of materials

Hours

Lect	Tut	PW	Proj	WP	Asst
16	16				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

Vibrations des structures, G. Venizelos, Technosup, Ed. 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.	•	✓	•	•	•
• Know the methods for determining eigen modes and frequencies	•	✓	•	•	•
• Be able to solve numerically a vibration problem	•	✓	•	•	•
• Determine internal strenghts in a simple structure	•	✓	•	•	•
• Calculate elements of a structure	•	✓	•	•	•

Manager : *Hervé GRAU*