Teaching program

Énergie Électrique

Academic year 2022-2023

Ecole polytechnique de Nantes Université

October 3, 2022

Contents

Part I

Tables of teaching units

Semester 5 - unit *GE 3*

Bases of Electrical Engineering 1 ECTS : 7

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Computer sciences S5	7.5	12.75	21			20	*3.5*
• Analog Electronics 5	16.25	13.75	9			20	*3.5*
TOTAL	23.75	26.5	30	0	0	40	

Reception

Manager : CARDELLI Michel

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Mathematical Reception		16.25				8	*0*
TOTAL	0	16.25	0	0	0	8	

Humanities S5 ECTS : 8

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• History, business knowledge and entrepreneurship	15	15				4	*1*
• Physical education and sport 1		21				2	*1*
• Professionnal project 1	1.5	16.5				4.5	*1*
• Sustainable development and social responsability 1			6				*1*
• Grammar and professional English 1		40					*1*
TOTAL	16.5	92.5	6	0	0	10.5	

Bases of Electrical Engineering 2 ECTS : 8

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electrical circuits	10	11	9			15	*2.5*
• Electrical Risk	10	6	6	6		14	*2.5*
• Electromagnetism	20	12.5	6			20	*3*
TOTAL	40	29.5	21	6	0	49	

Sciences fondamentale S5 ECTS : 5

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Complex Analysis	21.25	19.5				20	*3*
• Signals	5	7.25				6	*1*
• Systems	7.5	7.25				7	*1*
TOTAL	33.75	34	0	0	0	33	

PROJET S5 ECTS : 2

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Systèmes du GE				21		10	*1*
TOTAL	0	0	0	21	0	10	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	114	198.75	57	27	0	150.5	30
Face-to-face sum	396.75						

Semester 6 - unit *GE 3*

Humanities S6 — ECTS : 8

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Accounting business game		12	12			5	*1*
• Physical education and sport 2		21				2	*1*
• Soft skills		7.5					*1*
• Project management 1	4.5		3			2	*1*
• Socio-economic debates		18				10	*1*
• Grammar, Toeic and professional English 2		39	2				*3.5*
TOTAL	4.5	97.5	17	0	0	19	

Automatic Control S6 — ECTS : 9

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Automation	7.5	6.5	15			15	*2*
• Electronics and Computer Science	27.5	16.75	12			28	*4*
• Automatic Control	20	17.5	9			23	*3*
TOTAL	55	40.75	36	0	0	66	

Bases du GE 3 — ECTS : 5

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Analog Electronics 6	12.5	8.75	6			14	*2*
• Distribution électrique	15	15.25	12			20	*3*
TOTAL	27.5	24	18	0	0	34	

Sciences fondamentales S6 — ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Physics of semiconductor devices	6.25	6				6	*1*
• Probability and Statistics	16.25	17.5				16	*3*
TOTAL	22.5	23.5	0	0	0	22	

Internship GE3 — ECTS : 2

Manager : MOREAU Rémy

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Internship GE3							*1*
TOTAL	0	0	0	0	0	0	

Projet S6 ECTS : 2

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Au choix Projet Auto-info ou en XX				24		12	*2*
TOTAL	0	0	0	24	0	12	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	109.5	185.75	71	24	0	153	30
Face-to-face sum	390.25						

Semester 7 - unit *GE 4*

Humanities S7 — ECTS : 7

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Business analysis	4.5	6				3	*1*
• Physical education and sport 3		21				2	*1*
• Negotiations	3	7.5				2	*1*
• Quality, security and environmental approaches (QSE1)		4.5	3				*1*
• Professionnal project 2		6				6	*1*
• Professional English 3		19	2				*2.625*
• Continuous Assessment (bis)							*0.875*
• French as a Foreign Language for engineering students		18					*0.875*
• Second foreign language - German		18					*0.875*
• Second foreign language - Chinese		18					*0.875*
• Second foreign language - Spanish		18					*0.875*
• Second foreign language - Japanese		18					*0.875*
• Training for Toeic		18					*0.875*
• Circular economy	4.5	3				6	*1*
TOTAL	12	175	5	0	0	19	

Automatic Control S7 — ECTS : 5

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Stochastic processes	10	11.5				12	*2*
• State space control	15	17.5	12			25	*3*
TOTAL	25	29	12	0	0	37	

Electronics and Industrial IT S7 — ECTS : 7

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Computer sciences S7	8.75			24		17	*3*
• Electronics and Computer Science	3.75			11.25		8.25	*1.5*
• Analog electronics 7	18.75	13.75	7.5			25	*3.5*
TOTAL	31.25	13.75	7.5	35.25	0	50.25	

Energy Conversion S7 — ECTS : 9

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• EAO energy conversion				18		18	*2*
• Mechanics and thermal science	22.5	20.5				28	*2.5*
• Power electronics 7	15	11.25	8			15	*2.25*
• Modelisation of electrical machines 7	15	9	8			25	*2.25*
TOTAL	52.5	40.75	16	18	0	86	

Parcours S7

ECTS : 2

Course		Lect	Tut	PW	Proj	WP	Asst	*Coef*
• 3A Internship Assesment								*1*
1 à 4 ▷ Research S7					32			*1*
1 à 4 ▷ Entrepreneurship S7					32			*1*
1 à 4 ▷ Interdiscipinary S7					32			*1*
1 à 4 ▷ Ecological and Social Transition S7					32			*1*
TOTAL	min	0	0	0	32	0	0	
	max	0	0	0	128	0	0	

Sum of semester

		Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	min	120.75	258.5	40.5	85.25	0	192.25	30
	max	120.75	258.5	40.5	181.25	0	192.25	
Face-to-face sum		505 à 601						

Semester 8 - unit *GE 4*

Automatic Control S8 — ECTS : 6

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Numerical Analysis	16.25		20			15	*3*
• Automatic and Computer science				24		12	*2*
• Control of discrete time systems	12.5	15	12			21	*3*
TOTAL	28.75	15	32	24	0	48	

Energy Conversion S8 — ECTS : 6

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Drivers ansd switching of power transistors	12.5	7.25				20	*1.5*
• Power electronics 8	15	12	8			12	*3*
• Modelisation of electrical machines 8	17	12	12			30	*3*
TOTAL	44.5	31.25	20	0	0	62	

Humanities S8 — ECTS : 6

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Critical approaches of the firm		9				3	*1*
• Physical education and sport 4		21				2	*1*
• Professional Project 3		12				5	*1*
• Sustainable development and social responsability 2	1.5	9				10	*1*
• Intercultural explorations		18					*1*
• French as a Foreign Language for engineering students		18					*1.75*
• Second foreign language - German		18					*1.75*
• Second foreign language - Chinese		18					*1.75*
• Second foreign language - Spanish		18					*1.75*
• Second foreign language - Japanese		18					*1.75*
• Training for Toeic		18					*1.75*
• Quality, security ant environmental approaches (QSE2)		7.5					*1*
• Second foreign language - Sign language		18					*1*
TOTAL	1.5	202.5	0	0	0	20	

Electronics S8 — ECTS : 5

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Design electronic sessions				45		45	*3*
• Electronics and Computer Science (RTES)	5	2.75	8			8	*1.5*
• Analog electronics 8	8.75	7.75	15			20	*2*
TOTAL	13.75	10.5	23	45	0	73	

Internship GE4 ECTS : 5

Manager : MOREAU Rémy

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Internship 2							*1*
TOTAL	0	0	0	0	0	0	

Parcours S8 ECTS : 2

Course		Lect	Tut	PW	Proj	WP	Asst	*Coef*
1 à 4	▷ Research S8				32			*1*
	▷ Entrepreneurship S8				32			*1*
	▷ Interdisciplinary S8				32			*1*
	▷ Ecological and Social Transition S8				32			*1*
TOTAL	min	0	0	0	32	0	0	
	max	0	0	0	128	0	0	

Sum of semester

		Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	min	88.5	259.25	75	101	0	203	30
	max	88.5	259.25	75	197	0	203	
Face-to-face sum		523.75 à 619.75						

Semester 9 - unit *Option Contrôle Commande*

Humanities S9 ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• People and team management		10.5				6	*1*
• Professional project 4		12				2	*1*
• Training for TOEIC - s9		15					*1*
• Project management 2		15				3	*1*
• Designing the tomorrow's management	3	6				3	*1*
TOTAL	3	58.5	0	0	0	14	

Seminar

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Seminar	6						*0*
TOTAL	6	0	0	0	0	0	

Real-Time Systems ECTS : 6

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Industrial Communication (CC)	8.75	5		16		15	*1*
• Components and tools for digital control	15	1.5				8	*2*
• Reliability and safety requirement	12	1				6	*1*
TOTAL	35.75	7.5	0	16	0	29	

Applied Control & actuators ECTS : 9

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Advanced control and applications	15	1.5	6			12	*2*
• Sensors and signal conditioning	10	3.5				7	*1*
• Control of electrical machines (CC)	17.5	5.25	12			18	*2*
• Electrical drives	17.5	5.25	3.5			14	*2*
TOTAL	60	15.5	21.5	0	0	51	

Transversal project S9 ECTS : 11

Manager : LORON Luc

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Functional analysis	6	3		3		6	*1*
• Multidisciplinary project				128		76	*8*
• Speciality activity report						20	*1*
• Initiation à dSpace			8				*0*
• TP Variateurs			8				*0*
• Gestion de projet CC		6				4	*1*
TOTAL	6	9	16	131	0	106	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	110.75	90.5	37.5	147	0	200	30
Face-to-face sum	385.75						

Semester 9 - unit *Option Contrôle Commande - Contrat Pro*

Seminar

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Seminar	6						*0*
TOTAL	6	0	0	0	0	0	

Real-Time Systems ECTS : 6

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Industrial Communication (CC)	8.75	5		16		15	*1*
• Components and tools for digital control	15	1.5				8	*2*
• Reliability and safety requirement	12	1				6	*1*
TOTAL	35.75	7.5	0	16	0	29	

Applied Control & actuators ECTS : 9

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Advanced control and applications	15	1.5	6			12	*2*
• Sensors and signal conditioning	10	3.5				7	*1*
• Control of electrical machines (CC)	17.5	5.25	12			18	*2*
• Electrical drives	17.5	5.25	3.5			14	*2*
TOTAL	60	15.5	21.5	0	0	51	

Humanities S9 - Contrat pro ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• People and team management		10.5				6	*1*
• Professional project 4		12				2	*1*
• Training for TOEIC - s9		15					*1*
• Project management 2		15				3	*1*
• Designing the tomorrow's management	3	6				3	*1*
TOTAL	3	58.5	0	0	0	14	

Transversal project S9 -Contrat pro ECTS : 11

Manager : LORON Luc

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Functional analysis	6	3		3		6	*1*
• Multidisciplinary project				128		76	*1*
• Speciality activity report						20	*1*
• Initiation à dSpace			8				*0*
• TP Variateurs			8				*0*
• Gestion de projet CC		6				4	*1*
TOTAL	6	9	16	131	0	106	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	110.75	90.5	37.5	147	0	200	30
Face-to-face sum	385.75						

Semester 9 - unit *Option Intégration des Systèmes*

Humanities S9 ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• People and team management		10.5				6	*1*
• Professional project 4		12				2	*1*
• Training for TOEIC - s9		15					*1*
• Project management 2		15				3	*1*
• Designing the tomorrow's management	3	6				3	*1*
TOTAL	3	58.5	0	0	0	14	

Systems Design ECTS : 7

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electromagnetic compatibility	11.25	1				4	*1*
• Energy conversion			16			20	*2*
• Eco-design	9	1				3	*1*
• Maintenance management	9	1				5	*1*
• Reliability and safety requirement	12	1				6	*1*
• Electrical drive technology	5	6				5	*1*
TOTAL	46.25	10	16	0	0	43	

Seminar

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Seminar	6						*0*
TOTAL	6	0	0	0	0	0	

Systems Assembling ECTS : 9

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Sensors and signal conditioning	10	3.5				7	*1*
• Industrial Communication (IS)	8.75	5	12			12	*2*
• Electrical drives	17.5	5.25	3.5			14	*2*
• Decentralised electricity generation - smart grid	7.5	5				7	*1*
• Electricity transport network	7.5	5				6	*1*
• Embedded electric network	9	1				4	*1*
TOTAL	60.25	24.75	15.5	0	0	50	

Project ECTS : 10

Manager : DELFIEU David

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Functional analysis (IS)	6	7				6	*1*
• Energy conversion project				130		80	*1*
• Speciality activity report						20	*1*
TOTAL	6	7	0	130	0	106	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	121.5	100.25	31.5	130	0	213	30
Face-to-face sum	383.25						

Semester 9 - unit *Option Intégration des Systèmes - Contrat Pro*

Systems Design

ECTS : 7

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electromagnetic compatibility	11.25	1				4	*1*
• Energy conversion			16			20	*2*
• Eco-design	9	1				3	*1*
• Maintenance management	9	1				5	*1*
• Reliability and safety requirement	12	1				6	*1*
• Electrical drive technology	5	6				5	*1*
TOTAL	46.25	10	16	0	0	43	

Seminar

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Seminar	6						*0*
TOTAL	6	0	0	0	0	0	

Systems Assembling

ECTS : 9

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Sensors and signal conditioning	10	3.5				7	*1*
• Industrial Communication (IS)	8.75	5	12			12	*2*
• Electrical drives	17.5	5.25	3.5			14	*2*
• Decentralised electricity generation - smart grid	7.5	5				7	*1*
• Electricity transport network	7.5	5				6	*1*
• Embedded electric network	9	1				4	*1*
TOTAL	60.25	24.75	15.5	0	0	50	

Project

ECTS : 10

Manager : DELFIEU David

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Functional analysis (IS)	6	7				6	*1*
• Energy conversion project				130		80	*1*
• Speciality activity report						20	*1*
TOTAL	6	7	0	130	0	106	

Humanities S9 - Contrat pro ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• People and team management		10.5				6	*1*
• Professional project 4		12				2	*1*
• Training for TOEIC - s9		15					*1*
• Project management 2		15				3	*1*
• Designing the tomorrow's management	3	6				3	*1*
TOTAL	3	58.5	0	0	0	14	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	121.5	100.25	31.5	130	0	213	30
Face-to-face sum	383.25						

Semester 9 - unit *Option Maîtrise de l'énergie*

Energy conversion and power network — ECTS : 7

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electromagnetic compatibility	11.25	1				4	*1*
• Design of electrical machines	17.5	6.5	12			40	*2.5*
• Decentralised electricity generation - smart grid	7.5	5				7	*1*
• Electricity transport network	7.5	5				6	*1*
TOTAL	43.75	17.5	12	0	0	57	

Humanities S9 — ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• People and team management		10.5				6	*1*
• Professional project 4		12				2	*1*
• Training for TOEIC - s9		15					*1*
• Project management 2		15				3	*1*
• Designing the tomorrow's management	3	6				3	*1*
TOTAL	3	58.5	0	0	0	14	

Project — ECTS : 10

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Functional analysis	6	3		3		6	*1*
• Project				104		60	*8*
• Speciality activity report						20	*1*
• Initiation à dSpace			8				*0*
• TP Variateurs			8				*0*
• Gestion de projet		10				4	*0*
TOTAL	6	13	16	107	0	90	

Seminar

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Seminar	6						*0*
TOTAL	6	0	0	0	0	0	

Design and Control Of Electrical Actuators ECTS : 9

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Control of electrical machines (ME)	17.5	5.25	12			18	*2.5*
• Power converter design				20		16	*1.5*
• Electrical drives	17.5	5.25	3.5			14	*2*
• Dynamic modelling of electrical machines	17.5	5.25				20	*2*
TOTAL	52.5	15.75	15.5	20	0	68	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	111.25	104.75	43.5	127	0	229	30
Face-to-face sum	386.5						

Semester 9 - unit *Option Maîtrise de l'énergie - Contrat Pro*

Energy conversion and power network ECTS : 7

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electromagnetic compatibility	11.25	1				4	*1*
• Design of electrical machines	17.5	6.5	12			40	*2.5*
• Decentralised electricity generation - smart grid	7.5	5				7	*1*
• Electricity transport network	7.5	5				6	*1*
TOTAL	43.75	17.5	12	0	0	57	

Seminar

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Seminar	6						*0*
TOTAL	6	0	0	0	0	0	

Design and Control Of Electrical Actuators ECTS : 9

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Control of electrical machines (ME)	17.5	5.25	12			18	*2.5*
• Power converter design				20		16	*1.5*
• Electrical drives	17.5	5.25	3.5			14	*2*
• Dynamic modelling of electrical machines	17.5	5.25				20	*2*
TOTAL	52.5	15.75	15.5	20	0	68	

Humanities S9 - Contrat pro ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• People and team management		10.5				6	*1*
• Professional project 4		12				2	*1*
• Training for TOEIC - s9		15					*1*
• Project management 2		15				3	*1*
• Designing the tomorrow's management	3	6				3	*1*
TOTAL	3	58.5	0	0	0	14	

Project - Contrat pro

ECTS : 10

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Functional analysis	6	3		3		6	*1*
• Project				104		60	*1*
• Speciality activity report						20	*1*
• Initiation à dSpace			8				*0*
• TP Variateurs			8				*0*
• Gestion de projet		10				4	*0*
TOTAL	6	13	16	107	0	90	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	111.25	104.75	43.5	127	0	229	30
Face-to-face sum	386.5						

Semester 10 - unit *GE 5*

Engineering internship (Engineering senior project) ECTS : 30

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Training period 3					17		*30*
TOTAL	0	0	0	0	17	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	0	0	0	0	17	0	30
Face-to-face sum							

Semester 10 - unit *GE5 Contrat Pro*

Period in company

ECTS : 30

Manager : AIT-AHMED Mourad

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Period in company							*30*
• Retour d'expérience	24						*0*
TOTAL	24	0	0	0	0	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	24	0	0	0	0	0	30
Face-to-face sum	24						

Part II

Sheets of courses

3A Internship Assesment

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Rapport*

Manager : Bruno AUVITY

Accounting business game

Hours

Lect	Tut	PW	Proj	WP	Asst
	12	12			5

Evaluation

One evaluation : *Soutenance + CC*

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-2	·	✓	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-4	·	✓	·	·	·

Manager : Chrystèle GONCALVES

Advanced control and applications

Hours

Lect	Tut	PW	Proj	WP	Asst
15	1.5	6			12

Evaluation

One evaluation : *Examen*

Outline

1. Introduction
   2. Quadratic Linear Control
   Lyapunov Stability Analysis
   Optimal Control
   Reference tracking and disturbances rejection
   3. Optimal filtering
   Objective of optimal filtering
   Stochastic signals and models
   Kalman Filter
   4. Linear-Quadratic-Gaussien Control
   Objective of LQG Control
   Separation Principe
   Robustness problem of LQG Control
   LQG/LTR Control

Goals

Introduce the multivariable control problems and present the basis of a methodology based on linear quadratic optimal control. Optimal filtering (Kalman filter) is introduced by duality, before addressing the synthesis of LQG control (state feedback based on an optimal observer) and its robustness problem.

Bibliography

De Larminat P. ; Automatique ; Hermès, 1995

Borne P.,Dauphin-Tanguy G.,Richard J.P.,Rotella F.,Zambettakis I. ; Commande et Optimisation des Processus; Technip, 1990, Méthodes et Techniques de l'Ingénieur

Alazard D., Cumer C., Apkarian P., Gauvrit M., Ferreres G.; Robustesse et commande optimale ; Cépadues, 1999

Prerequisites

1. State space model and control
   2. Stochastic processes

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the specificities of multivariable control	✓	·	·	·	·
• Know how to tune a Linear Quadratic Controler	·	✓	·	·	·
• Know how to tune an optimal filter	·	✓	·	·	·
• Understanding the LQG Control	✓	·	·	·	·
• Know how to tune a combined observer and Linear Quadratic Controler	·	✓	·	·	·
• Introduce students to the problems of robustness of the LQG control (LTR)	✓	·	·	·	·

Manager : Mourad AIT-AHMED

Analog Electronics 5

Hours

Lect	Tut	PW	Proj	WP	Asst
16.25	13.75	9			20

Evaluation

3 evaluations :

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

Outline

Theory:
- Bipolar Transistors and Field Effect Transistors,
- Digital to Analog Interfaces - Optoelectronic Components,
- Negative feedback.

Teaching practice:
Cycle 1:
- Static and dynamic studies of bipolar transistor,
- Static and dynamic studies of JFET.

Goals

This fundamental teaching of Electrical Engineering introduces the principles of operation and characteristics of discrete components such bipolar transistors, field effect transistors, logic and optoelectronic components. The basic circuits, equipped with diodes, transistors and analog-digital interfaces, and the circuits involving negative feedbacks are studied.

Bibliography

M. GIRARD, Composants actifs discrets Tome I, Ediscience, 1990
M. GIRARD, Composants actifs discrets Tome II, Ediscience, 1990
MANNEVILLE - ESQUIEU, Systèmes bouclés de communication et de filtrage, Dunod, 1990

Prerequisites

Electronics/Electrotechnics Starter Training

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the analog electronics components.	·	·	✓	·	·
• Know the fundamental circuits using transistors.	·	·	✓	·	·
• Know the analog caracteristics of the logic circuits and opto-electronic circuits.	·	·	✓	·	·
• Know the types of negative feedbacks and properties.	·	✓	·	·	·

Manager : Jean-Claude LE CLAIRE

Analog Electronics 6

Hours

Lect	Tut	PW	Proj	WP	Asst
12.5	8.75	6			14

Evaluation

3 evaluations :

- *Exam 1*
- *Exam 2*
- *TP*

Outline

Theory:
- Operational Amplifiers,
- Filtering.

Teaching practice:
Cycle 2:
- Amplifier involving two stages based on discrete components,
- Operational Amplifiers: basic functions.

Goals

This fundamental teaching of Electrical Engineering presents the operational amplifiers using a voltage feedback and those using a current one, as well as the analog comparators. They are presented in idealized versions and then real. The basic stuctures are studied. A good knowledge of the characteristics of the operational amplifiers is requested in order to choose these components in function of the applications.

Bibliography

M. GIRARD, Composants actifs discrets Tome I, Ediscience, 1990
M. GIRARD, Composants actifs discrets Tome II, Ediscience, 1990
MANNEVILLE - ESQUIEU, Systèmes bouclés de communication et de filtrage, Dunod, 1990

Prerequisites

Electronics/Electrotechnics Starter Training
Analog Electronics 5

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the fundamental circuits which use ideal operational amplifiers.	·	·	✓	·	·
• Know the real operational amplifiers.	·	✓	·	·	·
• Know the basic active filters which use the ideal operational amplifiers.	·	·	✓	·	·

Manager : Jean-Claude LE CLAIRE

Analog electronics 7

Hours

Lect	Tut	PW	Proj	WP	Asst
18.75	13.75	7.5			25

Evaluation

3 evaluations :

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

Outline

1-Theoritical teaching:
- Transposition, modulation, demodulation, AM and FM
- Phase-locked loop
- Synthesis of passive and active filters

2-Practical teaching:
- Phase-locked loop
- Logic circuits

Goals

Knowing the elementary schemes and the applications studied in S5 and S6, this course deals with the synthesis of electrical filters and the study of some integrated functions of analog electronics. These functions are presented in the form of diagrams and are detailled using transistors or operational amplifiers schemes.

Bibliography

GIRARD M.-Boucle à verrouillage de phase. Mac Graw Hill, 1991

MANNEVILLE F., ESQUIEU J.-Systèmes bouclés linéaires de communication et de filtrage. Dunod, 1990

MORI Y.-Electronique pour le traitement du signal en huit volumes. Lavoisier, 2006

HOROWITZ P., HILL W.-The art of electronics. Cambridge University Press, 1995

Prerequisites

Analog electronics 5 and 6

Physics of semiconductor devices

Signals, systems and circuits

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the basic principles of modulation, demodulation of amplitude and frequency	·	✓	·	·	·
• Knowing the principle and applications of phase-looked loop	·	✓	·	·	·
• Knowing how to synthesize a passive or active analog electrical filter	·	·	✓	·	·

Manager : Rémy MOREAU

Analog electronics 8

Hours

Lect	Tut	PW	Proj	WP	Asst
8.75	7.75	15			20

Evaluation

2 evaluations :

- *Exam*
- *TP*

Outline

1-Theoritical teaching:
- Samplers and switched capacitor filters
- DAC and ADC
- Power amplifiers

2-Practical teaching:
- Switched capacitor filters
- Multiplier and oscillator applications
- Processing systems
- Operational amplifier applications

Goals

Knowing the elementary schemes and the applications studied in S5 and S6, this course deals with the power amplifiers and digital-electronic functions such as sampling and conversion devices.

Bibliography

GIRARD M.,-Amplificateurs de puissance. Ediscience, 1993
MANNEVILLE F., ESQUIEU J.-Théorie de signal et composants. Dunod, 1990
MORI Y.-Electronique pour le traitement du signal en huit volumes. Lavoisier, 2006
HOROWITZ P., HILL W.-The art of electronics. Cambridge University Press, 1995

Prerequisites

Analog electronics 5 and 6
Physics of semiconductor devices
Signals, systems and circuits

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the electronic principles of analog data acquisition	·	·	✓	·	·
• Knowing the different operating classes of power amplifiers	·	·	✓	·	·

Manager : Rémy MOREAU

Au choix Projet Auto-info ou en XX

Hours

Lect	Tut	PW	Proj	WP	Asst
			24		12

Evaluation

One evaluation : *Projet*

Automatic Control

Hours

Lect	Tut	PW	Proj	WP	Asst
20	17.5	9			23

Evaluation

3 evaluations :

- *Exam 1*
- *Exam 2*
- *TP*

Outline

- Introduction to automatic control
  - Basic models (Integrator, first and second order model, delay)
  - Control loops configuration, sensitivity, performances.
  - Stability, stability margines
  - Controllers synthesis in frequence domain
  - Basic identification methods

Goals

At the end of this course, students should have acquired the ability to synthesize PID controllers traditional.

Throughout this technique, it must appear that the fundamental problem of control is essential to manage a compromise between performance, stability, actuators stresses, sensitivity to noise and that management is not practiced only through formal mathematical problem solving.

Bibliography

[1] J.C. Gille, P. Decaulne, M. Pélegrin, "Théorie et calcul des asservissements linéaires", Ed : Dunod

[2] P. De Larminat, "Automatique : Commande des systèmes linéaires", Ed : Hermès

[3] G. Boisseaud, "Analyse des systèmes asservis linéaires continus", Ed : Imprimerie de l'ENSICA (Toulouse)

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

[5] R.C. Dorf, "Modern control systems", Sixth Edition, 60701, Ed : Addison Wesley

[6] T. Kailath, "Linear systems", 07632, Ed : Prentice Hall

[7] B.C. Kuo, "Automatic control systems", Seventh Edition, Ed : Prentice Hall

[8] P. De Larminat, Y. Thomas, ?Automatique des systèmes linéaires?, Ed. Flammarion Sciences

[9] . Ljung, "System Identification, theory for the user", Ed PTR Prentice Hall

[10] P. De Larminat, "Automatique Appliquée. 2ème édition revue et augmentée", Ed : Hermès

Prerequisites

1. Signal and Systems

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know how to analyse linear systems in the frequency domain.	·	·	✓	·	·
• Make students sensitive to compromise performance/stability	✓	·	·	·	·
• Acquire a logical approach to the study of the control of a linear dynamic system	·	·	✓	·	·
• Know how to analyse the stability of linear dynamic systems	·	·	·	✓	·
• Know how to tune PID controller	·	·	·	✓	·
• Know how to identify linear dynamic systems	✓	·	·	·	·

Manager : Mourad AIT-AHMED

Automatic and Computer science

Hours

Lect	Tut	PW	Proj	WP	Asst
			24		12

Evaluation

2 evaluations :

- *Exam*
- *TP*

Outline

- Introduction and initiation of the identification of linear system
  - Parametric method of identification of polynomial models: ordinary least squares and recursive
  - Implementation of the control loop
  - Study of the elements of the analog-digital conversion process.

Goals

Identification and Implementation on a micro-controller of a digital controller with fix point calculus.

Bibliography

Identification et commande des systèmes, I.D. LANDAU, collection Hermes, 1993.

Prerequisites

Automatic control, Eletronics, Computer science, Industrial Data Processing

Learning outcomes

Learning outcomes	N	A	M	E	O
• Identify linear systems	·	✓	·	·	·
• Knowing the Matlab Toolbox Ident	·	✓	·	·	·
• Implentation of numerical controller	·	✓	·	·	·

Manager : Nadia AIT-AHMED

Automation

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	6.5	15			15

Evaluation

One evaluation : *TP*

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

Prerequisites

Combinatory logic

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 SCHNEINDER	·	·	✓	·	·
• Programming with languages ??for automata with contacts, grafcet	·	·	✓	·	·

Manager : Kada DAKHOUCHE

Business analysis

Hours

Lect	Tut	PW	Proj	WP	Asst
4.5	6				3

Evaluation

One evaluation : *Etude de cas+QCM*

Bibliography

- A de Baynast, J Lendrevie, J Levy; Mercator"; Dunod. Dernières éditions
- F Canart ; Management de la qualité ; Gualino L Extenso Editions
- Henri Mintzberg, Structure et dynamique des organisations (Éd. d'organisation)
- M.Crozier ; A quoi sert la sociologie des organisations (Éd. Seli Arslan)
- S. Robbins, D. DeCenzo, M. Coulter ; Management, l'essentiel des concepts et des pratiques (9ème éd) Ed. Pearson
- https://www.l-expert-comptable.com/dossiers/evaluer-l-entreprise-reprendre-grace-l-analyse-economique.html
- https://www.fao.org/capacity-development/resources/practical-tools/analyse-organizational-performance/fr/

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	·	✓	·	·	·
• TPN-4	✓	·	·	·	·

Manager : Gwenael THOREL

Circular economy

Hours

Lect	Tut	PW	Proj	WP	Asst
4.5	3				6

Evaluation

One evaluation : *Diagnostic*

Bibliography

- AUREZ Vincent, GEORGEAULT Laurent, Economie circulaire, de Boeck
- Cf bibliographie donnée pendant le cours

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-3	✓	·	·	·	·

Manager : Chrystèle GONCALVES

Complex Analysis

Hours

Lect	Tut	PW	Proj	WP	Asst
21.25	19.5				20

Evaluation

2 evaluations :

- *Examen 2*
- *Examen 1*

Outline

1. Power Series and Analytic functions
2. Holomorphic functions
3. Fourier Series
4. Fourier Transform
5. Laplace Transform

Goals

Dispose fo concepts and computational tools which associated to complex analysis in order to understand easily the frequency domain approach

Bibliography

- Cartan H. : Théorie élémentaire des fonctions analytiques, Hermann 1961
- Combes J. : Suites et séries, Presses Universitaires de France 1982
- Rudin W. : Analyse réelle et complexe, Masson 1966
- Remmert R. : Theory of Complex Functions, Springer 1991
- Needham T. : Visual Complex Analysis : Oxford University Press 1997
- Gasquet C., Witomski P. : Analyse de Fourier et applications, Masson 1990
- Hladik J. : La transformation de Laplace, Masson 1969

Prerequisites

Real Analysis

Learning outcomes

Learning outcomes	N	A	M	E	O
• Being familiar with the frequency domain approach for signals and systems	·	·	✓	·	·
• Knowing how to transpose a problem from the time domain to the frequency domain and vice versa	·	·	·	✓	·
• Mastering the tools of calculation and analysis in the frequency domain	·	·	✓	·	·

Manager : Michel CARDELLI

Components and tools for digital control

Hours

Lect	Tut	PW	Proj	WP	Asst
15	1.5				8

Evaluation

One evaluation : *Examen*

Outline

1/ Introduction
Standard industrial needs, electrical drive applications
2/ Structure of industrial control
Control structures, PID controller variants
Saturation effects
3/ Digital control systems
Analog-to-digital and digital-to-analog converters
Fixed point and floating point representations of real numbers
Discretizing transfer functions, sampling period tuning
Discrete-time PID controllers

Goals

How to choose and implement a digital control architecture for a given application, more particularly for an electrical engineering application.

Bibliography

T. Hagglund and K. J. Astrom, « PID Controllers: Theory, Design, and Tuning », 2nd ed. : ISA Instrumentation, Systems, and Automation Society, 1995.

Charles L. Phillips, H. Troy Nagle, « Digital Control System Analysis and Design », Prentice Hall, 1995.

J. R. Leigh, « Applied Digital Control: Theory, Design and Implementation ». Second Edition, 2006, Dover publications.

Ioan D. Landau, Gianluca Zito, « Digital Control Systems - Design, Identification and Implementation » 2006, Springer.

Prerequisites

Linear system control

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing and operating the main control architecture: feed-forward and feedback control, cascade) structure	·	·	✓	·	·
• Knowing and operating the PID controller variants	·	·	✓	·	·
• Knowing the key elements of a control system and their impact on system performance	·	·	✓	·	·
• Being able to implement a control system on a digital target	·	·	✓	·	·

Manager : Nadia AIT-AHMED

Computer sciences S5

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	12.75	21			20

Evaluation

2 evaluations :

- *Examen*
- *TP*

Presentation

This course amis at acquiring the structures programment skills. Elements of algorithmic and programming are proposed.

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

Computer sciences S7

Hours

Lect	Tut	PW	Proj	WP	Asst
8.75			24		17

Evaluation

One evaluation : *Projet*

Goals

First part of the course : Object oriented programming

Second part : IT design office. The work done uses techniques or languages ??that were not necessarily covered in class. The student is placed in a real situation of an engineer project is its autonomy and initiative that are critical in achieving the assigned work.

Bibliography

Crgistiansen, "Perl en action", O'Reilly

Lerdorf, "PHP précis et concis", O'Reilly

Flanagan, "Javascript précis et concis", O'Reilly

Bradenbauch, "Pratique de MySQL", O'Reilly

Prerequisites

Algorithmic and programming

Learning outcomes

Learning outcomes	N	A	M	E	O
• Developing autonomy to search for information needed to complete the project	·	✓	·	·	·
• Argue and propose solutions which are discussed with the teacher	·	✓	·	·	·
• Manage time to achieve the goal	·	·	✓	·	·
• Prepare areport justifying its choice and highlighting its work	·	·	✓	·	·
• Present their work orally	·	·	✓	·	·

Manager : Salvy BOURGUET

Continuous Assessment (bis)

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *CC*

Control of discrete time systems

Hours

Lect	Tut	PW	Proj	WP	Asst
12.5	15	12			21

Evaluation

3 evaluations :

- *Exam 1*
- *Exam 2*
- *TP*

Outline

1- Introduction

2-Discrete-time signals, Z transform

3-Discrete Linear Invariant Systems: definition and modeling

4- Stability of discrete systems

5- Sampled systems, conversion continuous-discrete equations of state space models and transfer functions

6- Discrete-time control: controllers approximation, Transposition of continuous control methods to the discrete case: PID, RST, modal control.

7- Methods specific to the discrete case

8-Implementation of digital controllers

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.

Bibliography

DE LARMINAT P. ; Automatique : commande des sytèmes linéaires ; Hermès, Décembre 1996

ASTROM K.J., WITTENMARK B. ; Computer controlled systems : theory and design ; Prentice Hall, 1984

VANHEEGHE P., SUEUR C., BORNE P. ; Automatique des systèmes échantillonnés ; TECHNIP, Novembre 2000

Prerequisites

Representations and modeling of continuous systems

Synthesis of continuous controllers (PID,RST)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Acquire the mathematical tools necessary for the study and control of sampled systems	·	·	✓	·	·
• Acquire the methods of conversion of continuous-discrete state space equations and transfer functions of linear systems	·	·	✓	·	·
• Discretize analog controllers: transposition of continuous control to the discrete case	·	·	✓	·	·
• Studying the control laws specific to the discrete case	·	✓	·	·	·
• Solve the problems of implementing digital control	·	✓	·	·	·
• Implementation of digital controllers (PID, RST) and deal with problems of saturation	·	·	✓	·	·

Manager : Nadia AIT-AHMED

Control of electrical machines (CC)

Hours

Lect	Tut	PW	Proj	WP	Asst
17.5	5.25	12			18

Evaluation

2 evaluations :

- *examen*
- *TP*

Manager : Mohamed-Fouad BENKHORIS

Control of electrical machines (ME)

Hours

Lect	Tut	PW	Proj	WP	Asst
17.5	5.25	12			18

Evaluation

2 evaluations :

- *Examen*
- *TP*

Outline

1. Introduction
   Fundamentals
   PI controller tuning
   2. Inverter modeling
   3. Synchronous machine control
   Principle of the vector control
   Permanent magnet synchronous machine
   Wound rotor synchronous machine
   4. Induction motor control
   Scalar control schemes
   Vector control schemes
   Direct torque control

Goals

Presenting the fundamentals of control three-phase machines (synchronous and asynchronous), to determine the best use of modern variable speed drives

Bibliography

Bimal K. Bose, "Modern power electronics and AC drives", Prentice-Hall – 2001.
Stephen Chapman, "Electric machinery and power system fundamentals", McGraw-Hill, 2002.
John Chiasson, "Modeling and high performance control of electric machines", John Wiley, 2005.
Bill Drury, "The Control Techniques drives and control handbook ", Institution of Electrical Engineers, 2001.

Prerequisites

Dynamic model of three-phase machines
Linear system control

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing to tune current and speed loops	·	·	✓	·	·
• Knowing to model and simulate a machine with its inverter	·	·	✓	·	·
• Knowing the principle of the synchronous machine vector control	·	·	✓	·	·
• Knowing the principle of the induction motor scalar control	·	·	✓	·	·
• Knowing the principle of the induction motor vector control	·	·	✓	·	·

Manager : Mohamed-Fouad BENKHORIS

Critical approaches of the firm

Hours

Lect	Tut	PW	Proj	WP	Asst
	9				3

Evaluation

One evaluation : *Exposé*

Bibliography

- Carney, B. M., & Getz, I. (2016). Freedom, Inc: How Corporate Liberation Unleashes Employee Potential and Business Performance. International Creative Management.

- Detchessahar, M. (2019). L'entreprise délibérée: refonder le management par le dialogue. Nouvelle cité.

- Dujarier, M.-A. (2017). Le management désincarné: enquête sur les nouveaux cadres du travail. La découverte.

- Gomez, P.-Y. (2013). Le travail invisible: enquête sur une disparition. Paris: F. Bourin.

- Les statuts juridiques de l'entreprise (Dessine-moi l'éco)

- Rendre le travail visible : la solution pour sortir de la crise (Dessine moi l'éco)

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-6	✓	·	·	·	·

Manager : Roland BESSENAY

Decentralised electricity generation - smart grid

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	5				7

Evaluation

One evaluation : *Examen*

Outline

1. Presentation of the actual ratio of Dispersed Energy ressources inside the french energy mix and inside the world energy mix.
2. Presentation of the Wind turbine.
3. Presentation of the solar panels.
4. Presentation of power plant that used The sea energy.
5. Electric network history feedback.
6. Explain the distrubances generate by the insersion of dispersed energy ressouces in the distribution electric network.
7. Give an introduction of the SmartGrid concept
8. Explain the market of Electricity and the price of electricity

Goals

The aimed objectives are to raise the prejudices on the sector of the energy, and to inform students about the functioning/performs of the new technologies of production (wind, solar, tribal sea) and their problem of connection at the electricity network. Finally an introduction in Smart grid and the evolution of networks and market of the energy are realized.

Bibliography

Sources très diverses (vidéos, sites corporate (RTE, EDF), articles scientifiques, rapports techniques, ...)

Prerequisites

Not precisaly defined

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the electric production factories/power plant and theirs technicals contraintes	·	✓	·	·	·
• Understanding the wind power plan	·	·	✓	·	·
• Understanding the solar panel	·	·	✓	·	·
• Understanding the power plant that used the sea energy	·	✓	·	·	·
• Discovering the price of electricity and the electricity market	✓	·	·	·	·
• Discovering the Smartgrid concepts	✓	·	·	·	·

Manager : David DELFIEU

Design electronic sessions

Hours

Lect	Tut	PW	Proj	WP	Asst
			45		45

Evaluation

One evaluation : *Projet*

Manager : Jean-Claude LE CLAIRE

Design of electrical machines

Hours

Lect	Tut	PW	Proj	WP	Asst
17.5	6.5	12			40

Evaluation

2 evaluations :

- *Examen*
- *TP*

Outline

1. Soft and hard ferromagnetic materials: properties and modeling.
2. Elements of design of electrical machines.
3. Implementation and analysis of electrical machines windings.
4. Calculation of electrical machines inductances.
5. Permanent magnet machines. Study and design.
6. Project : design of rotating machine

Goals

1. Modeling of soft ferromagnetic materials and permanent magnets
2. Determination of the electrical machines inductances analytically and numerically
3. Permanent magnet machines
4. Design of electrical machines
5. tools for numerical electromagnetic field modeling

Bibliography

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2. SA NASAR, "Handbook of electrical machines", Mc Graw Hill, 1987.
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12. L. MOREAU ??Modélisation, conception et commande de génératrices à réluctance variable basse vitesse". Thèse de doctorat de l'université de Nantes, décembre 2005.
13. M.I. LAMGHARI ??Modélisation magnéto-thermique et optimisation de machines rapides. Application à la machine synchrone à réluctance variable". Thèse de doctorat de l'université de Nantes, octobre 2006.

14. R. MISSOUM ??Modélisation, conception et optimisation d'un moteur générateur pour coupleur électromagnétique?. Thèse de doctorat de l'université de Nantes, janvier 2008.

Prerequisites

Electrical engineering 6
Electrical machines 7
Numerical modeling in electrical engineering
Electrical machines 8

Learning outcomes

Learning outcomes	N	A	M	E	O
• Soft ferromagnetic and permanent magnets materials modeling	·	·	✓	·	·
• permanent magnets machines modeling	·	·	✓	·	·
• Design of electrical machines	·	✓	·	·	·
• tools for numerical machines modeling	·	✓	·	·	·

Manager : Mohammed-El-Hadi ZAIM

Designing the tomorrow's management

Hours

Lect	Tut	PW	Proj	WP	Asst
3	6				3

Evaluation

One evaluation : *Grille d'évaluation*

Bibliography

Partie don :

L'entreprise une affaire de don (Collectif, 2016)

Recevoir pour donner (Collectif, 2016)

Partie Jeux sérieux :

Theory of Fun for Game Design, Raph Koster, O'Reilly Media; Second edition, ISBN ? 978-1449363215

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	·	·	✓	·	·
• TPN-2	·	·	✓	·	·
• TPN-3	·	·	✓	·	·
• TPN-4	·	·	✓	·	·
• TPN-5	·	·	✓	·	·

Manager : Roland BESSENAY

Distribution électrique

Hours

Lect	Tut	PW	Proj	WP	Asst
15	15.25	12			20

Evaluation

4 evaluations :

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

Outline

1. The fundamentals of electrical engineering
   - use and application of phasors and complex algebra in three-phase sinusoidal balanced systems, impedance concept, electrical powers
   2. Typical layout of the electrical distribution system
   - national power grid structure (electrical system architecture and design characteristics / functional aspects)
   3- Introduction to the magnetic systems of power transformers
   - coil with iron core, manufacturing technology, roles of air gaps, behaviour modelling
   4- Role and uses of power transformers
   - single-phase transformer : operating rules, Kapp's model, performance characteristics
   - three-phase coil arrangement and three-phase power transformers
   - off-load transformer ratio / turn ratio, influence of the primary and secondary coupling, parallel operation, special transformers and specificities compared to conventional power transformers

Goals

The study of transformers aims at helping students to understand the operation of a great number of electrical machines (induction motors, generators and compensation synchronous machines), which are also based on the electromagnetic induction theory. Basic concepts will then be defined in order to carry out the analysis of the ideal transformer, and subsequently to study real transformers used in practice.

Bibliography

B. SAINT-JEAN, Electrotechnique et machines électriques, Eyrolles, 1976.

M. IVANES, R. PERRET, Eléments de Génie Electrique, Hermès, 1994.

B. HOCHART, Le transformateur statique - Calcul & Construction, Les Techniques de l'Ingénieur, D427, pp. : 1-21.

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 and basic circuit theories.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand the role of a transformer in the whole electric power system	·	✓	·	·	·
• Master the operational principles of a three-phase distribution transformer under load and no-load conditions	·	·	✓	·	·
• Know how to estimate the main characteristics of real-world transformers (i.e. voltage regulation, copper and iron losses, efficiency, ...)	·	·	·	✓	·
• Be able to model a steady-state transformer for the purpose of simulation and sizing (equivalent circuit and calculation of its typical values)	·	·	·	✓	·
• Know the basic properties of three-phase transformer banks (ratio of the 3-phase input voltage to the 3-phase output voltage, phase shift feature, ...)	·	·	✓	·	·
• Understand the role of the different possible three-phase coil arrangements under unbalanced operational conditions	·	✓	·	·	·

Manager : Laurence MIEGEVILLE

Drivers ansd switching of power transistors

Hours

Lect	Tut	PW	Proj	WP	Asst
12.5	7.25				20

Evaluation

One evaluation : *Exam*

Outline

1- Need of an electrical isloation in order to reduce the common mode currents
2- Components of isolation and specifications
3- Static and dynamic characteristrics of power transistors
4- Commutation mecanism and losses calculation
5- Switching circuits (snubber) : turn on and/or turn off transitions
6- Presentation and analysis of drive circuts
7- Resonant converters

Goals

The electromagnetic interference sources of common mode in the drive circuits of power switches and the components of galvanic isolation allowing to reduce them are presented.

Then, the characteristics of power transistors are reviewed to study the controls closer, calculate losses and analyze in detail the mechanism of commutation and snubber circuits.

Bibliography

1- 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

2- Mohan, undeland, Robins ; Power Electronics, converters, applications and design John Wiley and Sons, inc, 1989

3- Rachid. M. H; Power Electronics, circuits, devices and applications ; Prentice hall, 1988.

Prerequisites

Analog Electronics 5
Analog Electronics 6
Power Electronics 7
Power Electronics 8

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand the power converter disturbances and the electrical isolation to reduce the common mode currents	·	✓	·	·	·
• Know of the Galvanic isolation components adapted to local command circuits and their power sources	·	·	✓	·	·
• Analyze local control circuits	·	·	✓	·	·
• Know the static and dynamic characteristics of the power transistors and know how to calculate the losses in these components	·	✓	·	·	·
• Know how the switchings of the power switches operate	·	·	✓	·	·
• Know the principle of operating of the resonant converters	·	✓	·	·	·

Manager : Mohamed MACHMOUM

Dynamic modelling of electrical machines

Hours

Lect	Tut	PW	Proj	WP	Asst
17.5	5.25				20

Evaluation

One evaluation : *Examen*

Outline

1. Transformations applied to three phase systems
   Interest of transformations, diagonal matrix ...
   Correspondance between three-phase and two phase transformations
   Concordia and Park's transformations, equivalent two phase machines
   2. Dynamic models of Pole Slient or Smooth Synchromous Machines
   Structures and principles of operating
   Matrix form of electrical equations : voltages and flux
   Park's model, torque equation
   Analysis of steady-state behavioe, phasor diagram
   3. Dynamic model of asynchronous (induction) machine
   Structures and principles of operating
   Matrix form of electrical equations : voltages and flux
   Park's models : commonly used reference frame, Electromagnetic torque expressions
   Steady-state, state models in view of control

Goals

To establish dynamic models of alternating current machines in view of steady-state, transient behavior analysis and control

Bibliography

Lesenne. J, Notelet. F et Segnier. G ; Introduction à l'Electrotechnique approfondie ; ; techniques et documentation 1981

Chatelain. J ; Introduction à l'Electrotechnique approfondie ; Traité d'Electricité et d'Electronique, Editions Dunod, 1983, Tome I et Tome II

Vas. J ; Electrical machines and drives, a space vector theory approach ; Clarendon Press, Oxford 1992

Say. M. G. ; Alternating current machines ; Longman, Scientific and technical, 1983, 5ème édition

Prerequisites

Basic courses of electrical machines in steady state : structures, principles, basic equations, equivalent schemes and phasor diagrams.

Matrix calculation (diagonalisation, eigenvalues ...)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand the interest of Cocordia and Park's transformations	·	·	✓	·	·
• accure the methodology for establishing dynamic models of synchronous machines	·	·	✓	·	·
• Accure the methodology for establishing dynamic models of induction machines	·	·	✓	·	·
• To be able to extend the concept to non conventional machines and associted power electronics	·	✓	·	·	·
• Understand the interaction between conception, modelling and control of electrical machines	·	✓	·	·	·

Manager : Mohamed MACHMOUM

EAO energy conversion

Hours

Lect	Tut	PW	Proj	WP	Asst
			18		18

Evaluation

2 evaluations :

- *Projet EAO ETT*
- *Projet EAO EP*

Manager : Mohamed-Fouad BENKHORIS

Eco-design

Hours

Lect	Tut	PW	Proj	WP	Asst
9	1				3

Evaluation

One evaluation : *Examen*

Outline

1. Context and challenges :
   - political context
   - economical context
   - regulatory framework
   - illustration : Ecorizon program by STX France
   2. Definition of eco-design, methods and tools :
   - impacts of a product/service on the environment
   - definition of eco-design
   - methods and tools (Life Cycle Analysis, energy content, check-lists)
   - environmental communication
   3. Industrial case : the passenger ship
   - main maritime rules and regulation
   - black lists (Reach, IHM)
   - th collaborative project SSD : LCA of a ship
   - illustration : the concept-ship EOSEAS by STX France

Goals

The aim of this module is to give basics of eco-design, which aims to meet the environmental and economic challenges of current and future business, particularly through the example of the shipbuilding industry. It aims to understand the context, challenges and limitations of eco-design for the industry, the main tools and methods, and make the students want to explore more deeply.

Bibliography

- Le programme Ecorizon® de STX Europe
   - "Module de sensibilisation à l'éco-conception", ADEME
   - Formation ACV d'EVEA (Evaluation et Accompagnement, conseil en éco-conception)
   - Les dossiers thématiques de l'APESA : "L'éco-conception : un contexte réglementaire en forte évolution" - Juillet 2009
   - Thèse Marc Janin - ENSAM - 28 avril 2000

Prerequisites

No specific pre-requisites, except the basics of energy efficiency.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand the world environmental and economic context, requiring manufacturers to engage in eco-design	✓	·	·	·	·
• Know the basics of eco-design, as well as tools and methods commonly used	·	✓	·	·	·
• Understand the challenges and limitations of eco-design in the shipbuilding industry, and in particular for passenger ships	✓	·	·	·	·

Manager : David DELFIEU

Ecological and Social Transition S7

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

2 evaluations :

- *Validé ou non validé*
- *Evaluation*

Manager : Bruno AUVITY

Ecological and Social Transition S8

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Validé ou non validé*

Manager : Bruno AUVITY

Electrical Risk

Hours

Lect	Tut	PW	Proj	WP	Asst
10	6	6	6		14

Evaluation

3 evaluations :

- *Examen*
- *TP*
- *Projet*

Outline

1) Control of electrical risks: Analysis of electrical risks, electrical accident statistics, prioritization of responsibilities 2)Regulatory, context: regulatory instruments, standards

3)Training and empowerment: definitions, field of use, standard UTE C 18-510

4)Electricity and the human body: Effect of electric current on the human body, the human body resistance, the current path in the body, physiological explanation of the action of electricity on the human body, muscles, heart, protection against electric shock, What to do in case of an electrical accident.

5)Electrical Equipment, switch, switch, circuit breaker, contactor, fuses, fuse current protection diférentiel, Choice of protective devices: fuses, circuit breakers., Synthesis Example protections used Automatic Power Off, Earthing, diagrams Connection to Earth

6)Interventions in the field of low voltage arrangements for personnel and equipment (Interventions troubleshooting Intervention connection with the presence of voltage,...)

Goals

The objectif of this course is to introduce studentsto electrical risks and relevant standards.The issue of this course is to deliverer authorization to intervene in the hall of pratical work in the laboratories of the Deparment Electrical Engineerin and the laboratory during IREENA projects.

Bibliography

UTE C18-510-1 Juin 2012" Recueil d'instructions de sécurité électrique pour les ouvrages" AFNOR Editions

Learning outcomes

Learning outcomes	N	A	M	E	O
• Get the electrical risks accreditation (Reponsible for interventions)	·	·	✓	·	·
• Proceed safely operations: troubleshooting, connections with voltage presence, replacement fitting.	·	·	✓	·	·
• Take the necessary measures to ensure its own safety and the safety of personnel under his responsibility	·	·	✓	·	·
• Knowing the sizing protection devices: fuses, circuit breakers	·	✓	·	·	·

Manager : Kada DAKHOUCHE

Electrical circuits

Hours

Lect	Tut	PW	Proj	WP	Asst
10	11	9			15

Evaluation

2 evaluations :

- *Examen*
- *TP*

Manager : Mohamed MACHMOUM

Electrical drive technology

Hours

Lect	Tut	PW	Proj	WP	Asst
5	6				5

Evaluation

One evaluation : *Examen*

Outline

Mechanical power transmission
- Characteristics of a mechanical power transmission
- Mechanisms for rotation-rotation conversion
- Mechanisms for rotation-translation conversion
- Mechanical defaults
- Determination of the equivalent load on the motor shaft
- Choosing a rotation-rotation conversion
- Technological choice and sizing of a drive

Goals

Guide students in the choice and sizing of electrical drive for standard or high performance applications (industrial applications, machine tool, robotics).

Present the main families of mechanisms for movement conversion and calculate the equivalent load on the motor shaft.

Bibliography

Lacroux G. "Les actionneurs électriques pour la robotique et asservissements", Tec&Doc Lavoisier, 1994.

Bonal J. , "Entraînements électriques à vitesse variable . volume 1 . Rappels d'électrotechnique et de mécanique, les procédés de variation de vitesse", Lavoisier Tec & Doc, 1997.

Bonal J. , "Utilisation industrielle des moteurs à courant alternatif", Lavoisier Tec & Doc, 2001.

Techniques de l'Ingénieur : articles de la section "Energies/Convertisseurs et machines électriques/Différents types de machines électriques tournantes"

Prerequisites

Principles of conventional electric machines: DC, synchronous and induction machines. Bases of the dynamics of mechanical systems

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the strengths and weaknesses of the main families of electrical machines	·	·	✓	·	·
• Choose the right type of machine for a given application	·	·	✓	·	·
• Know the different families of power transmission mechanisms (gears and rotation- tranlation conversion)	·	✓	·	·	·
• Assess the dynamic model the mechanical load on the motor shaft	·	·	✓	·	·
• Size the complete system: static converter, machine and mechanical transmission	·	·	✓	·	·

Manager : Luc LORON

Electrical drives

Hours

Lect	Tut	PW	Proj	WP	Asst
17.5	5.25	3.5			14

Evaluation

2 evaluations :

- *Examen*
- *TP*

Outline

1. Variable Speed ??Drive 1. Introduction to
   2. Sets converter DC machine
   3. Sets synchronous converter machine
   3. Sets asynchronous converter machine

Goals

This course builds on the skills acquired in energy conversion and automatic to study a complete chain of energy conversion. We show the intrêt supplying an electrical machine by a static inverter for controlling its speed and its torque. The focus will be on the study of the quality of the couple and the study of reversibiltité torque and speed of a converter assembly machine

Bibliography

Jean-Paul Louis "Modélisation des machines électriques en vue de leur commande, concepts généraux." Traité EGEM électronique-génie électrique-micro systèmes. Hermes Lavoisier 2004, ISBN 2-7462-0916-0

Bimal K. Bose, "Modern power electronics and AC drives", Prentice-Hall – 2001.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Learn to associate an electronic power converter to an electrical machine	·	·	·	✓	·
• Analyze the operation of a converter assembly machine	·	·	✓	·	·
• Study the operation of a converter assembly machine	·	·	✓	·	·
• Being able to study torque and speed reversibilty of a converter assembly machine	·	·	·	✓	·
• Propose a set converter machine meets a specification	·	·	✓	·	·

Manager : Mohamed-Fouad BENKHORIS

Electricity transport network

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	5				6

Evaluation

One evaluation : *Examen*

Outline

- The components of the power network (lines, substation, transformer, protective device, programmable logic controllers, technology)

- The management of the power system (acess to the network, the management of the flows, power système reliability, the exchanges)

- The management of the power network (The control of the transits, frequency adjustment, the sécurity rules, the control system, the maintenance, the sizing)

- Economic notions

Goals

Power system : many components in constant interaction under control

Bibliography

D. Hoffmann, A. Cayol, Y. Harmand et J.-M. Tesseron, Mémento de la sûreté du système électrique, édition 2004, Montrouge, Édition VBD, 2004,

Prerequisites

Knowledge of electric laws

Knowledge of electric components

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the elements of a transmission network	·	✓	·	·	·
• Know the management of an Electricity System	·	✓	·	·	·
• Know the exploitation of a transport network Connaitre	·	✓	·	·	·
• discover economic notions to the market of the energie, to the companies	✓	·	·	·	·

Manager : Salvy BOURGUET

Electromagnetic compatibility

Hours

Lect	Tut	PW	Proj	WP	Asst
11.25	1				4

Evaluation

One evaluation : *Examen*

Outline

Essential definitions in electromagnetic compatibility
- Electromagnetic Sources
- Coupling mechanisms
- Methods and Devices for the protection of equipments and networks
- Electromagnetic Compatibilityof for broadbands systems (xDSL and PLC)
- Standardization and Regulation in EMC

Goals

To make aware the students in the problems of electromagnetic compatibility (EMC) susceptible to be met in their future professional life.

It is mainly a question of inculcating to them the essential EMC notions without making them real experts.

The objective is to know how to identify an EMC problem and to seek about the palliative solutions to be implemented.

Bibliography

Compatibilité électromagnétique : Des concepts de base aux applications
- sous la Direction de: Pierre Degauque et Ahmed Zeddam
- Collection technique et scientifique des télécommunications
- Editions : Hermes Lavoisier

Prerequisites

Electricity
- Electromagnetism Notions

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the essential notions of electromagnetic compatibility	·	·	✓	·	·
• Understand the origin of a problem of electromagnetic Compatibility	·	·	✓	·	·
• Know how to set up the suitable methods and protective devices	·	·	✓	·	·
• Know the methods of protection and the protective devices	·	·	✓	·	·

Manager : David DELFIEU

Electromagnetism

Hours

Lect	Tut	PW	Proj	WP	Asst
20	12.5	6			20

Evaluation

3 evaluations :

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

Outline

1. Introduction: Scope of the electricity
2. Laws and concepts of electromagnetism
3. dielectric media
4. magnetic media
5. magnetic circuits
6. magnetic circuits with permanent magnets
7. Field calculations

Goals

Lectures in electromagnetism aim to consolidate the theoretical knowledge of physics to understand the phenomena encountered in various applications in the field of electrical engineering and specially for transformers and electromechanical converters.

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

Prerequisites

- Basic knowledge of vector analysis and integral calculation
- Basic knowledge of linear algebra and complex analysis

Learning outcomes

Learning outcomes	N	A	M	E	O
• Acquire the basic knoledge of electromagnetism	·	·	✓	·	·
• Numerical resolution of partial differential equations	·	✓	·	·	·
• Application of electromagnetism's laws to calculate the electrical characteristics of circuits (inductance,capacitor, resistance) with an analytical or numerical approach	·	·	✓	·	·

Manager : Didier TRICHET

Electronics and Computer Science

Hours

Lect	Tut	PW	Proj	WP	Asst
3.75			11.25		8.25

Evaluation

2 evaluations :

- *TP*
- *Examen*

Presentation

Design of a 32-bit processor card. Learning of a low-level language and link with the hardware part.

Outline

- Study of the design of a 68000 mainboard
  - 68000 assembly lanhuage
  - Dealing with exception

Goals

Design of a 68000 mainboard

Bibliography

"Motorola, M68000 Family Reference Manual, 1990
P JAULENT, Le Microprocesseur 68000 et sa programmation, Eyrolles, 1991"

Prerequisites

Micro 8 bits

Learning outcomes

Learning outcomes	N	A	M	E	O
• Apprehend the design of a 68000 mainboard	·	✓	·	·	·
• Assess the programming in assembly Language	·	·	✓	·	·

Manager : David DELFIEU

Electronics and Computer Science

Hours

Lect	Tut	PW	Proj	WP	Asst
27.5	16.75	12			28

Evaluation

3 evaluations :

- *Exam*
- *Examen 2*
- *TP*

Presentation

This teaching is based on the study of an 8-bit microcontroller, the ATmega8, for the control of motors and TTL-type models.

Outline

Analogic digital Converter
  Timer - Pulse Width Modulated
  Interruption
  Programming

Goals

Control of DC motors with 8 bit microcontroler

Bibliography

www.atmel.com

Prerequisites

Logic, Algorithms and Programming

Learning outcomes

Learning outcomes	N	A	M	E	O
• Analogic digital Converter	·	·	✓	·	·
• Timers	·	·	·	✓	·
• Hardware Interruptions	·	·	✓	·	·
• Programming of controller on micro card.	·	·	✓	·	·

Manager : David DELFIEU

Electronics and Computer Science (RTES)

Hours

Lect	Tut	PW	Proj	WP	Asst
5	2.75	8			8

Evaluation

2 evaluations :

- *Exam*
- *TP*

Presentation

The purpose of this course is to introduce technics of the C language (under Linux and a version derived from RTAI) allowing the development of multi-threaded applications.

Outline

- Real-time scheduling
  - Unix Processus and Posix thread
  - Semaphores, pipes, ...
  - Communication with the embedded real-time target : Uboot, FTP, Telnet.

Goals

Design of multi-task application on a real-time embedded system

Bibliography

La programmation sous Unix - Jean-Marie Rifflet - Ed McGraw-Hill
La communication sous Unix - Jean-Marie Rifflet - Ed McGraw-Hill

Prerequisites

Algorithmics and Programming

Learning outcomes

Learning outcomes	N	A	M	E	O
• design of multi-task application on a real-time embedded system	✓	·	·	·	·
• To control and communicate with a an embedded system	·	✓	·	·	·

Manager : David DELFIEU

Embedded electric network

Hours

Lect	Tut	PW	Proj	WP	Asst
9	1				4

Evaluation

One evaluation : *Examen*

Outline

- The power distribution
  - Issues related to the current and voltage
  - The harmonic disturbances

Goals

Knowing the specifics of a network of electrical distribution board and its problems, particularly in terms of harmonic pollution

Prerequisites

Lecture of Electrotechnics

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the principles of designing a distribution network	·	·	✓	·	·
• Knowing how to manage the problems associated with embedded networks	·	·	·	✓	·

Manager : Salvy BOURGUET

Energy conversion

Hours

Lect	Tut	PW	Proj	WP	Asst
		16			20

Evaluation

One evaluation : *TP*

Manager : Luc LORON

Energy conversion project

Hours

Lect	Tut	PW	Proj	WP	Asst
			130		80

Evaluation

One evaluation : *Projet*

Goals

The main objective is to achieve a cross-acquisition knowledges in several subjects. These projects provide an implementation of theoretical knowledge or in the opposite of theoretical deepening of certain knowledge.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing how to implement a system approach	·	·	✓	·	·
• Mastering a methodological approach	·	·	✓	·	·

Manager : David DELFIEU

Entrepreneurship S7

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

2 evaluations :

- *Validé ou non validé*
- *Evaluation*

Manager : Bruno AUVITY

Entrepreneurship S8

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Validé ou non validé*

Manager : Bruno AUVITY

French as a Foreign Language for engineering students

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

French as a Foreign Language for engineering students

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Functional analysis

Hours

Lect	Tut	PW	Proj	WP	Asst
6	3		3		6

Evaluation

One evaluation : *Projet*

Manager : David DELFIEU

Functional analysis (IS)

Hours

Lect	Tut	PW	Proj	WP	Asst
6	7				6

Evaluation

2 evaluations :

- *Examen*
- *Projet (coef 1)*

Outline

- Introduction and Concepts of Value
  - Normative Corpus
  - The Working Group
  - The process of Functional Analysis
  - Essential Definitions
  - Steps Functional Analysis
  - Methods and Tools for Functional Analysis

Goals

Introducing the functional analysis approach. Assimilate the contributions of the approach to detect the timing of implementation. Locate the process with respect to a methodological context as Project Management or Value Analysis. Discover the methodological tools used to implement the process.

Bibliography

Référentiel Normatif du domaine AFNOR X50H "Management par La Valeur"

Learning outcomes

Learning outcomes	N	A	M	E	O
• Detect situations in a timely implementation of Functional analysis	·	·	✓	·	·
• Knowing the tools of Functional Analysis	·	·	✓	·	·
• Being able to implement Functional Analysis	·	✓	·	·	·

Manager : David DELFIEU

Grammar and professional English 1

Hours

Lect	Tut	PW	Proj	WP	Asst
	40				

Evaluation

2 evaluations :

- *CC*
- *DS*

Grammar, Toeic and professional English 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	39	2			

Evaluation

3 evaluations :

- *CC*
- *Tutorat*
- *Toeic*

History, business knowledge and entrepreneurship

Hours

Lect	Tut	PW	Proj	WP	Asst
15	15				4

Evaluation

One evaluation : *Etude de cas*

Bibliography

? Cyr, A. (2009). Les représentations entrepreneuriales, sous la direction de Louis Jacques Filion et Christian Bourion, Paris, Eska, 2008, 262 p. Revue internationale PME Économie et gestion de la petite et moyenne entreprise, 22(3-4), 174-176.

? Henri Mintzberg, Structure et dynamique des organisations (Éd. d'organisation)

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? M. Bidan et Y. Livian (2022), les grands auteurs aux frontières du management (Editions EMS)

? M.Crozier ; A quoi sert la sociologie des organisations (Éd. Seli Arslan)

? Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Clarifying business models: Origins, present, and future of the concept. Communications of the association for Information Systems, 16(1), 1.

? Ramadani, V. (2009). Business angels: who they really are. Strategic Change: Briefings in Entrepreneurial Finance, 18(7?8), 249-258.

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? Sarasvathy, S. D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. Academy of management Review, 26(2), 243-263.

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-6	✓	·	·	·	·

Manager : Luc OILI

Industrial Communication (CC)

Hours

Lect	Tut	PW	Proj	WP	Asst
8.75	5		16		15

Evaluation

One evaluation : *Projet*

Goals

PLC networks: network architectures, communication protocols Modbus, Jbus Unitelway. Supervisory systems: structure monitoring systems, communication interfaces, application examples, presentation of a terminal supervision and handling of Siemens and Schneider HMIs

Prerequisites

Automatismes S6

Learning outcomes

Learning outcomes	N	A	M	E	O
• knowledge networks, industrial and fine stranded bus systems through the study of real cases	·	✓	·	·	·
• discover the oversight through an industrial software	·	✓	·	·	·

Manager : Kada DAKHOUCHE

Industrial Communication (IS)

Hours

Lect	Tut	PW	Proj	WP	Asst
8.75	5	12			12

Evaluation

One evaluation : *TP*

Goals

PLC networks: network architectures, communication protocols Modbus, Jbus Unitelway. Supervisory systems: structure monitoring systems, communication interfaces, application examples, presentation of a terminal supervision and handling of Siemens and Schneider HMIs

Prerequisites

Automatismes S6

Learning outcomes

Learning outcomes	N	A	M	E	O
• knowledge networks, industrial and fine stranded bus systems through the study of real cases	·	✓	·	·	·
• discover the oversight through an industrial software	·	✓	·	·	·

Manager : Kada DAKHOUCHE

Intercultural explorations

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Interdiscipinary S7

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

2 evaluations :

- *Validé ou non validé*
- *Evaluation*

Manager : Bruno AUVITY

Interdisciplinary S8

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Validé ou non validé*

Internship 2

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Validation*

Manager : Rémy MOREAU

Internship GE3

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

One evaluation : *Validation*

Manager : Rémy MOREAU

Maintenance management

Hours

Lect	Tut	PW	Proj	WP	Asst
9	1				5

Evaluation

One evaluation : *Examen*

Outline

Concepts, definitions and panorama of the main methods of maintenance.

Presentation : maintainability (+ exercise), LCC (Life Cycle Cost), ILS (Integrated Logistic Support) and Inventory management (+ exercise)

RCM Method (Reliability Centered Maintenance) (elaboration of a préventive maintenance plan) : course and case study.

Goals

Bring to the students the concepts and the definitions of the maintenance.

Present a panorama of the main methods and techniques of maintenance of industrial systems.

Show the contribution of the Maintenance in the behavior of equipments and the functions of the system.

Bibliography

Documents de cours et d'exercices

Rappel des normes en vigueur concernant la Sûreté de Fonctionnement.

Prerequisites

Mathematics of the engineer: calculations of statistics and probability. Knowledge of the different departments of the company (maintenance dept. etc;)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the Concepts, the definitions, and the main methods and techniques of maintenance	·	✓	·	·	·
• Make the link between the techniques of maintenance and the notions of dependability (link between failures and maintenance tasks)	·	✓	·	·	·
• Realize a preventive maintenance plan (RCM) from technical documents and from analysis of the failures (FMECA - Failiure Modes, Effects and Criticality analysis)	·	✓	·	·	·

Manager : David DELFIEU

Mathematical Reception

Hours

Lect	Tut	PW	Proj	WP	Asst
	16.25				8

Outline

Linear Algebra

1. Algebraic structure : vector space
2. Linear Mapping
3. Matrix Operations
4. Changing Bases
5. Practice on Linear differential equations

Real Analysis

1. Derivatives
2. Riemann Integral
3. Multiple Integral

Goals

For students coming from technological training, this course given at the very beginning of the engineering training come back on the basis of the real analysis and the linear algebra. The aim of lessons and practical works is to base the knowledge and the mastery of tecniques of calculation.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing and master matrix representation and associated tools	·	·	✓	·	·
• Mastering the techniques of the calculation in real analysis	·	·	✓	·	·

Manager : Michel CARDELLI

Mechanics and thermal science

Hours

Lect	Tut	PW	Proj	WP	Asst
22.5	20.5				28

Evaluation

3 evaluations :

- *Examen Mécanique*
- *Examen Thermique*
- *Examen 3*

Manager : Rémy MOREAU

Modelisation of electrical machines 7

Hours

Lect	Tut	PW	Proj	WP	Asst
15	9	8			25

Evaluation

3 evaluations :

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

Outline

1. Electromagnetic energy conversion
2. Windings of electrical machines
3. harmonic fields
4. DC machines
5. Tests on DC machines

Goals

We first study the continuous electromechanical energy conversion, which allows us to introduce the different structures of conventional machines. We then present the winding used in these machines (DC and AC) and the rotating field harmonics. Finally we study the direct current machines.

Bibliography

1. F. Labrique, H. Buyse, ?Electromécanique - Convertisseurs d'énergie et actionneurs?, Dunod, 2001.
2. B. Saint-Jean, ?Electrotechnique et machines électriques? Eyrolles
3. R.P. Bouchard, G. Olivier, ?Electrotechnique?, Presses Internationales Polytechniques.
4. Notelet, Séguier, ?Electrotechnique industrielle?,Tec et Doc Lavoisier.
5. M. Jufer ?Electromécanique?, Dunod, 1983.
6. G. Pierron ?Introduction au traitement de l'énergie électrique? Ecole des mines de Paris, Les Presses, 2003
7. P. Barret ?Machines électriques, théorie et mise en oeuvre?, Ellipses, 2002
8. R. Le Doeuff, M. E. Zaïm ?Machines électriques tournantes. De la modélisation matricielle à la mise en oeuvre?. Ed. Hermes - Lavoisier, 2009.
9. M.E. Zaïm, R. Le Doeuff, M.F. Benkhoris, M. Machmoum ?Machines électriques tournantes. Exercices et problèmes corrigés?, Ed. Hermes Science - Lavoisier, 2012.

Prerequisites

Electrical engineering 6

Learning outcomes

Learning outcomes	N	A	M	E	O
• Study the electromechanical energy conversion	·	·	✓	·	·
• Study the DC machines	·	·	✓	·	·
• Study machines windings and field harmonics	·	✓	·	·	·

Manager : Mohammed-El-Hadi ZAIM

Modelisation of electrical machines 8

Hours

Lect	Tut	PW	Proj	WP	Asst
17	12	12			30

Evaluation

3 evaluations :

- *Exam 1*
- *Exam 2*
- *TP*

Outline

1. Electromechanical energy conversion in AC machines
2. Synchronous machines. Modeling in linear and saturated cases. Generator and motor functioning.
3. Induction machines. Modeling and equivalent circuits.
4. Unbalanced induction machines
5. Actuators and special low power machines
6. Lab: synchronous and asynchronous machines

Goals

We study synchronous machines, induction machines and special machines from a general theoretical approach of electromechanical energy conversion. We establish the principles of of the association machine-converter

Bibliography

1. F. Labrique, H. Buyse, ?Electromécanique - Convertisseurs d'énergie et actionneurs?, Dunod, 2001.
2. B. Saint-Jean, ?Electrotechnique et machines électriques? Eyrolles
3. R.P. Bouchard, G. Olivier, ?Electrotechnique?, Presses Internationales Polytechniques.
4. Notelet, Séguier, ?Electrotechnique industrielle?,Tec et Doc Lavoisier.
5. M. Jufer ?Electromécanique?, Dunod, 1983.
6. G. Pierron ?Introduction au traitement de l'énergie électrique? Ecole des mines de Paris, Les Presses, 2003
7. P. Barret ?Machines électriques, théorie et mise en oeuvre?, Ellipses, 2002
8. R. Le Doeuff, M. E. Zaïm ?Machines électriques tournantes. De la modélisation matricielle à la mise en oeuvre?. Ed. Hermes - Lavoisier, 2009.
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10. D. Namane-Sator ?Machines à courant alternatif?. Ed. Ellipse, 2009

Prerequisites

Electrical machines 6
Electrical machines 7
Numerical modeling in electrical engineering

Learning outcomes

Learning outcomes	N	A	M	E	O
• Study the electromechanical energy conversion in AC machines	·	·	✓	·	·
• Study the synchronous machines	·	·	✓	·	·
• Study the induction machines	·	·	✓	·	·
• Study special machines	·	✓	·	·	·

Manager : Mohammed-El-Hadi ZAIM

Multidisciplinary project

Hours

Lect	Tut	PW	Proj	WP	Asst
			128		76

Evaluation

One evaluation : *Projet*

Manager : David DELFIEU

Negotiations

Hours

Lect	Tut	PW	Proj	WP	Asst
3	7.5				2

Evaluation

One evaluation : *Vidéo*

Bibliography

Stimec A. ; « La négociation » ; Dunod
Fisher, Ury ; « Comment réussir une négociation » ; Seuil

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	·	✓	·	·	·
• TPN-2	·	✓	·	·	·
• TPN-4	✓	·	·	·	·

Manager : John KINGSTON

Numerical Analysis

Hours

Lect	Tut	PW	Proj	WP	Asst
16.25		20			15

Evaluation

2 evaluations :

- *Exam*
- *TP*

Outline

1. Examples of problems within the numerical linear algebra
2. Solving linear systems: direct methods
3. Solving linear systems: iterative methods
4. General points about numerical linear algebra
5. numerical quadratures
6. Solving ordinary differential equations: one step methods
7. Solving ordinary differential equations: Adams methods
8. Discrete Fourier transform and the FFT algorithm

Goals

The class of Numerical Analysis, which associates mathematical analysis and computer science, has for aim to prepare, from recurring examples of Electrical Engineering, the scientific computing beyond the man-machine interface.

Bibliography

- Ciarlet P. G. : Introduction à l'analyse numérique matricielle et à l'optimisation, Masson 1980
- Crouzeix M., Mignot A. L. : Analyse numérique des équations diérentielles, Masson 1984
- Hairer E., Norsett S. P., Wanner G. : Solving Ordinary Dierential Equations I, Springer-Verlag 1987
- Gasquet C., Witomski P. Y Analyse de Fourier et applications, Masson 1990

Prerequisites

Knowing the concepts and the techniques of calculation within linear algebra and about ordinary differential equations.

Mastering the C programming language

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the main algorithms for solving linear systems	·	·	✓	·	·
• Knowing the main algorithms for solving ordinary differential equations	·	·	✓	·	·
• Being aware of problems of numerical stability	·	✓	·	·	·
• Being aware of the algorithmic efficiency	·	·	✓	·	·

Manager : Michel CARDELLI

People and team management

Hours

Lect	Tut	PW	Proj	WP	Asst
	10.5				6

Evaluation

One evaluation : *DS*

Bibliography

- Le chaos Management / Tom Peters / Intereditions
- Manager dans la complexité / Dominique Genelot / Insep Editions
- Les responsables porteurs de sens / Vincent Lenhardt / Insep Editions
- De la performance à l'excellence / Jim Collins / Village Mondial
- Comment leur dire / Gérard Collignon / Intereditions
- Communiquer, motiver, manager en personne/ Taibi Kahler / Intereditions
- Vidéos d'Edgar Morin sur la complexité / Youtube
- Management et communication : 100 exercices / Denis Cristol / ESF editeur

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-2	✓	·	·	·	·
• TPN4	✓	·	·	·	·
• TPN-6	✓	·	·	·	·

Manager : Anouk GREVIN

Period in company

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *Note*

Manager : Jean-Claude LE CLAIRE

Physical education and sport 1

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				2

Evaluation

One evaluation : *Contrôle continu*

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	·	✓	·	·	·
• TPN-2	·	✓	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-5	·	✓	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-7	✓	·	·	·	·
• TPN-12	✓	·	·	·	·
• TPN-19	✓	·	·	·	·

Manager : Jérôme BEZIER

Physical education and sport 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				2

Evaluation

One evaluation : *Contrôle continu*

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	·	✓	·	·	·
• TPN-2	·	✓	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-5	·	✓	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-7	✓	·	·	·	·
• TPN-12	✓	·	·	·	·
• TPN-19	✓	·	·	·	·

Manager : Jérôme BEZIER

Physical education and sport 3

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				2

Evaluation

One evaluation : *Contrôle continu*

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	·	✓	·	·	·
• TPN-2	·	✓	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-5	·	✓	·	·	·

Manager : Jérôme BEZIER

Physical education and sport 4

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				2

Evaluation

One evaluation : *Contrôle continu*

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	·	✓	·	·	·
• TPN-2	·	✓	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-5	·	✓	·	·	·

Manager : Jérôme BEZIER

Physics of semiconductor devices

Hours

Lect	Tut	PW	Proj	WP	Asst
6.25	6				6

Evaluation

One evaluation : *Exam*

Outline

1-Basis of solid state physics
2-Study of the PN junction diode: linear and switching modeling
3-Study of transistors: linear and switching fine modeling

Goals

Starting from the simplified study of semiconductors, this course aims to make the link between the origins of the physical phenomena and the practical aspect useful for electronicians (equivalent diagrams, Spice models). The diode is discussed in its linear operation and switching. These studies are then transposed to the analysis of operation of transistors in general.

Bibliography

MATHIEU H.- Physique des semiconducteurs et des composants électroniques. Masson, 1991
LEFEBVRE S. & MISEREY F.- Composants à semiconducteurs pour l'électronique de puissance. Lavoisier, 2004
SZE S.M.- Physics of semiconductor devices. John Wiley and sons, 1981

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understanding the principle of operation of the semiconductor diode	✓	·	·	·	·
• Knowing to deduct equivalent diagram of components used in analog electronics	✓	·	·	·	·
• Knowing to deduct the operation of electronic components in linear and switching modes	✓	·	·	·	·

Manager : Rémy MOREAU

Power converter design

Hours

Lect	Tut	PW	Proj	WP	Asst
			20		16

Evaluation

One evaluation : *Projet*

Manager : Issam SALHI

Power electronics 7

Hours

Lect	Tut	PW	Proj	WP	Asst
15	11.25	8			15

Evaluation

3 evaluations :

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

Outline

1. Introduction to power electronics
    1.1. Characteristics of semiconductor components
    1.2. Functions of the power electronics
2. Signals in power electronics
3. rectifiers
    3.1. Single Phase (unordered and ordered)
    3.2. Phase rectifiers (unordered and ordered)
3. dimmers
    3.1. single phase dimmer
    3.2. phase dimmers

Goals

The course objective is to 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 are interested in the study of steady powered by AC mains converters: rectifiers and dimmers

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, secon edition

Prerequisites

Circuit
Analysis

Learning outcomes

Learning outcomes	N	A	M	E	O
• Analyze the operation of static power electronic converter AC-DC and AC-AC	·	·	✓	·	·
• Consider a static power electronic converter AC-DC and AC-AC	·	·	·	✓	·
• Sizing an electronic static power converter AC-DC and AC-AC	·	·	✓	·	·
• Study the impact of the energy converter of the supply network	✓	·	·	·	·
• Change the topology of a converter according to the application	·	·	✓	·	·
• Propose and study new converter topologies	✓	·	·	·	·

Manager : Mohamed-Fouad BENKHORIS

Power electronics 8

Hours

Lect	Tut	PW	Proj	WP	Asst
15	12	8			12

Evaluation

3 evaluations :

- *Exam 1*
- *Exam 2*
- *TP*

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

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

Learning outcomes

Learning outcomes	N	A	M	E	O
• Analyser de fonctionnement d'un convertisseur statique d'électronique de puissance DC-DC et DC-AC	·	·	✓	·	·
• Etudier un convertisseurs statique d'électronique de puissance DC-DC et DC-AC	·	·	·	✓	·
• Dimensionner un convertisseur statique DC-DC et DC-AC	·	·	✓	·	·
• Choisir la topologie d'un convertisseur d'un convertisseur en fonction de l'application	·	✓	·	·	·
• Proposer et étudier de nouvelles topologies de convertisseurs	✓	·	·	·	·
• Proposer une technique de commande d'un convertisseur DC-AC en fonction d'un cahier des charges	·	✓	·	·	·

Manager : Mohamed-Fouad BENKHORIS

Probability and Statistics

Hours

Lect	Tut	PW	Proj	WP	Asst
16.25	17.5				16

Evaluation

2 evaluations :

- *Examen 1*
- *Examen 2*

Outline

1. Basic fundamentals
   2. random variables
   3. Specific probability distributions
   4. Association of random variables
   5. Law of large numbers
   6. Descriptive Statistics
   7. Sampling, estimation
   8. Hypothesis testing

Goals

The class Probalitity - Statistics presents the fundamental concepts (random variables, probability distributions) and the use that is made of in Statistics (estimation, hypothesis testing). It is part of a cultural knowledge and prepare to the non-deterministic approach encountered in various disciplines such as the humanities and cybernetics.

Bibliography

- Ventsel H : Théorie des probabilités, MIR 1973
- Droesbeke J.-J. : Eléments de Statistique, Université de Bruxelles / Ellipses, 2nd édition 1992
- Fourastié J., Laslier J.-F. : Probabilité et Statistique, Dunod 1987
- Papoulis A. : Probability, Random Variables, and Stochastic Processes, McGRaw-Hill, 3rd edition 1991

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing how to transcribe a non-deterministic problem from any context in the probabilistic language	·	·	✓	·	·
• Knowing how to estimate and interpret parameters from observation of statistical populations	·	·	✓	·	·
• Knowing the fundamental bases of Statistics	·	·	✓	·	·

Manager : Michel CARDELLI

Professional English 3

Hours

Lect	Tut	PW	Proj	WP	Asst
	19	2			

Evaluation

3 evaluations :

- *CC*
- *Tutorat*
- *DS*

Professional Project 3

Hours

Lect	Tut	PW	Proj	WP	Asst
	12				5

Evaluation

One evaluation : *Note synthèse + oral*

Outline

Path : 4 sessions of 3h TD

1 / Portfolio "Exploration Project Professional" : my "professionnel journey" those last years - changes - choices - motivations...

2 / My professionnal project : what I intended, the way to go, anticipate steps (especially the choice of option at the end of the fourth year)

3 and 4 / I introduce myself, my skills, my project : simulations and role plays

Goals

Clarify the professional project and be able to present it orally in different circumstances (professional network meetings, hiring individual or collective interview , student lounge, video resume, ..)

Bibliography

"Le Carnet de Route universitaire et professionnel" - SUIO de l'Université de Nantes - 2008

Prerequisites

Professionnal project 1 (S5)

Discovery of firms and professions (S6)

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-2	✓	·	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-5	✓	·	·	·	·
• TPN-6	✓	·	·	·	·
• TPN-7	✓	·	·	·	·

Manager : Sylvaine GAUTIER

Professional project 4

Hours

Lect	Tut	PW	Proj	WP	Asst
	12				2

Evaluation

One evaluation : *Pas d'évaluation*

Bibliography

Ressources : Évolueront selon les thématiques choisies par les intervenants - en lien avec les TPN et les objectifs de ce module.

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-2	✓	·	·	·	·
• TPN-3	✓	·	·	·	·
• TPN-5	✓	·	·	·	·
• TPN-6	✓	·	·	·	·
• TPN-7	✓	·	·	·	·

Manager : Sylvaine GAUTIER

Professionnal project 1

Hours

Lect	Tut	PW	Proj	WP	Asst
1.5	16.5				4.5

Evaluation

One evaluation : *Contrôle continu*

Bibliography

- DE LASSUS René, L'analyse transactionnelle : une méthode révolutionnaire pour bien se connaître et mieux communiquer, Marabout (Savoir pratique n3516), 2013, 288 p., ISBN 2501085493

- DE LASSUS René, La communication efficace par la PNL, Marabout (Bien-être - Psy), 2019, 288 p., ISBN 2501089499

- DE LASSUS René, L'ennéagramme : les 9 types de personnalités, Marabout (Poche Psy n3568), 2019, 288 p., ISBN 2501084950

- DE MONICAULT Frédéric / RAVARD Olivier, 100 questions posées à l'entretien d'embauche, Jeunes Editions (Guides J), 2004 (3e édition), 182 p., ISBN-10 : 2844724221 / ISBN-13 : 978-2844724229

- LEONARD Thomas J., The portable coach, Simon & SCHUSTER, 1999, 336 p., ISBN-10 : 0684850419 / ISBN-13 : 9780684850412

- ROSENBERG Marshall B., Les mots sont des fenêtres (ou bien ce sont des murs) : initiation à la communication non-violente, La Découverte, 2016, 320 p., ISBN 2707188794

- www.16personalities.com

- www.acnv.com

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-2	·	✓	·	·	·
• TPN-6	·	✓	·	·	·

Manager : Sylvaine GAUTIER

Professionnal project 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	6				6

Evaluation

One evaluation : *Profil linkedin+rdv*

Bibliography

Grant : Givers & Takers TED

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-2	·	·	✓	·	·
• TPN-6	·	✓	·	·	·
• TPN-7	·	✓	·	·	·

Manager : John KINGSTON

Project

Hours

Lect	Tut	PW	Proj	WP	Asst
			104		60

Evaluation

One evaluation : *Projet*

Manager : David DELFIEU

Project management 1

Hours

Lect	Tut	PW	Proj	WP	Asst
4.5		3			2

Evaluation

One evaluation : *Vidéo*

Bibliography

- HEAGNEY, Joseph. Fundamentals of project management. Amacom, 2016
- BOURGEOIS, Jean-Paul. Gestion de projet. Ed. Techniques Ingénieur, 1997
- MARSHALL B. ROSENBERG Communication Non-Violente et Pouvoir - Les clés d'un langage instaurant adhésion et confiance, ISBN-13 : 978-2729620851.

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-2	·	✓	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-5	✓	·	·	·	·
• TPN-7	✓	·	·	·	·

Manager : John KINGSTON

Project management 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	15				3

Evaluation

One evaluation : *Contrôle continu*

Bibliography

Partie analyse du travail : PIERRE VERMERSCH, 1994 « L'entretien d'explicitation », ESF éditeur

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-2	·	✓	·	·	·
• TPN-3	·	✓	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-5	·	✓	·	·	·

Manager : John KINGSTON

Quality, security and environmental approaches (QSE1)

Hours

Lect	Tut	PW	Proj	WP	Asst
	4.5	3			

Evaluation

One evaluation : *QCM+exercices*

Bibliography

Ressources documentaires disponibles sur madoc :

o Le Code du travail numérique

o Code de l'environnement LEGIFRANCE

o Les aventures de Napo vidéos d'animation INRS pour sensibilisation à la sécurité au travail

o Publications et outils de l'INRS Institut national de recherche et de sécurité

o AIDA : Site web des textes réglementaires du Ministère en charge de l'environnement

o Les fiches sur le fonctionnement des principales institutions de la République, l'organisation de l'Union européenne et les relations internationales

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-3	·	✓	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-5	✓	·	·	·	·

Manager : John KINGSTON

Quality, security ant environmental approaches (QSE2)

Hours

Lect	Tut	PW	Proj	WP	Asst
	7.5				

Evaluation

One evaluation : *QCM+exercices*

Bibliography

Références ou ressources documentaires disponibles sur madoc :

- Les fiches sur le fonctionnement des principales institutions de la République, l'organisation de l'Union européenne et les relations internationales
- Publications et outils de l'INRS Institut national de recherche et de sécurité
- Rapports détaillés des accidents industriels sur la base de donnée ARIA
- Outils MARP de Techniques de l'Ingénieur.

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-3	·	✓	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-5	✓	·	·	·	·

Manager : John KINGSTON

Reliability and safety requirement

Hours

Lect	Tut	PW	Proj	WP	Asst
12	1				6

Evaluation

One evaluation : *Examen*

Outline

1. Modelling of the equipment : definition of the parameters (failure rate, MTTR - mean time to repair), modelling and quantification of the ageing, as well as the laws of behavior of Reliability and Availability.

2. Modelling of the system: faults tree (system of production) and events tree (sequential system and safety système) - analysis and quantification.

Goals

The Dependability is an indispensable tool for the engineer today to analyze, model, estimate and quantify an equipment as well as a system.

The objective is to bring the student to conceptualize an equipment and a system and to model the not functioning by the consideration of the failures by using the fundamental tools of this discipline.

Bibliography

Documents de cours et d'exercices

rappel des normes en vigueur concernant la Sûreté de Fonctionnement.

Prerequisites

Mathematics of the engineer: calculations of statistics and probability

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understanding the concepts of the reliability, failure and degradation of the equipment, and the effects on the system	·	·	✓	·	·
• Calculating the parameters of an equipment from experience feedback and the associated probability as Reliability and Availability	·	·	✓	·	·
• Using and choosing the good model of representation of the system to extract the synthetic results (critical failures) from it, and to calculate the probabilities	·	·	✓	·	·

Manager : David DELFIEU

Research S7

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

2 evaluations :

- *Validé ou non validé*
- *Evaluation*

Manager : Bruno AUVITY

Research S8

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Validé ou non validé*

Manager : Bruno AUVITY

Second foreign language - Chinese

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - Chinese

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - German

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - German

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - Japanese

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - Japanese

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - Sign language

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - Spanish

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - Spanish

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Seminar

Hours

Lect	Tut	PW	Proj	WP	Asst
6					

Goals

Lectures on embedded network, and electrical machines control

Manager : David DELFIEU

Sensors and signal conditioning

Hours

Lect	Tut	PW	Proj	WP	Asst
10	3.5				7

Evaluation

2 evaluations :

- *examen Capteurs*
- *ex. conditionneurs*

Outline

1. Introduction
   2 Channels of measures
   Metrological characteristics
   Conditioners of passive sensors
   Signal conditioners
   Reduction of electromagnetic interference
   3 Sensors
   Measurement of electrical and magnetic quantities
   Measurement of mechanical quantities
   Temperature measurement

Goals

Educate students to the measuring chains quantities used in electrical engineering.

Analyse the problems related to the amplification and the transport of weak signals in the presence of common mode. Present instrumentation and isolation amplifiers.

Introduce, compare, and model the sensors used in the field of electrical engineering.

Bibliography

Asch G. ; Les capteurs en instrumentation industrielle ; Dunod, 1998, 5e édition

F. CHAUVET, Filtrage antiparasite dans les circuits éléctronique, Techniques de l'ingénieur, E 3580, 1999.

T. WILLIAMS, Compatibilité Électromagnétique - de la conception à la modélisation, Publitronic/Eltektor-Paris, mars 1999, ISBN 2-86661-106-3.

ANALOG DEVICES ; Designers Reference Manual ; 1999

Prerequisites

Analog electronics

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the main metrological characteristics	✓	·	·	·	·
• Know the passive conditioners of sensors and signals	·	✓	·	·	·
• Evaluate the accuracy of the bridges and the analogue amplifiers	·	✓	·	·	·
• Know and operate the main families of sensors used in electrical engineering	·	·	✓	·	·
• Evaluate the performance of a digital speed measurement	·	✓	·	·	·

Manager : Luc LORON

Signals

Hours

Lect	Tut	PW	Proj	WP	Asst
5	7.25				6

Evaluation

One evaluation : *Examen*

Manager : Mohamed MACHMOUM

Socio-economic debates

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				10

Evaluation

One evaluation : *Exposé débat*

Bibliography

De nombreuses références seront proposées dans chacun des 6 thèmes (liens vidéos, articles et livres) ; quelques livres de base peuvent cependant servir à tous les thèmes :

- BRAQUET Laurent et MOUREY David, Comprendre les fondamentaux de l'économie, De Boeck, 2015, 475 p., ISBN 978-2-8041-9021-7
- BIASUTTI Jean-Pierre et BRAQUET Laurent, Les débats économiques d'aujourd'hui, Ellipses, 2019, 278p, ISBN 9782340-031210
- DESCAMPS Christian, L'analyse économique en questions, Vuibert, 2005, ISBN 2-71117-7413-9
- SINAÏ Agnès, Penser la décroissance, Sciences Po Les presses, 2018, 210 p, ISBN 9782724613001
- SINAÏ Agnès, Economie de l'après-croissance, Sciences Po Les presses, 2018, ISBN 9782724617559
- PIKETTY Thomas, Capital et idéologie, Seuil, 2019, ISBN 978-2-02-133804-1
- COHEN Daniel, Le monde est clos et le désir infini, Albin Michel, 2015, ISBN 978-2226240293

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-3	✓	·	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-1	·	✓	·	·	·
• TPN-2	·	✓	·	·	·
• TPN-3	·	✓	·	·	·
• TPN-8	✓	·	·	·	·
• TPN-9	✓	·	·	·	·
• TPN-10	·	✓	·	·	·
• TPN-11	✓	·	·	·	·

Manager : Chrystèle GONCALVES

Soft skills

Hours

Lect	Tut	PW	Proj	WP	Asst
	7.5				

Evaluation

One evaluation : *Examen:cas pratique*

Bibliography

- La confiance en gestion : un regard pluridisciplinaire (Boissieu & Oguchi, 2011)
- Trust Rules: How the World's Best Managers Create Great Places to Work (Lee, 2017)
- Give and Take: A Revolutionary Approach to Success (Grant, 2013)
- L'entreprise une affaire de don (Collectif, 2016)
- La théorie des jeux - Science étonnante
- Jeu sur l'évolution de la confiance
- The Office (NBC, 2005)
- Mad Men (HBO, 2007)

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-1	✓	·	·	·	·
• TPN-2	✓	·	·	·	·
• TPN-4	✓	·	·	·	·
• TPN-6	✓	·	·	·	·
• TPN-5	✓	·	·	·	·
• TPN-6	✓	·	·	·	·
• TPN-7	✓	·	·	·	·
• TPN-12	✓	·	·	·	·
• TPN-13	✓	·	·	·	·
• TPN-20	✓	·	·	·	·
• TPN-21	✓	·	·	·	·

Manager : Roland BESSENAY

Speciality activity report

Hours

Lect	Tut	PW	Proj	WP	Asst
					20

Evaluation

One evaluation : *Rapport*

Manager : Rémy MOREAU

State space control

Hours

Lect	Tut	PW	Proj	WP	Asst
15	17.5	12			25

Evaluation

3 evaluations :

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

Outline

1. Introduction
   2 Reminders of matrix calculation
   3 State space representation
   4 System response and stability
   5 Stabilization and state feedback control
   Commandability
   State feedback control
   6 State reconstruction
   Observability
   State observer
   Observer and state feedback association
   7 Two-parameter implementation

Goals

Introduce the modeling and control of linear systems by the state-space representation. Introduce the concepts of commandability and observability. The aim of the course is to achieve an continuous-time control based on a state estimation (by a state observer) and implemented in two-parameter form.

Bibliography

Larminat , P., " Automatique : commande des systèmes linéaires", 2e édition, Hermès, 1996

Gille , J.-C., "Systèmes linéaires, équations d'état", 2e éd, Eyrolles, 1990 .

Toscano , R., "Commande et diagnostic des systèmes dynamiques : modélisation, analyse, commande par PID et par retour d'état, diagnostic", Ellipses , 2011.

Prerequisites

Modelling and control of linear systems by the classical approach: Laplace transform, transfer function, PID control

Learning outcomes

Learning outcomes	N	A	M	E	O
• Write the state space representation of a linear system	·	·	✓	·	·
• Tune a state feedback control by pole placement	·	·	✓	·	·
• Build and tune a state observer	·	·	✓	·	·
• Define a two-parameter controller	·	·	✓	·	·

Manager : Luc LORON

Stochastic processes

Hours

Lect	Tut	PW	Proj	WP	Asst
10	11.5				12

Evaluation

One evaluation : *Examen*

Outline

Continuous stochastic processes (SP) :
- Elementary théorie of SP
- Stationnary stochastic processes
- Remarkable SP.

Discrete stochastic processes :
- Poisson process
- Markov chain

Goals

Make students aware to the problems of random signals (stochastic processes). Give them the tools to model these stochastic processes. See the behavior of the stochastic processes through linear filters.

Bibliography

Hélène Ventsel : Théorie des probabilités, Ed. Mir, 1973.

Athanasios Papoulis : Probability, Random Variables, and Stochastic Processes, McGraw-Hill, 3rd edition, 1991.

Alan Ruegg : Processus stochastiques, ED. Presses Polytechniques et universitaires romandes.

Prerequisites

1. Probability and statistics
2. Signals and Systems

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing how to model the stochastic process	·	·	✓	·	·
• Knowing how the stationary random processes are deformed through linear filters	·	·	✓	·	·
• Knowing how to model the remarkable stochastic processes.	✓	·	·	·	·
• Knowing how to model the Poisson process	·	·	✓	·	·
• Knowing how to model the Markov chain	·	·	✓	·	·

Manager : Mourad AIT-AHMED

Sustainable development and social responsability 1

Hours

Lect	Tut	PW	Proj	WP	Asst
		6			

Evaluation

One evaluation : *Pas d'évaluation*

Bibliography

- Travaux du GIEC
- Global carbon project

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-3	✓	·	·	·	·

Manager : Laurence CHARPENTIER

Sustainable development and social responsability 2

Hours

Lect	Tut	PW	Proj	WP	Asst
1.5	9				10

Evaluation

One evaluation : *Rapport+soutenance*

Bibliography

- Travaux du GIEC
- Global carbon project

Learning outcomes

Learning outcomes	N	A	M	E	O
• TPN-3	·	✓	·	·	·
• TPN-5	·	✓	·	·	·

Manager : Laurence CHARPENTIER

Systems

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	7.25				7

Evaluation

One evaluation : *Examen*

Outline

Introduction

1. Transfert function and block diagram algebra
2. Basic liner systems: 1st and 2sd order
3. Graphical representation: Bode and Nyquist diagram
4. Linear continuous system stability

Goals

To transmit to the students the mastery of basic concepts concerning temporal and frequency representations of linear systems. Beyond a mathematical representation, reduced to a minimum, the students will be able to apply these concepts to different examples from electrical circuits (RLC networks), mechanical systems (mass-spring), electromechanical systems, as well as elementary physical systems (hydraulics, thermics, etc.).

Bibliography

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

- M. Rivoire, J.L Ferrier, J. Groleau, « Cours d'automatique : Régulation, commande analogique (tome2) », Editions Eyrolles.

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

- J.P Caron, J.P Hautier, P.J Barre, « Systèmes automatiques : problèmes corrigés , applications industrielles, tome 3 », ISBN 2-7298-6780-5 , Edition Ellipses.

- C. Sueur, P. Vanheeghe, P. Borne, « Automatique des systèmes continus » , Editions TECHNIP.

Prerequisites

Mathematical course: complex numbers, differential equations

Signals and complex analysis courses: Laplace transform

Learning outcomes

Learning outcomes	N	A	M	E	O
• Modeling (transfer function,differential equation)	·	·	✓	·	·
• Analysis of linear systems : temporal response	·	·	✓	·	·
• Analysis of linear systems: frequencyl response	·	·	✓	·	·

Manager : Nadia AIT-AHMED

Systèmes du GE

Hours

Lect	Tut	PW	Proj	WP	Asst
			21		10

Evaluation

One evaluation : *Projet*

Training for Toeic

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Training for Toeic

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Training period 3

Hours

Lect	Tut	PW	Proj	WP	Asst
				17	

Evaluation

One evaluation : *Note*

Outline

During this internship the student must perform the activities of the engineer. The goal is to put the student in a situation, through a topic whose the technical content must allow him to demonstrate his knowledge but also his qualities as an engineer, i.e. initiative, creativity, communication. The topic must be approved by the company and the school. The intership period is 4 to 6 months. The intership runs from the beginning of February and the end of August. During the internship, the student writes a report which is checked by the supervisor before sending to school. Furthermore, an oral is required. It takes place at school and allows the student to present his work to a jury composed of members of the company and the school. These assess the work and behavior of the student.

Goals

The purpose of this final internship is to complete the training received by the student in the Electrical Engineering department.

Manager : Jean-Claude LE CLAIRE