Teaching program

ETN

Academic year 2025-2026

Ecole polytechnique de Nantes Université

December 4, 2025

Contents

Part I

Tables of teaching units

Semester 5 - unit *ETN 3*

Basis of electronic S5 — ECTS : 10

Manager : EL ASSAD Safwan

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Algorithmic and C language	5	9	21			1.5	15	*0.25*
• Basis of electronic	6.25	10.5	9			1.5	10	*0.25*
• Digital Electronic	5	18	27			2.5	20	*0.3*
• Tutored Project				30		2	20	*0.2*
TOTAL	16.25	37.5	57	30	0	7.5	65	

Physics S5 — ECTS : 6

Manager : GOULLET Antoine

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Basics of free and guided propagation	5	7.5	3			1.5	8	*0.2*
• Electromagnetism	7.5	6				1.5	12	*0.2*
• Physics of semiconductors and components	7.5	18	9			2.5	15	*0.6*
TOTAL	20	31.5	12	0	0	5.5	35	

Humanities S5 — ECTS : 6

Course		Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Business knowledge and entrepreneurship		1.5	13.5					4	*0.15*
• Project management 1		4.5	7.5					2	*0.15*
• Physical education and sport 1			21					2	*0.2*
• Job search strategy and techniques		1.5	9					6	*0.15*
• English grammar for engineers			22.5						*0.175*
• Business communication			21.5						*0.175*
▷ VIP : english and french as a foreign language				15					*0*
TOTAL	min	7.5	95	0	0	0	0	14	
	max	7.5	95	15	0	0	0	14	

Mathematics S5 — ECTS : 6

Manager : WANG Yide

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Complex analysis	6.25	9				1.5	8	*0.2*
• Analysis and approximation	8.75	15				1.5	10	*0.4*
• Basic mathematics for engineers	11.25	9				2.5		*0.4*
TOTAL	26.25	33	0	0	0	5.5	18	

Common core education program ECTS : 2

Manager : GADOIN Émilie

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Sustainability issues	10.5	7.5	1.5					*1*
TOTAL	10.5	7.5	1.5	0	0	0	0	

Sum of semester

		Lect	Tut	PW	Proj	WP	Exa	Asst	ECT$
Sum	min	80.5	204.5	70.5	30	0	18.5	132	30
	max	80.5	204.5	85.5	30	0	18.5	132	
Face-to-face sum		404 à 419							

Semester 6 - unit *ETN 3*

Analog electronic technologies S6 — ECTS : 4

Manager : GOURET Vincent

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Electrical energy	5	9	12			1.5	10	*0.3*
• Electronic functions	7.5	12	21			1.5	20	*0.7*
TOTAL	12.5	21	33	0	0	3	30	

Signals and electronic systems S6 — ECTS : 7

Manager : CHARGE Pascal

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Control engineering	3.75	4.5	3			1	6	*0.1*
• Numerical methodes	3.75	4.5	15			1.5	10	*0.25*
• Probabilities, Statistiques	10	13.5				1.5	10	*0.25*
• Deterministic signals ans linear systems	11.25	13.5	13.75			1.5	15	*0.4*
TOTAL	28.75	36	31.75	0	0	5.5	41	

Humanities S6 — ECTS : 6

Course		Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Serious game			10.5	12				10	*0.2*
• Physical education and sport 2			21					2	*0.2*
• Economy and controversy mapping			27					10	*0.25*
• Preparing the TOEIC			19.5						*0.15*
• Presenting and debating			19.5						*0.15*
• Tutorials				2					*0.05*
▷ VIP : english and french as a foreign language				15					*0*
TOTAL	min	0	97.5	14	0	0	0	22	
	max	0	97.5	29	0	0	0	22	

Computer technologies S6 — ECTS : 7

Manager : PILLEMENT Sébastien

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Microprocessors	7.5	13.5	27			2	10	*0.6*
• Computer systems	7.5	7.5	24			1.5	15	*0.4*
TOTAL	15	21	51	0	0	3.5	25	

Internship 3A — ECTS : 5

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Internship 3rd year					8			*1*
TOTAL	0	0	0	0	8	0	0	

Common core education education program — ECTS : 1

Manager : GADOIN Émilie

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Sustainability tools S6	6	9						*1*
TOTAL	6	9	0	0	0	0	0	

Sum of semester

		Lect	Tut	PW	Proj	WP	Exa	Asst	ECTS
Sum	min	62.25	184.5	129.75	0	8	12	118	30
	max	62.25	184.5	144.75	0	8	12	118	
Face-to-face sum		388.5 à 403.5							

Semester 7 - unit *ETN 4*

Humanities S7 — ECTS : 6

Course		Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Organizational analysis		4.5	6					3	*0.15*
• Physical education and sport 3			21					2	*0.1*
• Negotiation		3	7.5					2	*0.1*
• Communication and Professional Relationships			12					4.5	*0.1*
• Circular economy		4.5	3					6	*0.1*
• Becoming a professional			19						*0.3*
• Tutorials				2					*0.05*
• Responsible management 1			4.5					3	*0.1*
0 à 1 ▷ Modern language 2			18						*0.15*
0 à 1 ▷ Preparing the TOEIC			18						*0.15*
0 à 1 ▷ French as a foreign language			18						*0.15*
TOTAL	min	12	73	2	0	0	0	20.5	
	max	12	91	2	0	0	0	20.5	

Electronic and information processing S7 — ECTS : 9

Manager : DIOURIS Jean-François

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Electromagnetic compatibility		6				1.5	8	*0.1*
• Electronic midrange	12.5	19.5	27			3	30	*0.4*
• Microelectronics	2.5	12	9			1.5	10	*0.2*
• Random signal processing		12	9			1.5	10	*0.2*
• Optimisation		6	12			1.5		*0.1*
TOTAL	15	55.5	57	0	0	9	58	

Computer circuits and systems S7 — ECTS : 9

Manager : LE NOURS Sébastien

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Digital circuit design	3.75	16.5	18			1.5	15	*0.3*
• Object Oriented Programming	0.75	9	21			1.5	15	*0.3*
• Microprocessor systems	2.5	16.5	21			1.5	20	*0.4*
TOTAL	7	42	60	0	0	4.5	50	

System Engineering S7 — ECTS : 4

Manager : MAHÉ Yann

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Transdisciplinary project I				30			50	*1*
• Tools for Transdisciplinary project	24							*0*
TOTAL	24	0	0	30	0	0	50	

interspecialty S7 ECTS : 2

Manager : MARCHAL Luc

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
1 opt ▷ Entrepreneurship S7				36				*1*
1 opt ▷ Great Event S7				36				*1*
1 opt ▷ Research S7				36				*1*
1 opt ▷ Transitions S7				36				*1*
1 opt ▷ Sustainable building instrumented model S7				36				*1*
1 opt ▷ Electric assistance intermediate vehicle S7				36				*1*
1 opt ▷ Ecodesign of a Data Center S7				36				*1*
TOTAL	0	0	0	36	0	0	0	

Sum of semester

		Lect	Tut	PW	Proj	WP	Exa	Asst	ECTS
Sum	min	58	170.5	119	66	0	13.5	178.5	30
	max	58	188.5	119	66	0	13.5	178.5	
Face-to-face sum		427 à 445							

Semester 8 - unit *ETN 4*

Networks and multimedia S8 — ECTS : 3

Manager : BOUZID Salah eddine

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Databases	0.75	1.5	9				4	*0.3*
• Computer networks	2.5	7.5	12			1.5	10	*0.3*
• Multimedia signals	5	3	13.5			1.5	12	*0.4*
TOTAL	8.25	12	34.5	0	0	3	26	

System engineering S8 — ECTS : 5

Manager : MAHÉ Yann

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Transdisciplinary project II				50			50	*1*
TOTAL	0	0	0	50	0	0	50	

Humanities S8 — ECTS : 4

Manager : KINGSTON John

Course		Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• A critical perspective on business			9					3	*0.2*
• Responsible management 2			3					1	*0.05*
• Physical education and sport 4			19.5					2	*0.2*
• Recruitment Pitch			15					5	*0.2*
• Intercultural exploration : understanding differences			18						*0.35*
0 à 1 ▷ Modern language 2			18						*0.15*
0 à 1 ▷ Achieving TOEIC			18						*0.15*
0 à 1 ▷ French as a foreign language			18						*0.15*
TOTAL	min	0	64.5	0	0	0	0	11	
	max	0	82.5	0	0	0	0	11	

Telecommunication systems S8 — ECTS : 3

Manager : RAZBAN HAGHIGHI Tchanguiz

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Digital communications - foundations and techniques	6.25	10.5	12			1.5	15	*0.5*
• HF electronic	7.5	10.5	15			1.5	15	*0.5*
TOTAL	13.75	21	27	0	0	3	30	

Embedded systems S8 — ECTS : 4

Manager : PASQUIER Olivier

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Real time system design	3.75	13.5				1.5	8	*0.4*
• Real time operating systems	3.75	6	9			1.5	10	*0.3*
• SOpC : FPGA design and programming	3.75	3	9				8	*0.3*
TOTAL	11.25	22.5	18	0	0	3	26	

Internship 4A — ECTS : 10

Manager : MAHÉ Yann

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• S-8 Intership 4th year					13			*1*
TOTAL	0	0	0	0	13	0	0	

interspecialty S8 — ECTS : 1

Manager : MARCHAL Luc

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Ecological transition for sustainable development 2		9						*0.25*
1 opt ▷ Entrepreneurship S8				28				*0.75*
1 opt ▷ Great Event S8				28				*0.75*
1 opt ▷ Research S8				28				*0.75*
1 opt ▷ Transitions S8				28				*0.75*
1 opt ▷ Sustainable building instrumented model S8				28				*0.75*
1 opt ▷ Electric assistance intermediate vehicle S8				28				*0.75*
▷ Ecodesign of a Data Center S8				28				*0.75*
TOTAL	0	9	0	28	0	0	0	

Sum of semester

		Lect	Tut	PW	Proj	WP	Exa	Asst	ECTS
Sum	min	33.25	129	79.5	78	13	9	143	30
	max	33.25	147	79.5	78	13	9	143	
Face-to-face sum		328.75 à 346.75							

Semester 9 - unit *SCM 5*

Engineering project S9 ECTS : 13

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Engineering project				120				*1*
TOTAL	0	0	0	120	0	0	0	

SCM Option S9 ECTS : 14

Manager : DIOURIS Jean-François

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• C1 : RF systems	30		15	9			20	*0.216*
• S9-C2: Radar	7.5		3				10	*0.071*
• C3 : Digital Radio Architectures	6		9				15	*0.072*
• C4 : Design of electronic device	3		9				6	*0.071*
• C5 : Implementation of analog functions	9						5	*0.07*
• C6 : Telecom systems engineering	9		6				10	*0.072*
• CME5 : Conférences	15							*0.07*
• CME3: Artificial Intelligence for Embedded Systems	6		6				5	*0.071*
• CME1: IoT architecture	10.5		15				15	*0.144*
• CME4 : Frugal AI - Models optimization for sustainable computing	3		9				12	*0.071*
• CME2 : Security	6		9				10	*0.072*
TOTAL	105	0	81	9	0	0	108	

Humanities S9 ECTS : 3

Course		Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Supporting change			13.5					3	*3.5*
• Project management 2		1.5	15					3	*3*
• People management			10.5					6	*3*
• Skills day			8					2	*0.5*
▷ Achieving TOEIC			18						*0*
TOTAL	min	1.5	47	0	0	0	0	14	
	max	1.5	65	0	0	0	0	14	

Sum of semester

		Lect	Tut	PW	Proj	WP	Exa	Asst	ECTS
Sum	min	106.5	47	81	129	0	0	122	30
	max	106.5	65	81	129	0	0	122	
Face-to-face sum		363.5 à 381.5							

Semester 9 - unit *SETR 5*

Engineering project S9 — ECTS : 13

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Engineering project				120				*1*
TOTAL	0	0	0	120	0	0	0	

SETR Option S9 — ECTS : 14

Manager : PASQUIER Olivier

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• CME5 : Conférences	15							*0.07*
• CME3: Artificial Intelligence for Embedded Systems	6		6				5	*0.071*
• E1 : Embedded system design	6	16					10	*0.073*
• E2 : SoC design	2	15	9				15	*0.142*
• E3 : Hardware coprocessor for AI	3		9				8	*0.07*
• E4 : Embedded softwares	9		18				15	*0.143*
• CME1: IoT architecture	10.5		15				15	*0.144*
• ME2 : Hardware description languages, reuse and integration	3		12				10	*0.072*
• CME4 : Frugal AI - Models optimization for sustainable computing	3		9				12	*0.071*
• ME1: Real-time systems	4.5	1.5	9				5	*0.072*
• CME2 : Security	6		9				10	*0.072*
TOTAL	68	32.5	96	0	0	0	105	

Humanities S9 — ECTS : 3

Course		Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Supporting change			13.5					3	*3.5*
• Project management 2		1.5	15					3	*3*
• People management			10.5					6	*3*
• Skills day			8					2	*0.5*
▷ Achieving TOEIC			18						*0*
TOTAL	min	1.5	47	0	0	0	0	14	
	max	1.5	65	0	0	0	0	14	

Sum of semester

		Lect	Tut	PW	Proj	WP	Exa	Asst	ECT$
Sum	min	69.5	79.5	96	120	0	0	119	30
	max	69.5	97.5	96	120	0	0	119	
Face-to-face sum		365 à 383							

Semester 9 - unit *SMTR 5*

Engineering project S9 ECTS : 13

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Engineering project				120				*1*
TOTAL	0	0	0	120	0	0	0	

SMTR Option S9 ECTS : 14

Manager : SAADANE Abdelhakim

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• CME5 : Conférences	15							*0.07*
• CME3: Artificial Intelligence for Embedded Systems	6		6				5	*0.071*
• CME1: IoT architecture	10.5		15				15	*0.144*
• M1 : Internet and multimedia	3		9				10	*0.07*
• M2 : Multimedia standards and services	15		12				15	*0.144*
• M3 : RISC-V programming and modelisation	3		9				10	*0.07*
• M4 : Parallel programming on multicore CPUs	3	3	12				7	*0.072*
• M5 : Deep Learning with GPUs	3		14.5			0.5	8	*0.072*
• ME2 : Hardware description languages, reuse and integration	3		12				10	*0.072*
• CME4 : Frugal AI - Models optimization for sustainable computing	3		9				12	*0.071*
• ME1: Real-time systems	4.5	1.5	9				5	*0.072*
• CME2 : Security	6		9				10	*0.072*
TOTAL	75	4.5	116.5	0	0	0.5	107	

Humanities S9 ECTS : 3

Course		Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Supporting change			13.5					3	*3.5*
• Project management 2		1.5	15					3	*3*
• People management			10.5					6	*3*
• Skills day			8					2	*0.5*
▷ Achieving TOEIC			18						*0*
TOTAL	min	1.5	47	0	0	0	0	14	
	max	1.5	65	0	0	0	0	14	

Sum of semester

		Lect	Tut	PW	Proj	WP	Exa	Asst	ECT$
Sum	min	76.5	51.5	116.5	120	0	0.5	121	30
	max	76.5	69.5	116.5	120	0	0.5	121	
Face-to-face sum		365 à 383							

Semester 10 - unit *ETN 5*

end of study internship ECTS : 30

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	*Coef*
• Final project					22			*1*
TOTAL	0	0	0	0	22	0	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Exa	Asst	ECTS
Sum	0	0	0	0	22	0	0	30
Face-to-face sum								

Part II

Sheets of courses

A critical perspective on business

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	9					3

Evaluation

One evaluation : *Rapport Gpe*

Manager : Gwenael THOREL

Achieving TOEIC

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	18					

Evaluation

One evaluation : *DS*

Bibliography

Newcombe, H. McDonald Bertail, C. Pass the TOEIC® Test. First Press ELT

Manager : Carole CHAUSSE

Achieving TOEIC

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	18					

Evaluation

One evaluation : *DS*

Bibliography

- Grant Trew, Tactics for Toeic , Oxford
- Lin Lougheed,600 essential words, Barron's
- Lin Lougheed, Méthode complète pour le Toeic 6eme edition, Pearson France
- Renald Rilcy, Achieve Toeic, Cengage Learning
- Kaplan Prep Plus 2019-2020 Tests 2 et 3

Manager : Carole CHAUSSE

Algorithmic and C language

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
5	9	21			1.5	15

Evaluation

3 evaluations :

- *Devoir surveillé*
- *Rapport groupe*
- *Rapport individuel*

Outline

1. Algorithms
2. Programming bases
3. C language, advanced concepts
4. Advanced data structures

Goals

This course presents the foundation of algorithms and C language. It covers the essential bases for problem solving and explains how to code a design using a structural programming language.

Bibliography

Thomas H.Cormen , Charles E.Leiserson , Ronald L. Rivest et Clifford Stein ;
Introduction à l'algorithmique ; Dunod, 2002, 1146 p.
Rémy Malgouyres ; Initiation à l'algorithmique et aux structures de données en C ,Dunod, 2011
Claude Delannoy ; Programmer en langage C ; Eyrolles, 2009, 267 p.

Prerequisites

none

Learning outcomes

Learning outcomes	N	A	M	E	O
• Definition of the concepts related to structural programming: iterative and conditional structures, function calling	·	·	✓	·	·
• Knowladge of C language	·	·	✓	·	·
• Definition of the major concepts of algorithms and advanced structures: dynamic tables, hash tables, linked lists, binary trees	·	·	✓	·	·
• algorithm design and its implementation in C language	·	·	✓	·	·

Analysis and approximation

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
8.75	15				1.5	10

Evaluation

2 evaluations :

- *Rapport individuel*
- *Devoir surveillé*

Outline

The study of the Fourier series development, the Fourier transform, the Laplace transform and the convolution product are in the heart of this course. The latter begins with studying different convergences of sequences or series of functions. Then, normed vectorial spaces and of Hilbert are detailed, in order to define the notions of norm and scalar product. The development of T-periodic function in Fourier series is described for different types of functions. Last, the convolution and the Fourier and Laplace transforms are detailed.

Goals

The main objective of this course is to acquire the knowledge of Fourier series development of periodic functions, and of the calculation of the convolution product and of the (direct and inverse) Fourier and Laplace transforms of real functions. All these notions are necessary for various courses to follow, such as signal processing, physics, optimization, analogue electronics and telecommunications.

Bibliography

P. Bénichou, R. Bénichou, N. Boy, J.-P. Pouget, Séries de Fourier - Transformation de Laplace, Ellipses, 1995

H. Lacombe, Analyse fonctionnelle, Masson

M. Samuelides, L. Touzillier, Analyse harmonique, Cépaduès-éditions, 1990

Prerequisites

Fundamental mathematics for engineers (limits, continuity, integrals)

Complex analysis

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing how to use different types of convergences of sequences and series of functions	·	✓	·	·	·
• Recognizing and knowing how to use different norms and scalar products	·	✓	·	·	·
• Knowing how to develop periodic functions in Fourier series	·	·	✓	·	·
• Calculating the convolution product of two function and knowing its relation with the Fourier transform	·	·	✓	·	·
• Knowing how to calculate direct and inverse Fourier transforms	·	·	✓	·	·
• Knowing how to calculate direct and inverse Laplace transforms, and their applications to the resolution of differential equations	·	·	✓	·	·

Manager : Pascal CHARGE

Basic mathematics for engineers

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
11.25	9				2.5	

Evaluation

2 evaluations :

- *Devoir surveillé 1*
- *Devoir surveillé 2*

Outline

1. Function of a single real variable: limits, continuity, derivative, Taylor's series expansion, integral and differential equations.

2. Function of several variables: Function at 2, 3 and more variables, partial derivatives, Taylor's series expansion, curvilinear integral and double integral.

4. Matrix calculations: Addition, product, determinant, inversion, eigen values and eigen vectors, diagonalization.

Goals

According to the level of the students, first course allows them to either upgrade or recall basic concepts of a real function of one variable and several variables. The curvilinear integral, double are also taught. The last chapter is dedicated to the manipulation of matrices.

Prerequisites

Notion of functions of a single variable: continuity, derivative, Taylor's series expansion, differential equation of the first and second orders, integral.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Derivative of usual functions, product functions and composite functions of a single variable.	·	·	✓	·	·
• Calculate the integral of the usual functions and of a rational function. Control the change of variable, integration by parts.	·	·	✓	·	·
• Solve a linear differential equation of the first and second orders.	·	·	✓	·	·
• Multiply two matrices, invert a matrix, compute the eigenvectors and eigenvalues??, solving a linear system.	·	·	✓	·	·

Manager : Yide WANG

Basics of free and guided propagation

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
5	7.5	3			1.5	8

Evaluation

One evaluation : *Devoir surveillé*

Outline

1. Introduction
   2. Free-space propagation / in an homogeneous and infinite medium
   3. Continuity conditions at the interfaces between two media
   4. Reflection of a plane wave on a planar conductor in normal incidence angle
   5. Reflection of a plane wave on a planar conductor in oblique incident angle
   6. Reflection/ refraction of a plane wave at the interfac between two dielectrics
   7. Equation and Scatter diagram
   8. General method used forf waveguides study
   9. Loss Analysis in metallic waveguides

Goals

Explain :
- the issue of the frequency increase,
- how a signal can be propagated in a guiding structure (conditions),
- what is a propagation mode,
- which modes can propagate inside a homogeneous cross section plane closed waveguide and how they could be characterized ((TE, TM, TEM classification, order 's mode, electric and magnetic fields maps, dispersion diagram)

Bibliography

André DUBOST : "Propagation libre et guidée des ondes électromagnétiques. Applications", MASSON
Paul COMBES : "Micro-ondes", DUNOD, 1997, tomes 1 et 2, ISBN 2100027530
Marc HELIER : "Techniques Micro-ondes", ELLIPSES, 2001, Collection Supélec, ISBN 2729804978

Prerequisites

Mathematics, Electromagnetism

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand the issue of the frequency increase	✓	·	·	·	·
• Explain how a signal can be propagated in a guiding structure (conditions)	·	✓	·	·	·
• Explain what is a propagation mode	·	✓	·	·	·
• Precise which modes can propagate in a specific waveguide and their description (TE, TM, TEM classification, n-order modes, electric and magnetic fields maps, dispersion diagram)	·	✓	·	·	·

Manager : Anne CHOUSSEAUD

Basis of electronic

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
6.25	10.5	9			1.5	10

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport Groupe*

Outline

1- Kirchhoff circuits
2- Continuous current approximations, high frequencies
3- Major theorems and extensions
4- Diodes and Operational Amplifiers, applications
5- Bipolar transistors and Field effect transistors.

Goals

To enable students to perform the analysis of a simple electronic circuit whatever the running mode. Reminders and supplements about Kirchhoff circuits are presented.

Analysis tools are developed and illustrated. Lab classes focus on electronics basic measurements (oscilloscope, measurement error)

Bibliography

Théorie des réseaux de Kirchhoff, Boite & Neirynck - Thérie des réseaux et systèmes linéaires, M. Feldmann - Cours d'électronique (AOP et composants actifs, 4 tomes), M. Girard

Prerequisites

Basic electrocinetics (RLC circuits for sinusoidal mode).

Complex calculus.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the Kirchhoff's laws. Applying them for basic circuits.	·	·	✓	·	·
• Measurement methods using an oscilloscope (gain/phase, voltage/duration).	·	·	✓	·	·
• Analysis of a basic circuit under any operating mode.	·	✓	·	·	·
• Using a circuit simulator.	·	✓	·	·	·

Manager : Vincent GOURET

Becoming a professional

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	19					

Evaluation

2 evaluations :

- *Situation Ind*
- *DS*

Bibliography

UNCLOUD => Pedagogie Partagée => Ressources accessibles vacataires => 4eme année => S1 4A => Livret "POLYPRO - Becoming a professional" -

Manager : Carole CHAUSSE

Business communication

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	21.5					

Evaluation

2 evaluations :

- *Situation Gpe*
- *DS*

Manager : Pascale SIMON LLOBREGAT

Business knowledge and entrepreneurship

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
1.5	13.5					4

Evaluation

One evaluation : *Situation Ind.*

Bibliography

- Les fonctions de l'entreprise / Pierre Baranger (Vuibert)
- Management et économie des entreprises / Gilles Dressy (sirey)
- Structure d'une organisation / xerfi canal https://www.youtube.com/watch?v=twVz2QhRyKw
- L'orga, l'entreprise et .../ xerfi canal https://www.youtube.com/watch?v=24rY9YfeADU

Manager : Gwenael THOREL

C1 : RF systems

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
30		15	9			20

Evaluation

3 evaluations :

- *Rapport groupe*
- *Situation Gpe*
- *Devoir surveillé*

Outline

1. Introduction and context
2. High frequency and optical telecommunication technologies
3. Passive circuits
4. Active circuits
5. High-frequency measurements
6. Introduction to antennas
7. MEMS, MOEMS and sensors
8. Antenna theory
9. Antenna arrays
10. Main antennas (wire antennas, horn, paraboles, printed)
11. Practice (CAD and measurements in anechoic chamber)

Goals

Know main high frequency architectures and circuits, their advantages and their drawback. Know design procedures of passive and active circuits. Know to use them in HF design softwares (HP ADS, IE3D, MOMENTUM, Microwave Studio, HFSS).

Know how to design a sensor for an application and using a speci c technology. Know how to design an antenna. Know how to use antenna softwares (IE3D, HFSS, Microwave Studio). Know how to measure an antenna in anechoic chamber.

Bibliography

1) Paul Combes ; Micro-ondes ; Masson, 1995
2) Villegas ; Radio-communications num riques ; Masson, 2003
3) Henry Mathieu ; Physique des semiconducteurs et composants lectroniques ; Masson, 2004.
4) G. Asch ; Les capteurs en instrumentation industrielle ; Dunod, 1999
5) Salvador Mir ; Dispositifs et physique des microsyst mes sur silicium ; Herm s, 2002
6) Eyraud Grange, Ohanessian ; Th orie et technique des antennes ; Vuibert
7) Nhu Bui Hai ; Antennes Micro-ondes ; Dunod
8) Leo Thourel ; Les antennes ; Masson
9) PAul Combes ; Micro-ondes - Tome 2 ; Masson, 1995

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the main architectures of high frequency front-ends devices	·	✓	·	·	·
• Know to specify high frequency elements of a transmission system	·	✓	·	·	·
• Know the existing technologies	·	✓	·	·	·
• Know design procedures of passive and active circuits	·	✓	·	·	·
• Know to use an HF design softwares (HP ADS, IE3D, MOMENTUM, Microwave Studio, HFSS)	·	✓	·	·	·
• Know the manufactoring technologies, properties and applications of microsystems and sensors	✓	·	·	·	·
• Know how to design an antenna	·	✓	·	·	·
• Know how to use antenna softwares (IE3D, HFSS, Microwave Studio)	·	·	✓	·	·
• Know how to measure an antenna in anechoic chamber	·	✓	·	·	·

Manager : Tchanguiz RAZBAN HAGHIGHI

C3 : Digital Radio Architectures

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
6		9				15

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport groupe*

Outline

1. Optimum receivers
   . Representation of modulated signals in the Hilbert space
   . Maximum-Likelihood coherent receiver for digital modulations
   . Performance of digital communications systems (BER, spectrale efficiency...)
2. Multipath channels
3. Equalization
4. Spread spectrum signals and techniques : CDMA
5. OFDM and associated techniques

Goals

This teaching is a complement of the digital communication unit given at semester 8 ETN. The aim is to provide advanced principles and techniques of the nowadays telecommunication systems.

Bibliography

J.G. PROAKIS, "Digital Communications", McGraw-Hill, 4th edition, 2001.
M. RICE, "Digital Communications: A Discrete-Time Approach", Pearson Prentice-Hall, 2009.
S. BENEDETTO and E. BIGLIERI, "Principles of Digital Transmission, with wireless applications", Kluwer academic/Plenum Publishers, 1999

Prerequisites

Random signals
Basis of digital communications : Information theory
Digital communications

Learning outcomes

Learning outcomes	N	A	M	E	O
• To understand the theory of maximum-likelihood optimum receivers for memoryless modulation	·	·	✓	·	·
• To evaluate theoretical performance of digital modulation in terms of BER and spectral efficiency	·	✓	·	·	·
• To understand equalization requirments, principle and common techniques	·	·	✓	·	·
• To know CDMA and OFDM techniques and their applications	·	✓	·	·	·

Manager : Pascal CHARGE

C4 : Design of electronic device

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3		9				6

Evaluation

One evaluation : *Rapport groupe*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the different sources of autonomous energy	·	·	·	✓	·
• Know the principles of the energy consumption of a circuit and techniques to reduce its consumption	·	·	✓	·	·
• Know the energy optimization techniques of microcontroller-based systems.	·	·	·	✓	·
• Know the energy efficiency of the main standards of short and long distance radio communication	·	·	✓	·	·
• Know how to optimize the energy consumed by a radio link to transmit information	·	·	✓	·	·

Manager : Jean-François DIOURIS

C5 : Implementation of analog functions

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
9						5

Evaluation

One evaluation : *Devoir surveillé*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the different sources of autonomous energy	·	·	·	✓	·
• Know the principles of the energy consumption of a circuit and techniques to reduce its consumption	·	·	✓	·	·
• Know the energy optimization techniques of microcontroller-based systems.	·	·	·	✓	·
• Know the energy efficiency of the main standards of short and long distance radio communication	·	·	✓	·	·
• Know how to optimize the energy consumed by a radio link to transmit information	·	·	✓	·	·

Manager : Jean-François DIOURIS

C6 : Telecom systems engineering

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
9		6				10

Evaluation

One evaluation : *Rapport groupe*

Outline

First part: network architecture (E. Motta Cruz)
1) Introduction to mobile networks
2) Cellular network planning
3) Technical evolutions
4) Quality of service

Second part: Cellular network engineering
5) Radio and transmission engineering
6) Cellular network design and planning
7) Cellular network design and planning project

Goals

The first objective is to provide to the students fundamental knowledge on cellular communication systems based on GSM, UMTS and LET norms with the point of view of the operator and field technicians. The second objective is to learn the engineering rules for the transport and radio access using simulation tools.

Bibliography

Les réseaux DSC et GSM - X. LAGRANGE - Dunod

Les faisceaux hertziens analogiques et numériques - E. FERNANDEZ - CENET/ENST

GSM Networks : Protocols, Terminologie and implementation - G. HEINE - Artech House

GSM, GPRS and EDGE performance - T. HALONNEN et al. - Wiley

GPRS, Gateway to third Generation Mobile Networks - G. HEINE et al - Arthech House

EDGE for Mobile Internet - E. SEURRE - Artech House

UMTS, réseaux mobiles de 3ème génération - H. HOLMA et al - Osman Eyrolles

Prerequisites

Radio, digital communications

Learning outcomes

Learning outcomes	N	A	M	E	O
• To know the bases of a cellular network	·	·	✓	·	·
• To plan and to design a cellular network	·	✓	·	·	·

Manager : Jean-François DIOURIS

CME1: IoT architecture

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
10.5		15				15

Evaluation

One evaluation : *Devoir surveillé*

Outline

? IOT system architecture
  ? IOT specific computer architecture
  ? Power management

Goals

Manage the full organization of an IOT System from the cloud to the endpoint node. Manage the power consumption of the latter, both for computing data and for wireless data transmission. Implementation of a full IOT system.

Prerequisites

? Wireless data transmission
  ? Microprocessor

Learning outcomes

Learning outcomes	N	A	M	E	O
• Organization and implementation of an IOT system	·	·	✓	·	·
• Power management of data computing	·	·	✓	·	·
• Power management of wireless data transmission	·	✓	·	·	·

Manager : Olivier PASQUIER

CME2 : Security

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
6		9				10

Evaluation

One evaluation : *Devoir surveillé*

Presentation

Security

Outline

- Course:
  - o Introduction
  - o Security services using cryptography
  - o Cryptography
  - o Secure boot and certificates
  - o Attacks and countermeasures
  - o Threat modeling
  - o Developing secure firmware
  - o Regulation
  - - Hands-on sessions (TP)
  - o Exploitation of vulnerabilities voluntarily introduced in embedded software
  - o Implement robust software to resist to various physical attacks

Goals

This course is designed to equip students with a comprehensive understanding of the critical role security plays in electronic devices. It addresses the identification and characterization of security assets along with their associated properties, namely confidentiality, integrity, and availability. The course explores foundational cryptographic techniques, including symmetric and asymmetric encryption algorithms, hash functions, and post-quantum cryptographic approaches. Students will examine various categories of security vulnerabilities, encompassing both physical threats (e.g., timing attacks, side-channel analysis, fault injection) and logical threats (e.g., buffer overflow). The course further introduces systematic threat modeling methodologies to enable the design of effective countermeasures. Students will develop practical skills in the implementation and rigorous evaluation of secure firmware. Finally, the module provides an introductory overview of key European regulatory frameworks governing device security.

Bibliography

- Menezes, Alfred J., Jonathan Katz, Paul C. van Oorschot, and Scott A. Vanstone. 2018. Handbook of Applied Cryptography. London, England: CRC Press.

- Paar, Christof, Jan Pelzl, and Tim Güneysu. 2024. Understanding Cryptography: From Established Symmetric and Asymmetric Ciphers to Post-Quantum Algorithms. Springer.

- Woudenberg, Jasper van, and Colin O'Flynn. 2021. The Hardware Hacking Handbook: Breaking Embedded Security with Hardware Attacks. San Francisco, CA: No Starch Press.

- Erickson, Jon. 2007. Hacking: The Art of Exploitation, 2nd Edition: The Art of Exploitation. San Francisco, CA: No Starch Press.

Prerequisites

- Math knowledge for cryptography
  - Python programming, C programming

Learning outcomes

Learning outcomes	N	A	M	E	O
• ? Identify security assets and related risks in electronic systems	✓	·	·	·	·
• ? Select and apply cryptographic algorithms ensuring security properties	✓	·	·	·	·
• ? Analyze vulnerabilities and implement effective countermeasures	·	✓	·	·	·
• ? Understand how to develop secure firmware compliant with best practices and regulations.	✓	·	·	·	·

Manager : Salah eddine BOUZID

CME3: Artificial Intelligence for Embedded Systems

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
6		6				5

Evaluation

One evaluation : *Devoir surveillé*

Presentation

Artificial Intelligence for Embedded Systems

Outline

- Course:
  - o Introduction to artificial intelligence and machine learning
  - ? Generalities and fields of application
  - ? Impacts
  - - Future of jobs
  - - Critical thinking and cognitive impacts of generative AI
  - ? What machine learning is
  - ? Importance of data
  - o Understanding concepts and getting intuitions from linear regression
  - ? Univariate linear regression
  - ? Gradient descent and its challenges
  - ? Multivariate linear regression
  - ? Data preparation
  - ? Polynomial regression, under-fitting, over-fitting
  - o Traditional machine learning algorithms
  - - Supervised learning
  - - Logistic Regression
  - - Support Vector Machine
  - - Decision Trees
  - ? K-Nearest Neighbors
  - ? Ensemble Learning
  - ? Unsupervised Learning
  - ? Clustering with K-Means
  - ? Anomaly Detection with multi-variate Gaussian distribution
  - o Neural networks
  - ? Multi-layer perceptron, convolution neural network, auto-encoder, recurrent neural network
  - ? Training and its challenge
  - o Running a machine learning project
  - o Challenge with deep learning
  - o Data mining and ethics
  - ? European privacy law
  - ? Anonymization and re-identification
  - - Hands-on sessions (TP)
  - o Train a very basic neural network to understand how it ?learns? from data
  - o Train different neural networks (multi-layer perceptron, convolution neural network, auto-encoder) with TensorFlow to understand the concepts of underfit/overfit, the confusion matrix.

Goals

- Understand what machine learning is
- Understand how a machine can learn from data and how to prepare the data
- Understand how supervised and unsupervised algorithms can be used for regression, classification, and anomaly detection
- Understand the different stages of a machine learning project
- Be aware of the ethical aspects of data privacy
- Be able to train different neural networks

Bibliography

- I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning. MIT Press, 2016.
Available online: http://www.deeplearningbook.org/
- A. Géron, Hands-on machine learning with Scikit-Learn and TensorFlow?: concepts, tools, and techniques to build intelligent systems, 3rd edition. Sebastopol, CA: O'Reilly Media, 2022.
- R. S. Sutton and A. G. Barto, Introduction to Reinforcement Learning, 2nd edition nearly finalized. Cambridge, MA, USA: MIT Press, 2018.

Prerequisites

- Mathematical knowledge for machine learning (linear algebra, probability and statistics)
- Python programming

Learning outcomes

Learning outcomes	N	A	M	E	O
• ? Use and training of a neural network	·	✓	·	·	·
• ? Use of linear regression in AI	·	✓	·	·	·
• ? Learning algorithms	·	✓	·	·	·
• ? Ethics and AI	✓	·	·	·	·

Manager : Olivier PASQUIER

CME4 : Frugal AI - Models optimization for sustainable computing

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3		9				12

Evaluation

One evaluation : *Devoir surveillé*

Presentation

Frugal AI - Models optimization for sustainable computing

Outline

1. Introduction
   2. AI for resource-constrained systems
   3. Quantization
   4. Pruning
   5. Hardware acceleration
   6. Deployment of AI models
   7. Challenges, Outlook, and Conclusion

Goals

? Identify hardware and software constraints of embedded AI systems.
   ? Understand optimization techniques to reduce resource usage.
   ? Explore frameworks for deploying lightweight AI models.
   ? Design AI solutions adapted to resource-limited environments.

Bibliography

? David B. Kirk and Wen-mei W. Hwu. Programming Massively Parallel Processors: A Hands-on Approach (1st. ed.). Morgan Kaufmann Publishers Inc., San Francisco, CA, USA. 2010

? T. Hoefler, D. Alistarh, T. Ben-Nun, N. Dryden, et A. Peste, « Sparsity in Deep Learning: Pruning and growth for efficient inference and training in neural networks »

? Enderich, Lukas. Pruning and quantization for efficient deep neural networks. 2022.

? Embedded Artificial Intelligence: Real-Life Applications and Case Studies. N.p.: CRC Press, 2025.

Prerequisites

? Basic knowledge in machine learning and optimization.
   ? Programming skills (Python recommended).
   ? Familiarity with embedded systems and hardware constraints.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Identify and address the main challenges of hardware-software integration	·	·	✓	·	·
• Optimize machine learning models	·	·	✓	·	·
• Evaluate the trade-offs between model accuracy and computational cost	·	·	✓	·	·

Manager : Salah eddine BOUZID

CME5 : Conférences

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
15						

Evaluation

One evaluation : *Devoir surveillé*

Outline

5 conferences. Each conference as a duration of 3 hours and is on a specific subject

Goals

Obtain a basic knowledge on different hot topics

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowledge on few hot topic	✓	·	·	·	·

Manager : Olivier PASQUIER

Circular economy

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
4.5	3					6

Evaluation

One evaluation : *Rapport groupe*

Bibliography

- Thierry Le Moigne, L'économie circulaire, Stratégie pour un monde durable, 2018
- Vincent Aurez, Laurent Georgeault, Economie circulaire : système économique et finitude des ressources, 2019
- Manuel de la grande transition, Collectif FORTES, oct 2020

Manager : Chrystèle GONCALVES

Communication and Professional Relationships

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	12					4.5

Evaluation

One evaluation : *Situation Ind*

Bibliography

- Livret fourni

- DE LASSUS René, L'analyse transactionnelle : une méthode révolutionnaire pour bien se connaître et mieux communiquer, Marabout (Savoir pratique n°3516), 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 n°3568), 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

- GOLEMAN Daniel, L'intelligence émotionnelle - Intégrale (Analyser et contrôles ses émotions, et ceux des autres), 2014 , 925 p.,Editions J'ai lu

- www.16personalities.com

- www.acnv.comFormat APA (Auteur, A. A. (année). Titre en italique. Éditeur), au moins 2 références

Manager : Sylvaine GAUTIER

Complex analysis

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
6.25	9				1.5	8

Evaluation

One evaluation : *Devoir surveillé*

Outline

Short recall of the complex numbers
Holomorphic and harmonic functions
Integration in the complex plane
Cauchy's integral theorem
Laurent series expansion
Residue theorem
Calculation of real integrals using the residue theorem.

Goals

This course is an important branch of applied mathematics fo engineers in electronics an telecommunications. Many subjects taught in the ETN department use the concepts and tools of complex analysis. It aims to provide students with an essential foundation in the analysis of complex valued functions of complex variables.

Bibliography

Polycopié du cours;
Kurt ARBENZ et Alfred WOHLHAUSER: Variable Complexe, Presse Polytechniques Romandes;
Michel BALABANE, Marie DUFLO, Marc FRISCH, Dominique GUEGAN: Sommes, fonctions de variables complexe. Maths en kit 4, Vuibert Université
Jean-François PABION: Eléments d'Analyse Complexe, Licence de mathématiques, Ellipses
Murray R. SPIEGEL: Variables Complexes, cours et problèmes, Série Schuman

Prerequisites

Basic analysis
Complex number
Algebra

Learning outcomes

Learning outcomes	N	A	M	E	O
• Correctly and efficiently manipulate operations on complex numbers	·	·	✓	·	·
• Know whether a complex-valued function of a complex variable is differentiable, its properties and the relationship between holomorphic functions and harmonic functions	·	·	✓	·	·
• Know how calculate the integral in the complex plane	·	·	✓	·	·
• Use the residue theorem and Cauchy's integral theorem to perform real integrals, including the Fourier transform	·	✓	·	·	·

Manager : Yide WANG

Computer networks

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
2.5	7.5	12			1.5	10

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Mise en situation*

Outline

1. Network Fundamentals: Introduction to key network concepts
2. Protocols and Standardization: Exploration of functional layers in the OSI and TCP/IP models
3. The Physical Layer
4. The Data Link Layer: Focus on media access and Ethernet technology
5. The Network Layer: IPv4, subnetting and masking techniques, static routing, and the ARP protocol
6. The Transport Layer: Comparison and applications of TCP and UDP protocols

Goals

? Gain a solid understanding of main network protocols: ARP, ICMP, UDP, TCP, DHCP, HTTP, and DNS
? Explore the principles of broadcasting, encapsulation, and fragmentation
? Study subnet design and master IP addressing, both static and dynamic
? Analyze and simulate data transfer within networks
? Apply core concepts of network programming in Linux systems
? Use the socket API in C to develop interactive client/server applications

Bibliography

- "Réseaux", Andrew Tanenbaum, Ed. Pearson
- "Les réseaux", Pujolle Guy, Ed. Eyrolles.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand the operation of computer networks and protocols of the Internet system.	·	·	✓	·	·
• Know how to program in C language applications communicating through "socket" functions.	·	✓	·	·	·

Manager : Salah eddine BOUZID

Computer systems

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
7.5	7.5	24			1.5	15

Evaluation

3 evaluations :

- *Devoir surveillé*
- *Rapport groupe 1*
- *Rapport groupe 2*

Outline

1. Evolution of computer systems and their functions
2. A session in UNIX environment
3. Edition, compilation, program execution
4. Communication between users, use of standard I/O
5. Operating system functions - "system calls"
6. Development of system level applications
7. File subsystems
8. I/O subsystem and asynchronous operations
9. Generation of processes
10. Communication between processes
11. IPC mechanisms
12. Programming for multiprocessing with multiple "threads"

Goals

In this module we examine the main functions of a professional operating system LINUX/UNIX. We study how to use UNIX commands and utilities and how to program applications based on the operating system. For this purpose we use the C language This language is the basis of all programming at system level.

Bibliography

textes de TP, TD, cours - livre

Prerequisites

C language programming skills.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand the functions of an operating system.	·	·	✓	·	·
• Know how to use the UNIX operating system.	·	✓	·	·	·
• Know how to program simple applications.	·	·	✓	·	·

Manager : Salah eddine BOUZID

Control engineering

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3.75	4.5	3			1	6

Evaluation

One evaluation : *Devoir surveillé*

Outline

1. Linear controlled systems in the continuous time domain
2. Design of digital controllers
3. Controlled systems in the descrete time domain
4. Design of descrete time controllers

Goals

The aim is to introduce basis of linear control theory and control engineering, in the continuous and discrete time domain.

Bibliography

Y. GRANJON, "Automatique : Systèmes linéaires, non linéaires, à temps continu, à temps discret, représentation d'état", Dunod, Paris, 2e édition, 2010.

B. PRADIN, "Automatique continue", Cours INSA Toulouse, 2009.

J-F. DIOURIS, "Systèmes asservis", Cours ETN, Polytech'Nantes, 2010.

Prerequisites

Deterministic signals, Linear systems, Laplace transform, Z-transform

Learning outcomes

Learning outcomes	N	A	M	E	O
• To understand and to known basis of the linear control theory (stability and accuracy of feedback control devices...)	·	·	✓	·	·
• To know how to design the most common controllers using classical control theory (i.e. PID controllers)	·	✓	·	·	·
• To know how to map a simple controller into the descrete time domain	·	✓	·	·	·

Manager : Pascal CHARGE

Databases

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
0.75	1.5	9				4

Evaluation

One evaluation : *Rapport*

Outline

Introduction
- UML modelling
- The relational model
- Normalization
- Relational algebra
- SQL
- JDBC

Goals

This course is an introduction to relational databases, from UML modelling to its SQL implementation.

Bibliography

Bases de données de la modélisation au SQL, Laurent Audibert, Ellipses UML 2 pour les bases de données, Christian Soutou et Frédéric Brouard, Eyrolles

Prerequisites

JAVA language for section JDBC

Learning outcomes

Learning outcomes	N	A	M	E	O
• UML modelling	·	·	✓	·	·
• Database design	·	·	✓	·	·
• Knowledge of SQL language	·	·	✓	·	·

Deterministic signals ans linear systems

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
11.25	13.5	13.75			1.5	15

Evaluation

3 evaluations :

- *Devoir surveillé 1*
- *Rapport groupe*
- *Devoir surveillé 2*

Outline

1. Continuous Signals: Basic signals, Frequency Representation, Fourier and Laplace Transforms
2. Sampling and Discretization: Sampling with a pulse train, Reconstruction with a zero order hold, Down-sampling effects, Quantization
3. Discrete Signals: Frequency Representation, Fourier Transform of discrete signals, Discrete Fourier Transform, Z Transform.
4. Characterization of Linear and Time-Invariant Systems
5. Linear Filtering: Analog Filter Design, FIR Filter Design and IIR Filter Design

Goals

Provide the basis for understanding a linear and time-invariant system: Acquisition, Filtering and Signal Reconstruction

Bibliography

1. P.S.R. Diniz, E.A.B DA Silva, S.L. Netto "Digital Signal Processing, System Analysis and Design", Editions Cambridge, 2010
2. M. Weeks "Digital Signal Processing using Matlab and Wavelets" Infinity Science Press LLC Massachsetts, 2007
3. Y.Thomas "Signaux et Systèmes Linéaires" Editions Masson, 1994

Prerequisites

Continuous signals and associated Transforms
Response of usual systems
Analog Filters: Butterworth, Chebyshev I and II, Cauer)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Specify the main operations of analog-to-digital and digital-to-analog conversions	·	·	✓	·	·
• Calculate and interpret the frequency representation of a discrete signal	·	·	·	✓	·
• Calculate the Laplace and Z Transforms	·	·	·	✓	·
• Use Z and Laplace transforms to characterize a linear and time-invariant system	·	·	·	✓	·
• Design and implement discrete filters	·	·	✓	·	·

Manager : Abdelhakim SAADANE

Digital Electronic

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
5	18	27			2.5	20

Evaluation

4 evaluations :

- *Rapport groupe MP*
- *Rapport groupe TP*
- *Devoir surveillé 2*
- *Devoir surveillé 1*

Outline

1) Binary number representation
2) Boole algebra
3) Logic equations representation and reduction
4) Combinational logic - Standard functions - Standard blocks based implementation - Look Up Table based implementation
5) Sequential logic - Sequential circuit definition - Sequential specific difficulties - Sequential circuit performances - The Moore/Mealy machine model - Flip-flops - Standard sequential functions - Specification model : the graphical finite state machine - Moore machine implementation techniques
6) VHDL basics
Model structure - Main VHDL data types - Coding basic examples - Moore machine models

Goals

Master the main numeric standard functions : de/coding, de/multiplexing, binary arithmetic, memorisation, counting. Master the modelisation and the implementation of any sequential function using the Moore machine structure. Be able to write synthesisable VHDL models for those functions.

Bibliography

Lang TRAN TIEN : Electronique numérique, Masson 1995
R. H. KATZ & G. BORRIELLO : Contemporary logic design, Prentice Hall 2005
J. F. WAKERLY : Digital design : Principles and practices, Prentice Hall 2005

Prerequisites

No particular pre-requisites. The course starts with the very basic concepts.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Be able to model any combinational function, and to propose an implementation based on standard functions	·	·	✓	·	·
• Be able to write a VHDL synthesisable model for any combinational function	·	·	✓	·	·
• Be able to model any sequential function, and to propose an implementation based on standard functions	·	·	✓	·	·
• Be able to write a VHDL synthesisable model for any sequential function	·	·	✓	·	·
• Be able to define a Moore machine model for any sequential function, and master its implementation	·	·	✓	·	·

Manager : Bastien DEVEAUTOUR

Digital circuit design

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3.75	16.5	18			1.5	15

Evaluation

3 evaluations :

- *DS 2*
- *Rapport Gpe*
- *DS 1*

Outline

Introduction to the design of embedded systems

1. Organization of logic resources in digital circuits
2. Methodology for design electronic circuits
3. Design flow of digital circuits
4. Technologies for fabrication of digital circuits
5. Use of a hardware description language

Goals

This module aims at putting into practice a methodology for designing digital circuits. This module is also concerned by the design of logic resources for complex sequential functions, the definition of main characteristics of circuits technologies and by the use of languages and tools for circuit design.

Bibliography

J.-P. Calvez, Spécification et conception des ASICs, Masson, 1993
D.J. Smith, HDL chip design, 2002
D.D. Gajsky, Principles of digital design, Prentice Hall, 1997
R.H. Katz, Contemporary logic design, 1994

Prerequisites

Digital electronic

Learning outcomes

Learning outcomes	N	A	M	E	O
• To apply a methodology for designing a circuit	·	✓	·	·	·
• - To master the design of sequential logic functions as a digital architectures with logic resources	·	·	✓	·	·
• To master steps and related tools for designing a circuit	·	·	✓	·	·
• To know principles related to hardware description languages	·	✓	·	·	·

Manager : Sébastien LE NOURS

Digital communications - foundations and techniques

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
6.25	10.5	12			1.5	15

Evaluation

3 evaluations :

- *Devoir surveillé 1*
- *Rapport groupe*
- *Devoir surveillé 2*

Outline

1) Information theory
- Information definition for a discrete source
- Source coding
- Continuous source information
- Channel capacity

2) Baseband digital communication
- Baseband codes, spectral occupancy
- Inter-symbol interference
- Error probability

3) Modulations
- Baseband representation of narrowband signals and systems
- Digital modulation definition
- Modulation performance: error probability, spectral efficiency, energy efficiency

4) Chanel coding
- Channel coding principle
- Code examples and performance

5) Implementation of digital communication techniques in communication standards
- Lora physical layer

Goals

- To know the information theory, source coding and channel capacity
- To choose a baseband code and determine its characteristics and performance
- To now (or to justify the choice) of a digital modulation et determine its characteristics and performance
- To understand the implementation of digital communication techniques in a communication standard

Bibliography

Michel Joindot, Alain Glavieux : « Introduction aux communications numériques », Dunod, 8/2

J. Proakis, « Digital communications », Mc Graw Hill, 2008

Prerequisites

Deterministic signal processing, random signal processing, probability.

Learning outcomes

Learning outcomes	N	A	M	E	O
• To know the information theory, source coding and channel capacity	·	✓	·	·	·
• To choose a baseband code and determine its characteristics and performance	·	·	✓	·	·
• To now (or to justify the choice) of a digital modulation et determine its characteristics and performance	·	·	✓	·	·
• To understand the implementation of digital communication techniques in a communication standard	·	·	✓	·	·

Manager : Pascal CHARGE

E1 : Embedded system design

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
6	16					10

Evaluation

One evaluation : *Rapport groupe*

Outline

This module is divided in two 15 hours parts:

The first one is mainly dedicated to theoritical aspects and gives informations about technology, hardware and software architecture in embedded system. It presents also basics informations about system reliability and safety design. This part also improve knowledge about sytem design (requirements, spécifications, functional design, detailed design and perfomances analysis) and briefly presents main methodologies for system design.

The second part improves system design skills using MCSE methodology by working on specific use cases (from requirements to solution detailed design).

Goals

The purpose of this module is to improve skills to design and realize digital embedded systems. It also improves knowledge of up-to-date technology used in embedded systems and gives basic skills for system safety and reliability.

Bibliography

J.P. Calvez, "Spécification et conception des systèmes: une méthodologie", Masson 1993,

J.P. Calvez, "Spécification et conception des systèmes: des études de cas", Masson 1993,

J.P. Meinadier, "Ingénierie et intégration des Systèmes", Hermes 1998

Prerequisites

- Multi-task systems.
- System design.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Design a système according to a system design methodology	·	·	·	✓	·
• Know basics about sytem safety and reliability	✓	·	·	·	·

Manager : Olivier PASQUIER

E2 : SoC design

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
2	15	9				15

Evaluation

One evaluation : *Rapport groupe*

Outline

1. Introduction
   2. Current trends in circuit design
   3. Design flow and tools
   4. Design dethodology
   5. Use of VHDL pour circuit synthesis
   6. Technologies for circuit implementation
   7. Design for test
   8. Design of operative units
   9. Conclusion

Goals

In this module students must achieve a good practise of a methodology for circuit design. This is done by the complete design of specific case studies. The course presents advanced notions related to the design of complex circuits.

Bibliography

J.P. Calvez, Spécification et conception des ASICs, Masson, 1993

M. Zwolinski, Digital Design with VHDL, Prentice-Hall, 2000

D. Gajski, Principles of Digital Design, Prentice-Hall, 1997

M. Keating, P. Bricaud, Reuse Methodology Manual for systems-on-a-chip designs, Kluwer Academic Publishers, 1998

Prerequisites

Digital electonic, circuit design

Learning outcomes

Learning outcomes	N	A	M	E	O
• To master the design of circuits at RT level, using VHDL	·	·	·	✓	·
• To master the process of design, validation and documentation of a medium complexity IP	·	·	·	✓	·
• To master the tool chain for circuit description, synthesis and simulation	·	·	·	✓	·
• To know main characteristics of current circuit technologies	✓	·	·	·	·

Manager : Sébastien LE NOURS

E3 : Hardware coprocessor for AI

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3		9				8

Evaluation

One evaluation : *rapport groupe*

Outline

1. Introduction
   2. Optimization of artificial intelligence algorithms
   3. Dedicated hardware architectures
   4. Overview of architecture design tools
   5. Conclusion

Goals

This module aims at describing main methods, models, languages, and tools for the process of hardware/software codesign.

Prerequisites

SoC design, Circuit design, microprocessor systems, object oriented programming

Learning outcomes

Learning outcomes	N	A	M	E	O
• To understand main optimization methods for artificial intelligence algorithms	·	·	✓	·	·
• To understand architectures of dedicated hardware accelerators	·	·	✓	·	·
• To develop a HW/SW architecture on FPGA	·	·	✓	·	·

Manager : Sébastien LE NOURS

E4 : Embedded softwares

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
9		18				15

Evaluation

One evaluation : *Rapport groupe*

Outline

1) The module firstly presents the constraints due to embedded architectures (energy consumption, size, computing power, ...)

2) The constraints on software development and some solutions to implement are introduced.

3) An introduction to the programmation on the Autosar automotive environment is presented.

4) The use of a micro Java virtual machine is studied.

5) All notions are used in a project in the form of practical work in the Android environment. The complete design flow is implemented for the realization of an embedded application running on a smartphone or a tablet.

Goals

The objective of this course is to understand the constraints of embedded software programming. In the form of courses and conferences advanced techniques for achieving applications for embedded systems on Linux, Java and AUTOSAR are presented. A tutorial illustrate the concepts covered by programming an application in Android.

Bibliography

Embedded Systems Handbook. R. Zurawski and all. Editions CRC Press. 2005

Handbook of Real-Time and Embedded Systems. I. Lee, J. Leung, S. Son. Editions Chapman & Hall/CRC. 2007.

Programmation Android, de la conception au déploiement avec le SDK Google Android, Damien Guignard, Julien Chable, Emmanuel Robles, Eyrolles, 2009.

Android Cookbook, Ian F. Darwin, O'Reilly Media, decembre 2011.

Prerequisites

Knowledge on Java programming and embedded hardware architectures.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Embedded softwre design	·	✓	·	·	·
• Embedded constraints knowledge	✓	·	·	·	·
• Android SDK	·	·	✓	·	·
• Knowledge of middleware and embedded software frameworks	✓	·	·	·	·

Manager : Olivier PASQUIER

Ecodesign of a Data Center S7

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			36			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Manager : Claudia MARINICA

Ecodesign of a Data Center S8

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			28			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Manager : Claudia MARINICA

Ecological transition for sustainable development 2

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	9					

Evaluation

One evaluation : *DS*

Manager : Émilie GADOIN

Economy and controversy mapping

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	27					10

Evaluation

One evaluation : *DS*

Bibliography

- Christine Dollo, Laurent Braquet, Economie, Sirey
- Grégory N. Mankiw, Mark P. Taylor, Principes de l'économie, DeBoeck, 2022.
- Bruno Latour, La science en actions : introduction à la sociologie des sciences, La découverte Poche, 2005.

Manager : Chrystèle GONCALVES

Electric assistance intermediate vehicle S7

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			36			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Définir son projet (cadrage, analyse système, objectifs)	·	·	✓	·	·
• Construire son environnement projet (ressources)	·	·	✓	·	·
• Elaborer une stratégies de réduction des impacts	·	·	✓	·	·
• Proposer un cahier des charges	·	·	✓	·	·

Manager : Christophe PAYEN

Electric assistance intermediate vehicle S8

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			28			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Learning outcomes

Learning outcomes	N	A	M	E	O
• Définir un cahier des charges	·	·	✓	·	·
• Concevoir un système et faire des choix techniques	·	·	✓	·	·
• Evaluer la réduction des impacts environnementaux	·	·	✓	·	·
• Valoriser ses résultats, faire le bilan des compétences acquises	·	·	✓	·	·

Manager : Christophe PAYEN

Electrical energy

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
5	9	12			1.5	10

Evaluation

2 evaluations :

- *Devoir Surveillé*
- *Rapport groupe*

Outline

- Tools: Average, RMS, Powers, harmonic
  - Single phase diode rectifier : Continuous and discontinuous conduction
  - Switched-mode power supply. Application to class D audio power amplifier

Goals

The objective is to understand the basic mechanisms of energy conversion and implement the tools necessary for the analysis of the phenomena encountered in modern electronic systems.

Bibliography

[1] Batard, C.; Poitiers, F., Millet C., Ginot, N : Chapter 3, 'Simulation of Power Converters using Matlab-Simulink', 26 pages, ouvrage 'Matlab - A fundamental tool for Scientific Computing and Engineering Applications - Volume 1', INTECH, ISBN 978-953-51-0750-7, Sept 2012

[2] Mohan, Undeland et Robbins,'Power Electronics : Converters, Applications and Design' - Wie Wiley

[3] J. Bonal, G. Séguier, 'Rappels d'électronique de puissance et d'automatique - Les variateurs de vitesse' Tech & doc - Prométhée

Prerequisites

- basic electronics

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the principles of electrical energy conversion	·	·	✓	·	·
• Knowing the main systems of power conversion	·	✓	·	·	·
• Knowing to analyse and synthesize an electrical energy conversion architecture	·	✓	·	·	·

Manager : Yann MAHÉ

Electromagnetic compatibility

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	6				1.5	8

Evaluation

One evaluation : *Devoir surveillé*

Outline

- Modeling of passive components
  - Electromagnetic radiation
  - Electromagnetic couplings
  - Filtering solutions, shielding and protection
  - Decoupling

Goals

Understand the basic mechanisms involved in the phenomena of CEM

Prerequisites

- Basics of electronics

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing the principles of EMC	✓	·	·	·	·
• Understand strategies to make electronic circuits and systems consistent with the standard EMC	✓	·	·	·	·

Manager : Yann MAHÉ

Electromagnetism

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
7.5	6				1.5	12

Evaluation

One evaluation : *Devoir surveillé*

Outline

We have 6 lecture sessions of 1h15 each. In addition to these sessions, you will have 5 self-study sessions to review the concepts covered in class or to explore others in greater depth, and 4 tutorial sessions to work on exercises and address any difficulties. You will work in groups that must include students from the different academic tracks leading to admission to Polytech (PeiP, IUT, CPGE).

General introduction and mathematical tools - 1 lecture + 1 tutorial
Origin of the electric field - 1 lecture + 1 self-study session + 1 tutorial
Study of the electric field - 1 lecture + 1 self-study session
Electrostatic potential - 1 lecture + 1 self-study session + 1 tutorial
Electrokinetics - 1 lecture + 1 self-study session
Conductors in electrostatic equilibrium, applications - 1 lecture + 1 self-study session + 1 tutorial

Goals

The course objectives are divided into two categories: physical objectives and mathematical objectives.

The physical objectives involve understanding certain effects caused by static or time-independent moving charges:

- Electric fields and electrostatic potential;
- Storage of electrostatic energy and capacitors;
- Electric current and energy considerations in ohmic conductors.

The mathematical objectives involve describing sources and their effects at two different scales (local and macroscopic), and transitioning between them:

- The notion of volumetric, surface, and linear (lineic) density (of charge or current);
- Scalar or vector integration of densities to obtain a macroscopic quantity (charge, current);
- Use of local laws through the gradient and divergence operators;
- Transition from Maxwell-Gauss's equation to Gauss's theorem using the Green-Ostrogradsky theorem;
- Difference between a local law and a macroscopic theorem;
- Application of Gauss's theorem in highly symmetric cases.

The main knowledge you must master to pass the course:

- The different scales of description (microscopic, mesoscopic, macroscopic);
- The notion of density as a sliding average at the mesoscopic scale of a quantity defined at the microscopic scale;
- Coulomb's force (the electric component of the Lorentz force) on a point charge;
- Curie's principle;
- The concept of field lines and field tubes;
- The local form of Maxwell-Gauss's equation;
- The relationship between potential and electric field (in both forms);
- Poisson's equation;
- The concept of a conductor in electrostatic equilibrium;
- The concept of capacitance of a conductor and a capacitor;
- The rules for combining capacitors;
- Gauss's theorem;

- The Drude model and its implications (local or integral form of Ohm's law, local or integral form of Joule's law).

Here is an (exhaustive) list of skills you may be assessed on:

- Use of vector operators (divergence, gradient) if the formulas are provided;
- Use of the superposition principle;
- Charge calculation via integration of a charge distribution (lineic, surface, or volumetric);
- Use of symmetries and invariances to determine the form (variable dependence and direction vector) of the electric field;
- Application of Gauss's theorem to a standard geometry;
- Voltage calculation from the electric field;
- Capacitance calculation of a capacitor;
- Current calculation via integration of a current distribution (surface or volumetric);
- Knowledge and use of Ohm's law and Joule's law.

Bibliography

Electromagnétisme; Paul roux; Ed ellipses (1993)

Prerequisites

Concepts of vectors, scalar product and vector product; cartesian, cylindrical and spherical coordinates

Manager : Thomas LEPETIT

Electronic functions

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
7.5	12	21			1.5	20

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport individuel*

Outline

Part 1, filters
- Simplified template concept
- Approximation functions
- Active electronic filters

Part 2, amplifiers
- Basic transistor circuits
- Voltage amplifiers
- Synthetic approach to feedback in amplification

Part 3, oscillators
- Relaxation oscillators
- Stability of linear systems
- Linear theory of sinusoidal oscillators

Goals

1 - Allow students to analyze active filter schematics and design these filters of any order (the design start from a simplified template)

2 - Allow students to analyze integrated or non-integrated voltage amplifier schematics

3 - Allow students to analyze oscillator schematics and enable them to design simple devices

Bibliography

1- Paul bildstein, fonctions de transfert des filtres électriques, pages E3 110-1-E3 11030, techniques de l'ingénieur, 2002

2- M. Hassler & J. Neirynck, Filtres électriques, presses polytechniques romandes, Dunod 1981

3- Sylvain Larribe, traitement analogique du signal - le filtrage analogique, CNAM Saclay, Paris, 2006

3- Michel Girard, amplificateurs de puissance, McGraw-Hill, Paris 1988

4- Michel Girard, Composants actifs discrets, McGraw-Hill, 1990

5- E.P. Popov, dynamics of automatic control systems, Pergamon press, 1961

6- A. Vatasesco, H. Sinnreich, St. Gavat, R. Stere & R. Piringer, circuits à semi-conducteurs dans l'indutrie, tome 2, amplificateurs et oscillateurs, Masson, Paris, 1972

Learning outcomes

Learning outcomes	N	A	M	E	O
• Analyze an active filter scheme	·	·	✓	·	·
• Design an active filter (low frequencies)	·	·	✓	·	·
• Analyze a voltage amplifier scheme	·	·	✓	·	·
• Design a voltage amplifier	·	✓	·	·	·
• Analyze a sinusoidal oscillator scheme	·	·	✓	·	·
• Design a simple sinusoidal oscillator	·	✓	·	·	·

Manager : Vincent GOURET

Electronic midrange

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
12.5	19.5	27			3	30

Evaluation

3 evaluations :

- *Devoir surveillé 2*
- *Devoir surveillé 1*
- *Rapport groupe*

Outline

1- PLL (Phase Locked Loop)
2-Modulation and demodulation
3-Mixers
4-Noise
5-Special functions of midrange circuits
6-Impedance matching
7-Signal transmission
8-Power amplifier
9-Passive filters

Goals

Analyze an electronic function. Measure electronic signals. Understand an electronic circuit.Understand modulations. Model a signal in frequency domain. Model a signal in Time domain. Decompose an electronic circuit in elementary blocs. Understand limitations of a circuit.

Bibliography

1) J.C Pérez,... ; Electronique : fondements et applications ; Dunod, 2006,
2) F. Manneville , J. Esquieu ; Electronique ; Dunod
3) Gray, Hurst, Lewis, Meyer ; Analysis and design of analog integrated circuits ; Wiley
4) A. Pacaud ; Electronique radiofréquence ; Ellipse
5) Norbert R. Malik ; Analysis, Simulation and Design ; Prentice Hall

Prerequisites

Basic electronics

Learning outcomes

Learning outcomes	N	A	M	E	O
• To know how to analyze an electronic function, how to measure electronic signals.	·	·	·	✓	·
• To know how to modelise a signal in the time and frequency domain	·	·	✓	·	·
• To decompose an electronic circuit into elementary blocs, and to understand limitations of circuits	·	·	✓	·	·

Manager : Tchanguiz RAZBAN HAGHIGHI

Engineering project

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			120			

Evaluation

2 evaluations :

- *Soutenance*
- *Projet*

Goals

The acquisition of skills is through research and development issues. The proposed technique is performed by a binomial students under the supervision of one or more teachers.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Able to solve a R&D problem	·	✓	·	·	·
• Know how to conduct a bibliography review	·	✓	·	·	·
• Able to develop new tools and implement new concepts / techniques independently	·	·	·	✓	·
• Return the results if necessary popularizing	·	·	✓	·	·
• Mastering Project Management	·	·	✓	·	·

English grammar for engineers

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	22.5					

Evaluation

2 evaluations :

- *Situation Gpe*
- *DS*

Manager : Pascale SIMON LLOBREGAT

Entrepreneurship S7

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			36			

Evaluation

One evaluation : *Situation Ind*

Manager : John KINGSTON

Entrepreneurship S8

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			28			

Evaluation

One evaluation : *Situation Ind*

Manager : John KINGSTON

Final project

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
				22		

Evaluation

2 evaluations :

- *Soutenance*
- *Note*

Manager : Sébastien LE NOURS

French as a foreign language

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	18					

Evaluation

One evaluation : *Situation Ind*

Manager : Carole CHAUSSE

French as a foreign language

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	18					

Evaluation

One evaluation : *Situation ind.*

Manager : Carole CHAUSSE

Great Event S7

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			36			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Manager : Jérôme BEZIER

Great Event S8

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			28			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Manager : Jérôme BEZIER

HF electronic

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
7.5	10.5	15			1.5	15

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport groupe*

Outline

1. Introduction
2. Transmission Line
3. Smith Chart and impedance matching
4. Discontinuities
5. High Frequency passive and active circuit design
6. Project on the filter and amplifier design. CAD software using and characterization methods

Goals

The aim is to understand phenomenon propagation phenomenon in a transmission line in order to solve some problem design of high frequency circuits

Bibliography

1) Paul COMBES : Micro-ondes : DUNOD, 2004, Tomes 1 et 2. ISBN 2100027530
2) Marc HELIER : Techniques Micro-ondes, ELLIPSES, 2001, Collection Supélec, ISBN 2729804978
3) David M. POZAR : Microwave engineering, John Wiley, 2004, ISBN : 0471448788
4) Christopher BOWICK : RF Circuit Design, 2nd Edition, Newnes, 2007, ISBN : 9780080553429

Prerequisites

All teaching part from Function of electronic to middle range frequency electronic. Teaching of free and guided propagation.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing to treat a propagation phenomenon in a transmission line	·	·	✓	·	·
• Knowing to treate impedance matching using Smith Chart	·	·	✓	·	·
• Knowing to treate design of high frequency circuits	·	·	✓	·	·

Manager : Yann MAHÉ

Intercultural exploration : understanding differences

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	18					

Evaluation

One evaluation : *Situation ind.*

Bibliography

? Polycopié : Intercultural exploration (2025-2026)

? Dignen, B. (2011). Communicating across cultures. Cambridge.

? Meyer, E. (2014). The culture map: Breaking through the invisible boundaries of global business. PublicAffairs.

? Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). Cultures and organizations: Software of the mind - Intercultural cooperation and its importance for survival (3rd ed.). McGraw-Hill.

? Bourrelle, J. S., Elise H. Kollerud (2015). Cracking the Scandinavian code. Mondå Forlag.

? Stringer, D. M., & Cassiday, P. A. (2006). 52 activities for improving cross-cultural communication. Intercultural Press.

Manager : Carole CHAUSSE

Internship 3rd year

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
				8		

Evaluation

One evaluation : *Rapport individuel*

Manager : Anne CHOUSSEAUD

Job search strategy and techniques

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
1.5	9					6

Evaluation

One evaluation : *Situation groupe*

Bibliography

? www.16personalities.com
? www.acnv.com

Manager : Sylvaine GAUTIER

M1 : Internet and multimedia

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3		9				10

Evaluation

One evaluation : *Rapport groupe*

Presentation

The main aim of this module is the understanding of Internet Protocols used to carry the multimedia content "video-audio streaming" and new AI applications transforming speech to text (STT) and text to speech (TTS). In some cases this kind of operation is called "text streaming". The essential Internet Protocols such as : IP, TC, and UDP do not provide any information about the timing. That is why to correctly send/receive the multimedia content we need an additional protocol called RTP, Real Time Protocol. RTP carries time markers and the sequence numbers related to the data packets (media frames). In case of transformed Speech-To-Text we just use UDP packets to send/receive text messages. These text message are transformed into speech at the receiving node.

Outline

Lab 0: exercises exploiting UDP and TCP protocols used to send/receive text messages and files; including multimedia files.

Lab 1: introduces the basic functions Gstreamer allowing us to capture the audio/video content and to reproduce it on the speaker/display devices

Lab 2 and Lab 3: dedicated to the streaming with UDP/RTP and UDP/RTP/RTCP

Lab 4 and Lab 5: building complete STT-TTS architecture with the prepared components and provided AI models

Goals

Study and understand the Internet protocols and how to carry multimedia content.

Bibliography

J.F.Kurose, W.Ross : 'Computer Networking : A Top-Down Approach Featuring Internet', P.Bakowski - www.polytech2go.fr

Prerequisites

C programming, computer networking fundamentals, multimedia standards fundamentals

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand network object oriented programming	·	·	✓	·	·
• Understand Internet protocols for multimedia	·	✓	·	·	·
• Mastering multimedia programming interface	·	·	✓	·	·
• Understand streaming mechanisms	·	✓	·	·	·

Manager : Abdelhakim SAADANE

M2 : Multimedia standards and services

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
15		12				15

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport groupe*

Presentation

The course addresses principles and standard of compression of three media: image, audio & video. Concepts of multi resolution and JPEG2000 supplement knowledge of 4th year. Audio & video are addressed through a panorama of compression standards from the historical point of view.

Outline

1. speech modeling & compression principles
   2. standard G72x
   3. standard MPEG1 et 2 audio
   4. JPEG2000
   5. video signals
   6. principles of video compression & motion estimation
   7. from MPEG1 to H263
   8. H264 AVC, SVC & beyond, standard for 3DTV

   Four illustrative lab sessions supplement lecture courses: 2 on image/audio, 2 on video

Goals

The course addresses principles and standard of compression of three media: image, audio & video. Concepts of multi resolution and JPEG2000 supplement knowledge of 4th year. Audio & video are addressed through a panorama of compression standards from the historical point of view.

Bibliography

M. Barlaud et C. Labit ; Compression et codage des images et des vidéos , Ed. Hermes

M. Wien, "High efficiency video coding. Coding Tools and specification", Ed. Springer

D.S.Taubman, M.W.Marcellin ; JPEG2000 : Image compression fundamentals, standards and practice

Prerequisites

basics of image processing

still image compression (JPEG)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know characterization and modeling of speech signal & related compression principes and standards	·	·	✓	·	·
• Understand audio compression standards	·	✓	·	·	·
• Understand principles of JPEG2000	·	✓	·	·	·
• Know video signal, digital and analog formats	·	✓	·	·	·
• Know priciples of motion estimation in the context of video compression	·	✓	·	·	·
• Know video compression standards	·	✓	·	·	·

Manager : Vincent RICORDEL

M3 : RISC-V programming and modelisation

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3		9				10

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport groupe*

Outline

1. What is RISC and RISC-V ?
   2. Ecosystem (business models) : x86, ARM and RISC-V
   3. Origins of RISC-V (RISC I/II, ..)
   4. ISA RISC-V and essential architectural features of RV32 and RV64
   5. Main actors - IP design and implementation: SiFive, Andes, T-HEAD, Espressif, .

Prerequisites

Circuit design, system design

Learning outcomes

Learning outcomes	N	A	M	E	O
• ? Know characterization and modeling of speech signal & related compression principes and standards	·	·	✓	·	·

Manager : Abdelhakim SAADANE

M4 : Parallel programming on multicore CPUs

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3	3	12				7

Evaluation

One evaluation : *Rapport groupe*

Outline

1. Introduction
   2. MCU vs DSP
   3. DSP: Software optimization
   4. MCU : Vector Extensions
   5. SIMD concept
   6. ARM-A: optimization using Neon
   7. RISC-V : Optimization using RVV
   8. Optimization using OpenMP

Goals

Practice parallel programming on multicore CPU (Neon - OpenMP).

Bibliography

https://community.arm.com/android-community/b/android/posts/arm-neon-programming-quick- reference#_ednref4

ARM Cortex -A Series Version: 4.0 Programmer's Guide: 7.2.4 NEON instruction set ARM Quick Reference:

http://infocenter.arm.com/help/topic/com.arm.doc.qrc0001l/QRC0001_UAL.pdf Cortex A8 Technical Reference Manual:

http://infocenter.arm.com/help/index.jsp?topic=/com.arm.doc.ddi0344k/index.html
http://www.openmp.org

http://openmp.org/wp/resources

Patterson D, Waterman A. The RISC-V Reader: An Open Architecture Atlas. Strawberry Canyon, 2017.

Waterman A, Asanovi? K. The RISC-V instruction set manual volume II: Privileged architecture version

20190608-Priv-MSU-Ratified. RISC-V Foundation, 2019.

Prerequisites

Microprocessors. Programming with C language.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand high-performance processing and instruction sets specific of Neon and OpenMP	✓	·	·	·	·
• Know how to improve performance of signal processing application	✓	·	·	·	·

Manager : Abdelhakim SAADANE

M5 : Deep Learning with GPUs

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3		14.5			0.5	8

Evaluation

One evaluation : *Devoir surveillé*

Outline

1. Introduction to parallel computing and GPU architectures
   2. Architecture of NVIDIA GPUs (threads, blocks, grids, SMs, warps, memory, etc.)
   3. CUDA programming model
   4. Optimization, performance, and profiling
   5. Practical applications in multimedia and AI

Goals

This course introduces the fundamental concepts of parallel programming applied to embedded GPU architectures. Students will learn how GPUs function and how their massively parallel execution model works. The course is based on the CUDA and Python programming languages, allowing students to implement efficient parallel algorithms. Special emphasis is placed on performance analysis, memory usage optimization, and application profiling to make the most of available hardware in constrained environments.

Bibliography

? J. Sanders et E. Kandrot, CUDA by example: an introduction to general-purpose GPU programming, 3. printing. Upper Saddle River, NJ Munich: Addison-Wesley, 2011.

? J. Han, Learn CUDA Programming: A beginner's guide to GPU programming and parallel computing with CUDA 10.x and C/C++, 1re éd. Birmingham: Packt Publishing Limited, 2019.

? R. Ansorge, Programming in Parallel with CUDA: A Practical Guide, 1re éd. Cambridge University Press, 2022. doi: 10.1017/9781108855273.

? Wen-mei W. Hwu, David B. Kirk, Izzat El Hajj, Programming Massively Parallel Processors : A Hands-on Approach, 4th Edition - May 28, 2022, Morgan Kaufmann

ISBN: 9780323912310 eBook ISBN: 9780323984638

Prerequisites

C++ programming, Parallel programming on multicore CPUs

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand GPU architecture	·	·	✓	·	·
• ? Program parallel applications using CUDA C to efficiently leverage GPU resources	·	·	✓	·	·
• ? Analyze CUDA code performance using profiling and optimization tools	·	·	✓	·	·

Manager : Salah eddine BOUZID

ME1: Real-time systems

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
4.5	1.5	9				5

Evaluation

One evaluation : *Rapport groupe*

Outline

The first part of this module introduces some advanced task scheduling techniques in single-processor real-time systems to meet time constraints (laxity management, aperiodic task management, task server, etc.). It also covers real-time system implementation solutions for the automotive industry (OSEK, AUTOSAR), the use of Linux environments for time-based applications, and the fundamentals of real-time operation for real-time applications implemented on advanced processors (multi-core, multi-processor, cache, etc.).

The second part of this module deals with a lab which consists in implementing a time-constrained application on an embedded mono processor, mono core architecture (microcontroller, embedding and loading of a real-time operating system, input/output and timer management).

Goals

The purpose of this module is to clarify task modeling and the main scheduling policies in single- or multi-processor embedded and real-time operating systems. This objective is illustrated by the example of a single-processor embedded real-time application. The process involves configuring the application for a given platform and then deploying it by loading a real-time OS and developing an application.

Bibliography

Buttazo, "Hard Real-Time Computing Systems", Kluwer, 2002,
P. Ficheux, "Linux embarqué", Eyrolles 2002,
C. Blaess, "Solutions temps réel sous LINUX", Eyrolles 2019.

Prerequisites

Multi-task scheduling,
Specificity of real-time systems,
Operating systems

Learning outcomes

Learning outcomes	N	A	M	E	O
• Scheduling policies for real-time tasks	·	·	·	✓	·
• Linux for embedded and real-time applications	·	·	✓	·	·
• Basic knowledge of real-time multi-processor applications	·	✓	·	·	·

Manager : Olivier PASQUIER

ME2 : Hardware description languages, reuse and integration

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3		12				10

Evaluation

One evaluation : *Rapport groupe*

Outline

Introduction to HDL.

Reuse mechanisms. Processors 'open source'. Integration of a complex system 'open source'.

Goals

This involves learning how to develop reusable components in hardware description language and how to use them in a complex system with an open source RISC-V processor

Bibliography

P. Ashender : The Designer's Guide to VHDL VHDL

B. Zeidman Introduction to Verilog Broché

D. Patterson, J. Hennessy Computer Organization an design: The Hardware Software Interface: Risc-v Edition

Prerequisites

Microprocessor. Some VHDL practice.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Integrate reusable VHDL / Verilog	·	·	✓	·	·
• Know how to build a complete system (rapid prototyping) incorporating a microprocessor	·	✓	·	·	·
• Mastering toolchain design / simulation	·	·	✓	·	·
• Understand the rules of use of open source code	·	·	✓	·	·

Manager : Sébastien PILLEMENT

Microelectronics

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
2.5	12	9			1.5	10

Evaluation

3 evaluations :

- *Devoir surveillé 1*
- *Devoir surveillé 2*
- *Rapport groupe*

Outline

1. Electrical models for bipolar transistors, 2. Introduction to Digital and analog bipolar integrated circuits, 3. MOS capacitance and field effect, 4. Electrical models for MOS transistors (Spice 1 and 3), 5. Basic logic circuits in NMOS and CMOS technology,

Goals

This teaching is mainly focused on CMOS processes which dominate the semiconductor market. The aim is to: - Understand the principles of operation of active components and to use standard electrical simulation models (SPICE) used for simulation and analog design of integrated circuits. - Understand the impact of technological and physical properties of transistors on the electrical characteristics of digital and analog functions.

Bibliography

Micro et Nano-électronique, Bases Composants Circuits; Hervé Fanet; Ed. Dunod (2006) Physique des semiconducteurs et composants électroniques; Henry Mathieu et Hervé Fanet; Ed. Dunod (2009) Understanding Semiconductor devices; Sima Dimitrijev; Oxford Univ. Press (2000)

Prerequisites

Physics of semiconductor materials and devices

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand the physical principles of transistors and elementary cells in bipolar and MOS technologies	·	✓	·	·	·
• Know how to use parametrized transistor electrical models related with the Integrated Manufacturing Technology	·	✓	·	·	·
• Being able with CAD tools to size cells used in digital application	·	✓	·	·	·
• Know the basic principles for the layout of integrated circuits	✓	·	·	·	·

Manager : Antoine GOULLET

Microprocessor systems

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
2.5	16.5	21			1.5	20

Evaluation

3 evaluations :

- *DS 1*
- *Rapport Gpe*
- *DS 2*

Outline

1- Hardware resources of a microprocessor system
1. 1- Basic mechanisms of processors
1.2- Organization of a microprocessor system
1.3- Memories
1.4- Peripherals
1.5- Interconnections between systems
2- Software resources of a microprocessor system
2.1- Programming languages
2.2- Basic notions about programming a microprocessor system
2.3- Instruction set
2.4- Management of hardware resources
2.5- Management of interuptions

Goals

This module aims at defining advanced mechanisms related to 16 and 32 bits microprocessor systems. Properties attached to hardware and low level software resources are presented.

Bibliography

Andrew Tanenbaum, Architecture de l'ordinateur, Pearson, 2005

J. L. Hennessy, D. Patterson, Architecture des ordinateurs une approche quantitative, Vuibert, 2002

Arnold S. Berger, Embedded Systems Design, an introduction to process, tools and techniques, CMP Books

J. Ganssle, M. Barr, Embedded Systems Dictionnary, CMP Books

Prerequisites

Digital electronics, digital circuits design, 8 bits microprocessor systems, notions of structured programming

Learning outcomes

Learning outcomes	N	A	M	E	O
• To master characteristics of hardware resources of a 16-32 bits microprocessor	·	·	✓	·	·
• To be able to propose different organizations of a microprocessor system	·	✓	·	·	·
• To master languages and tools for programming microprocessor systems	·	·	✓	·	·
• To be able to develop a medium complexity application on a microprocessor system with a reduced set of basic peripherals	·	✓	·	·	·

Manager : Sébastien LE NOURS

Microprocessors

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
7.5	13.5	27			2	10

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport groupe*

Outline

- General information on systems with micro-processors and micro-controllers
  - Languages and tools (software and hardware)
  - Internal view of a µC, core and peripherals
  - microP-based board
  - Introduction to assembly language
  - Access analysis (timings)
  - Implementation of classic peripherals.

Goals

Understand both the spatial-temporal hardware aspects (architecture, dynamic characteristics), and the software aspects (instruction set, programming) of 8-bit micro-controllers / micro-processors.

Use an 8-bit microP card and an 8-bit microC.

Bibliography

Patterson, David A., and John L. Hennessy.
Computer organization and design RISC-V edition : the hardware software interface.
Morgan kaufmann, 2018.
Chaine youtube de Ben Eater. Building an 8-bit breadboard computer !

Prerequisites

C Language, Digital electronics

Learning outcomes

Learning outcomes	N	A	M	E	O
• to be familiar with the vocabulary	·	·	✓	·	·
• To understand the architecture of a processor and to be able to identify its hardware ressources.	·	·	✓	·	·
• To understand the instruction set and its relationship with the hardware architecture	·	·	✓	·	·
• To be able to analyse features and to exploit ressources of a processor	·	✓	·	·	·
• To be able to design a microprocessor board	·	✓	·	·	·

Manager : Sébastien PILLEMENT

Modern language 2

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	18					

Evaluation

One evaluation : *Situation Ind*

Manager : Carole CHAUSSE

Modern language 2

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	18					

Evaluation

One evaluation : *Situation ind.*

Manager : Carole CHAUSSE

Multimedia signals

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
5	3	13.5			1.5	12

Evaluation

One evaluation : *Devoir surveillé*

Presentation

Representation, analysis and coding of still images.

Outline

1 - Introduction (domains, application examples, basic representations)
2 - Point transformation and histogram (LUT, binarization, histogram)
3 - Linear transform (2D convolution, FFT)
4 - Non-linear transform (filtering order, morphological filtering)
5 - Quantization
6 - Predictive coding
7 - DCT transform, JPEG standard

Goals

To provide elements to understand the representation, the analysis and the coding of still images. To describe some methods of image processing.

Bibliography

Henri Maitre : Le traitement des images (éd. Hermes, 2003).

Michel BARLAUD et Claude LABIT : La compression et codage des images et des vidéos (éd. Hermes, 2002).

Gibson, Berger, Lookabaugh, Lindbergh et Baker : Digital compression for multimedia, principles and standards (éd. Morgan Kaufmann, 1998).

Prerequisites

Signal processing background.

Learning outcomes

Learning outcomes	N	A	M	E	O
• To know the basic representations of still images.	·	✓	·	·	·
• To know the methods of image processing.	·	·	✓	·	·
• To know the methods of still image coding.	·	✓	·	·	·
• To know how to process still image (using Matlab).	·	·	✓	·	·
• To know how to code still image.	·	✓	·	·	·

Manager : Vincent RICORDEL

Negotiation

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3	7.5					2

Evaluation

One evaluation : *Situation Ind*

Bibliography

- Salzer, J. et Stimec, A. (2019). Outil 63. Les qualités d'un bon accord. La boîte à outils de la Gestion des conflits (p. 182-183). Dunod. https://shs.cairn.info/la-boite-a-outils-de-la-gestion-des-conflits–9782100791415-page-182?lang=fr.

- https://web.archive.org/web/20140427011407/http://www.commerciaux.fr/profession/methode_soncas.php

Manager : John KINGSTON

Numerical methodes

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3.75	4.5	15			1.5	10

Evaluation

2 evaluations :

- *Rapport groupe*
- *Devoir surveillé*

Outline

1- Introduction to numerical methods, 2- Representation of real numbers in a computer, and its consequences, 3- Solving linear systems, 4- Numerical approximation of functions, 5- Solving non-linear equations, 6- Numerical differentiation and integration, 7- Numerical solution for ordinary differential equations

Goals

To know the basic classes of numerical problems and the main algorithms.To knowing how to implement these algorithms in C language. To estimate the cost of these algorithms (time / resources) and their results (accuracy).

Bibliography

Méthodes numériques, Alfio Quarteroni, Riccardo Sacco, Fausto Saleri - Analyse numérique pour ingénieurs, André Fortin - Elementary numerical analysis, Samuel D. Comte, Carl de Boor - Analyse numérique et équations différentielles, J.P. Demailly

Prerequisites

Real function basic analysis, linear algebra, sequences and series.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowing classes of basic problems for numerical methods.	·	·	✓	·	·
• Knowing the algorithms and their properties for the numerical resolution of basic problems.	·	·	✓	·	·
• Implementing the algorithms in C language.	·	·	✓	·	·
• Transcribing an engineering problem into a numerical problem and sizing it up (cost/acuracy).	·	✓	·	·	·

Manager : Vincent GOURET

Object Oriented Programming

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
0.75	9	21			1.5	15

Evaluation

2 evaluations :

- *DS*
- *Situation Gpe*

Outline

1. Introduction
   2. Object-oriented Concepts
   3. Inheritance and Polymorphism
   4. Abstract Classes and Interfaces
   5. Advanced Techniques (Exceptions, Collections)
   6. Graphical User Interfaces
   7. Conclusion

Goals

? Master the fundamentals of the Java language
? Understand and apply basic concepts of object-oriented programming (classes, objects, encapsulation, inheritance, polymorphism)
? Organize a Java project effectively using packages
? Manage exceptional cases (exception handling) and utilize collections
? Design simple graphical user interfaces in Java

Bibliography

Benjamin J. Evans et David Flanagan, Java en action : Guide pratique, Dunod, 2019.
Anne Tasso; Le livre de Java premier langage; Eyrolles, 2011
Michel Divay; Java et la programmation objet; Dunod, 2002

Prerequisites

Algorithmics, structured programming, C language.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Design and implement object-oriented programs in Java	·	·	·	✓	·
• Use control structures, manage data streams and exceptions	·	·	✓	·	·
• Apply advanced concepts such as polymorphism, encapsulation, inheritance, interfaces, and collections	·	·	✓	·	·
• Develop simple applications integrating a graphical interface	·	·	✓	·	·

Manager : Salah eddine BOUZID

Optimisation

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	6	12			1.5	

Evaluation

3 evaluations :

- *Devoir surveillé 1*
- *Devoir surveillé 2*
- *Rapport groupe*

Outline

1) Introduction
   2) Optimization without constraint
   3) Optimization of a stochastic gunction
   4) Optimization with constraints
   5) Stochastic algorithms

Goals

The objective is to present the problematic of optimization: modelization of the problem, existence of the solution. The course describes the deterministic optimization methods with and without constraint, the optimization of a stochastic function and the stochastic methods

Bibliography

Jean-Christophe Culiolo : "Introduction à l'optimisation", Ellipses, 1994

Prerequisites

Random signal processing, Linear Algebra

Learning outcomes

Learning outcomes	N	A	M	E	O
• To modelize an optimization problem	·	·	✓	·	·
• To solve an optimisation without constraint using deterministic methods	·	·	✓	·	·
• To optimize a stochastique function	·	·	✓	·	·
• To solve an optimisation with constraint using deterministic methods	·	·	✓	·	·
• To solve an optimisation without constraint using stochastic methods	·	✓	·	·	·

Manager : Jean-François DIOURIS

Organizational analysis

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
4.5	6					3

Evaluation

One evaluation : *DS*

Bibliography

Droits et devoirs du salarié :
- la pyramide des normes https://www.youtube.com/watch?v=xpWzj66Lxk0
- la négociation collective https://www.youtube.com/watch?v=giwvtotJjws
- Légifrance ingénieurs https://www.legifrance.gouv.fr/conv_coll/id/KALICONT000005635173

Théorie des organisations :
- Théorie des organisations / j m plane (dunod)
- Théorie des orga et écosystèmes / maclouf https://www.youtube.com/watch?v=fn-4ZxWRjNE

Manager : Gwenael THOREL

People management

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	10.5					6

Evaluation

One evaluation : *DS*

Manager : John KINGSTON

Physical education and sport 1

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	21					2

Evaluation

One evaluation : *Situation ind.*

Manager : Jérôme BEZIER

Physical education and sport 2

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	21					2

Evaluation

One evaluation : *Situation ind.*

Manager : Jérôme BEZIER

Physical education and sport 3

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	21					2

Evaluation

One evaluation : *Situation Ind*

Manager : Jérôme BEZIER

Physical education and sport 4

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	19.5					2

Evaluation

One evaluation : *Situation ind.*

Manager : Jérôme BEZIER

Physics of semiconductors and components

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
7.5	18	9			2.5	15

Evaluation

3 evaluations :

- *Devoir surveillé 2*
- *Devoir surveillé 1*
- *Rapport groupe*

Outline

1. Basis of quantum physics
2. Interaction material-electromagnetic radiation
3. Electronic band structure
4. Intrinsic and extrinsic semiconductor
5. Diffusion and drift current
6. Continuity equation of charge carriers
7. Introduction to microelectronic fabrication methods
8. PN junction

Goals

This course aims at presenting the specific properties of semiconductors, linked with the fundamentals of matter, and using it to understand the working of diodes and bipolar transistors. The specific points related with integration of components are presented with TCAD tools including virtual fabrication and electrical simulation.

Bibliography

H. Mathieu, Physique des semiconducteurs et des composants électroniques; Masson

A. Vapaille, R. Castagné, Dispositifs et circuits intégrés semiconducteurs; Dunod

B. Boittiaux, Cours d'Electronique: Les composants semiconducteurs; Tec&Doc/Lavoisier

C. et H. Ngô, Les semiconducteurs: de l'électron aux dispositifs; Dunod, 2003

F. Cerf, Les composants optoélectroniques; Hermès, 2000

Learning outcomes

Learning outcomes	N	A	M	E	O
• To understand the origin of the electronic band structure in semiconductor and effective mass of carrier	✓	·	·	·	·
• To calculate the concentration of charge carriers and to draw the simplified energetic diagram of semiconductor	·	·	✓	·	·
• To calculate drift and diffusion current in semiconductor	·	·	✓	·	·
• To use continuity equations of charge carriers	·	✓	·	·	·
• To know the principles and specificities of basic components and to establish their electrical model	·	✓	·	·	·
• To link the fabrication process and components properties.	✓	·	·	·	·

Manager : Antoine GOULLET

Preparing the TOEIC

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	19.5					

Evaluation

One evaluation : *DS*

Manager : Carole CHAUSSE

Preparing the TOEIC

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	18					

Evaluation

One evaluation : *DS*

Bibliography

Newcombe, H. McDonald Bertail, C. Pass the TOEIC® Test. First Press ELT

Manager : Carole CHAUSSE

Presenting and debating

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	19.5					

Evaluation

One evaluation : *Situation Gpe*

Bibliography

- Matchan, L. (2015). Schools seek balance for cellphones in class. The Boston Globe.
- Wilson, J. (2013). Cool things DNA testing can do. CNN.
- Gascoigne, A. (2023). Silicon Valley's huge diversity problem holds tech back. The Los Angeles Tmes.

Manager : Pascale SIMON LLOBREGAT

Probabilities, Statistiques

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
10	13.5				1.5	10

Evaluation

2 evaluations :

- *Rapport Indiv. QCM*
- *Devoir surveillé*

Outline

Recall of classical probability
  Probability and Conditional probabilities
  Dependence and independence of events
  Law of total probability and and Bayes' theorem
  Random variables and vectors
  Classical probability distributions
  Central limit theorem
  Law of large numbers
  Comparison of two means (homogeneity test)
  Confidence interval with a predefined significance level
  Chi-2 test

Goals

This course presents the theory of probability, conditional probability, the various laws of probability to model physical phenomenon. It also introduces some concepts of statistics needed for engineering students such as the central limit theorem, the law of large numbers, estimation by confidence intervals, the test of comparison, chi-2.

Bibliography

Polycopié du cours;
  MR. Spiegel ; Probabilités et statistiques ; Mac Graw-Hill, Schaum

Prerequisites

Basic analysis
  Algebra

Learning outcomes

Learning outcomes	N	A	M	E	O
• Manipulate conditional probabilities and be able to apply Bayes' theorem in a detection problem	·	·	✓	·	·
• Be able to apply the binomial, Poisson distribution, hypergeometric distribution, geometric distribution,and normal (Gaussian) distribution	·	·	✓	·	·
• Calculate the law of a function of a random variable	·	·	✓	·	·
• Use and apply the central limit theorem. Master the concept of confidence intervals	·	·	✓	·	·
• Calculate the mean and standard deviation from a set of samples and understand their physical meaning	·	·	✓	·	·
• Determine the distribution of a function of a random variable with a know distribution	·	·	✓	·	·

Manager : Yide WANG

Project management 1

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
4.5	7.5					2

Evaluation

One evaluation : *Situation Gpe*

Manager : Sylvaine GAUTIER

Project management 2

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
1.5	15					3

Evaluation

One evaluation : *DS*

Manager : Sylvaine GAUTIER

Random signal processing

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	12	9			1.5	10

Evaluation

3 evaluations :

- *Devoir surveillé 1*
- *Devoir surveillé 2*
- *Rapport groupe*

Outline

1. Summary of deterministic signal processing 2. Summary of probability and random variables 3. Random signal or process 4. Random signal modelization 5. Estimation 6. Detection

Goals

The objective is to present to the students the random sipgnal processing which is used in a lot of applications such as signal synthesis, source coding, analogic or digital transmissions and radar.

Bibliography

M. Charbit ; Eléments de traitement du signal : aspects aléatoires; Ellipses, 1996
Y. Thomas ; Signaux et Systèmes linéaires; Masson, 1994
M. Bellanger ; Analyse des Signaux et Filtrage Numérique Adaptatif; Masson,1989
M. Bellanger ; Traitement numérique du signal, théorie et pratique; Dunod, 2006

Prerequisites

Deterministic signal processing, probability theorry

Learning outcomes

Learning outcomes	N	A	M	E	O
• To characterize a random signal	·	·	✓	·	·
• To modelize a random signal	·	·	✓	·	·
• To estimate the parameters of a random signal	·	·	✓	·	·
• To detect a caracteristic of a random signal	·	·	✓	·	·

Manager : Jean-François DIOURIS

Real time operating systems

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3.75	6	9			1.5	10

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport groupe*

Outline

This module introduces main specific properties of real-time systems. It then presents the main scheduling policies for multi-task and mono-processor, mono core, real-time applications. It also presents main solutions to implement inter-task relations like synchronisation, mutual exclusion and message queue.

Some particular situations in real-time application like circular deadlock, ressource competition and priority inversion are presented.

This theoretic concepts are illustrated by labs based on a real-time operating system and tools from the industry.

Goals

This module purpose is to explain real time specific aspects in an application and implementation of basic concepts in a real-time operating system for task scheduling, task synchronisation, mutual exclusion and message queue.

Bibliography

Cottet, Delacroix, Kaiser, Mameri, "Ordonnancement Temps-Réel", Hermes, 2000

F. Cottet, E. Grolleau, "Systèmes Temps réel de contrôle-commande", Dunod, 2005

Buttazo, "Hard Real-Time Computing Systems", Kluwer, 2002

Prerequisites

- sequential programming (C language),
- microprocessor basic structure and behavior (registry, stack, procedure call),
- structural and behavioral modelisation.

Learning outcomes

Learning outcomes	N	A	M	E	O
• specific aspect of real-time systems and classification	·	·	✓	·	·
• Scheduling policies for real-time applications	·	✓	·	·	·
• Inter-task relations (synchronization, data sharing, message queue)	·	·	✓	·	·
• Mutual exclusion difficulties	·	✓	·	·	·

Manager : Olivier PASQUIER

Real time system design

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3.75	13.5				1.5	8

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport groupe*

Outline

This module firstly exposes basics and theoritical aspects for requirements and system design for a system methodology.

All the previously presented concepts are illustrated according to the MCSE design methodology models and methods. To achieve this goal, specification job is presented with mainly considering analysis and modeling of the environment of the system. Then, functional specifications and techological specifications are considered. Then, functional design is considered and finally physical interface and hardware and software specification are introduced.

Goals

The purpose of this module is to express needs and requirements for system design methodologies. These concepts are illustrated with the MCSE methodology when considering a problem from the customer requirement to expression of a solution including technological aspects.

Bibliography

J.P. Calvez, "Spécification et Conception des Systèmes: une méthodologie", Masson 1993,
J.P. Meinadier, "Ingénierie et intégration des Systèmes", Hermes 1998

Prerequisites

- behavioral modelisation (finite state machine)

Learning outcomes

Learning outcomes	N	A	M	E	O
• Need of a methodology for system design	·	·	✓	·	·
• Functional view and technological view of a system	·	·	✓	·	·
• Abstraction levels consideration of a system	·	·	✓	·	·
• Use of méthodes and modèles of MCSE methodology	·	·	✓	·	·

Manager : Olivier PASQUIER

Recruitment Pitch

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	15					5

Evaluation

One evaluation : *Situation ind.*

Bibliography

- Fiches métier France Travail - https://www.francetravail.fr/employeur/vos-recrutements/le-rome-et-les-fiches-metiers.html
- MétierScope France Travail - https://candidat.francetravail.fr/metierscope/
- APEC - https://www.apec.fr/

Manager : Sylvaine GAUTIER

Research S7

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			36			

Evaluation

One evaluation : *Situation Ind*

Manager : Antoine GOULLET

Research S8

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			28			

Evaluation

One evaluation : *Situation Ind*

Manager : Antoine GOULLET

Responsible management 1

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	4.5					3

Evaluation

One evaluation : *Rapport groupe*

Bibliography

https://www.inrs.fr

- Évaluation des risques professionnels et document unique?Brochure?INRS. (n.d.). Retrieved 25 August 2025, from https://www.inrs.fr/media.html?refINRS=TJ 29

- Lettre d'information de l'INRS - Publications et outils?INRS. (n.d.). Retrieved 25 August 2025, from https://www.inrs.fr/publications/lettre-information.html

Manager : Dominique BARBELIVIEN

Responsible management 2

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	3					1

Evaluation

One evaluation : *Rapport Gpe*

Bibliography

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Manager : Dominique BARBELIVIEN

S-8 Intership 4th year

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
				13		

Evaluation

One evaluation : *Rapport individuel*

Manager : Salah eddine BOUZID

S9-C2: Radar

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
7.5		3				10

Evaluation

One evaluation : *Devoir surveillé*

Presentation

Its aim is to understand the different modules that make up a radar system. One chapter is dedicated to the propagation of the radar wave between the transmitter and the receiver, where the concept of fading is introduced. A third chapter focuses on the processing of the received signal by introducing the probabilities of detection and false alarms, illustrated in practical work. Finally, an expert from the DGA-MI addresses the issue of radar stealth. The main principles of adapting shapes and the use of radar-absorbing materials are explained. The issue of controlling the radar signature and that of measurement is also introduced.

Outline

1. General Description
   1.1. Definition
   1.2. Basic Principles
   1.3. Composition of a Radar
   1.4. Antenna Characteristics
   1.5. Performance Criteria
   2. Radar Equation
   2.1. Introduction
   2.2. Power Received by a Radar
   2.3. Radar Range
   2.4. Propagation Disturbing Factors
   3. Detection and False Alarm Probabilities
   3.1. Introduction of Random Noise
   3.2. False Alarm Probability
   3.3. Detection Probability
   4. Introduction to Radar Stealth and the Measurement Problem

Goals

The general objectives of the course can be broken down as follows:
- Learn how to find and manipulate the radar equation.
- Assess the link between a transmitter and a receiver.
- Factors that promote or hinder radar wave propagation.
- Understand the relationship between speed measurement accuracy and target distance.
- Establish the connection between the concepts of detection, estimation, and signal-to-noise ratio.
- Introduction to radar stealth and the measurement problem.

Prerequisites

Electromagnetic waves, microwaves and antennas, free space propagation, random signals, signal processing

Manager : Christophe BOURLIER

SOpC : FPGA design and programming

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
3.75	3	9				8

Evaluation

2 evaluations :

- *Devoir surveillé*
- *Rapport groupe*

Outline

1. Introduction to SoC and related issues
2. FPGA architecture and optimal exploitation
3. Case study on Xilinx FPGA
4. Project: Image processing applications on FPGA

Goals

The objective of this course is to master the interest of SopC technologies, their architecture and the way to optimally exploit them. Advanced concepts are implemented by students leading a project that encompasses all the steps of design flow till implementation and test on FPGA

Prerequisites

VHDL basics Digital electronics systems and circuits

Learning outcomes

Learning outcomes	N	A	M	E	O
• Circuit technologies (ASIC, FPGA, SoC, SopC, ...)	·	✓	·	·	·
• Taking advantage of a given FPGA architecture from a VHDL description	·	✓	·	·	·
• Implenting mutilmedia algorithms on FPGA	·	✓	·	·	·
• FPGA design workflow (synthesis, implementation, analysis tools)	·	·	✓	·	·

Manager : Bastien DEVEAUTOUR

Serious game

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	10.5	12				10

Evaluation

One evaluation : *Soutenance*

Bibliography

- Pierre Vernimmen, Pascal Quiry et Yann Le Fur, Finance d'entreprise, Dalloz, 2025
- Philippe Thomas, Principes de finance d'entreprise, RBédition
- Anna Shapiro-Niel, Denis Fasse, Marketing & Communication : le mix gagnant, Dunod

Manager : Chrystèle GONCALVES

Skills day

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	8					2

Evaluation

One evaluation : *AutoévaL*

Manager : Sylvaine GAUTIER

Supporting change

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	13.5					3

Evaluation

One evaluation : *DS*

Bibliography

- Autissier D (2024), Néo change
  - Detchessahar M (2019), L'entreprise délibérée
  - Gomez PY (2013), Le travail invisible
  - Grevin A & Préchoux V (2025), Reconnaître le don au travail
  - Masclef O, Glaisner J & Gallon F (2025), L'entreprise du travail vivant
  - Morin E (2005), Introduction à la pensée complexe
  - Taskin L & Dietrich A (2024), Le management humain

Manager : Anouk GREVIN

Sustainability issues

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
10.5	7.5	1.5				

Evaluation

One evaluation : *DS*

Manager : Nicolas VERRE

Sustainability tools S6

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
6	9					

Evaluation

One evaluation : *Devoir surveillé*

Manager : Nicolas VERRE

Sustainable building instrumented model S7

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			36			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Learning outcomes

Learning outcomes	N	A	M	E	O
• To define their project (frame, system analysis, goals)	·	·	✓	·	·
• To build their project environement (resources)	·	·	✓	·	·
• To elaborate a strategy to reduce impacts	·	·	✓	·	·
• To propose specifications	·	·	✓	·	·

Manager : Dominique TARLET

Sustainable building instrumented model S8

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			28			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Learning outcomes

Learning outcomes	N	A	M	E	O
• To define specifications	·	·	✓	·	·
• To design a system and to make technical choices	·	·	✓	·	·
• To quantify the decrease in environmental impact	·	·	✓	·	·
• To valorise their results, to account for the acquired skills	·	·	✓	·	·

Manager : Dominique TARLET

Tools for Transdisciplinary project

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
24						

Evaluation

One evaluation : *Pas d'évaluation*

Outline

Different notions of project management are covered:

? Introduction to project management and agile methods (3H)
? Presentation on version management and the GIT tool (3H)
? Methodology in projects (V Cycle, Writing specifications, Specifications) (2x1H30)
? Eco-design approach (2x1H15)
? System industrialization (Board manufacturing (3H) and Industrialization management in projects (6H))

Goals

The aim of this course is to provide key tools for managing a Transdisciplinary project.

Prerequisites

No additional prerequisites other than admission to the semester.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Learning outcomes are assessed during the Transdisciplinary project.	·	·	·	·	✓

Manager : Yann MAHÉ

Transdisciplinary project I

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			30			50

Evaluation

One evaluation : *Situation Gpe*

Outline

The project starts in September and ends in may and is split into two asymmetrical steps along the two semesters.

First semester:
Internal negotiation: team building, project leader identification, project choice
Bibliography studies
Work plan and deliverables writing
Project management tools set up
External negociation: MoU
Pre development and specifications

Goals

Transdisciplinary project is a first experience of a mid term project conducted by a team of 4 to 6 students based on the needs expressed by an industrial customer and formalised by a Memoradum of Understanding between the two parties. The expected outcome is a HW and/or SW demonstrator presented at the final FORUM event.

Prerequisites

no specific requirement besides those leading to be admitted in 4th year

Learning outcomes

Learning outcomes	N	A	M	E	O
• managing the complexity of a project (specification, intrediscplinarity, industrial scanning)	·	·	✓	·	·
• operating management project tools	·	✓	·	·	·
• managing relationship with a customer	·	✓	·	·	·
• managing and optimising team works	·	✓	·	·	·
• learning to source and identify missing knowledge in previous education background	·	✓	·	·	·

Manager : Yann MAHÉ

Transdisciplinary project II

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			50			50

Evaluation

One evaluation : *Situation Gpe*

Outline

The project starts in September and ends in may and is split into two asymmetrical steps along the two semesters.

second semester:
external negotiation: final agreement on deliverables
conception and final development
industrialization report

Goals

Transdisciplinary project is a first experience of a mid term project based on the needs expressed by an industrial customer and formalised by a Memoradum of Understanding between the two parties. The expected outcome is a HW and/or SW demonstrator presented at the final FORUM event.

Prerequisites

no specific requirement besides those leading to be admitted in 2nd semester of 4th year

Learning outcomes

Learning outcomes	N	A	M	E	O
• managing the complexity of a project (specification, intrediscplinarity, industrial scanning)	·	·	✓	·	·
• operating management project tools	·	·	✓	·	·
• managing relationship with a customer	·	·	✓	·	·
• managing and optimising team works	·	·	✓	·	·
• learning to source and identify missing knowledge in previous education background	·	·	✓	·	·

Manager : Yann MAHÉ

Transitions S7

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			36			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Presentation

This Transitions Course aims to train Transition actors within organisations.

The course consists of presentations by transition professionals on topics such as Corporate Social Responsibility, sustainability and ecological redirection. These presentations, in the form of workshops, provide students with the tools they need to define and carry out a transition project.

A project defined by the students working in teams is carried out throughout the semester (and into the following semester).

Goals

Training actors in the transition

Objectives for the engineering school:

Mobilise Polytech Nantes to decide on environmental impact reduction targets in consultation with the DDRS Monitoring Committee and the school's decision-making bodies.

Participate in the action plan.

Deploy reduction measures.

Approach focused on the transition of organisations/structures/institutions: how can we encourage/support/engage in the necessary transition of organisations?

Learning outcomes

Learning outcomes	N	A	M	E	O
• Critically analyse the environmental impact indicators of an organisation (company, public institution, etc.).	·	·	✓	·	·
• Explaining a transition issue (= problem setting)	·	·	✓	·	·
• Identify stakeholders in an organisational transition project	·	·	✓	·	·
• Participate in the implementation of a team project	·	·	✓	·	·
• Integrating into a project	·	·	✓	·	·

Manager : Bruno AUVITY

Transitions S8

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			28			

Evaluation

2 evaluations :

- *Situation Gpe*
- *Situation Ind*

Presentation

This Transitions Course aims to train Transition actors within organisations.

The course consists of presentations by transition professionals on topics such as Corporate Social Responsibility, sustainability and ecological redirection. These presentations, in the form of workshops, provide students with the tools they need to define and carry out a transition project.

A project defined by the students working in teams is carried out throughout the semester (and into the following semester).

Goals

Training actors in the transition

Objectives for the engineering school:

Mobilise Polytech Nantes to decide on environmental impact reduction targets in consultation with the DDRS Monitoring Committee and the school's decision-making bodies.

Participate in the action plan.

Deploy reduction measures.

Approach focused on the transition of organisations/structures/institutions: how can we encourage/support/engage in the necessary transition of organisations?

Learning outcomes

Learning outcomes	N	A	M	E	O
• Participate in the organisation of a team project	·	·	✓	·	·
• Identify transition measures/actions to reduce impacts	·	·	✓	·	·
• Implement a transition action (= problem solving)	·	·	✓	·	·
• Reporting on a transition project in a manner appropriate to stakeholders	·	·	✓	·	·

Manager : Bruno AUVITY

Tutored Project

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
			30		2	20

Evaluation

3 evaluations :

- *Situation Gpe*
- *Rapport groupe*
- *Soutenance*

Outline

1 - Analysis of specifications
2 - Behavioural description and environment delimitation
3 - Functional breakdown and tasks delegating
4 - Design, realization, integration and tests
5 - Technical report writing
6 - Robot contest
7 - Competition

Goals

The course is a first sight on the ETN training. With a kit and requirements, each team of 6 students have to design and build an autonomous mobile robot. Finally, they write a report, give an oral presentation and each team confront each other in a timed race.

Bibliography

documents internes fournis

Prerequisites

1 - Basic skills on electricity
2 - Basic skills in electronics and sensors
3 - Basic skills in embedded sofware computing
4 - Familiar with measurement (multimeters, oscilloscopes, probe...)

Learning outcomes

Learning outcomes	N	A	M	E	O
• be able to describe behavioral using a finite-state diagram	·	✓	·	·	·
• Write a technical report and make an oral presentation	·	✓	·	·	·
• Know the main steps of technical project	·	·	✓	·	·
• Know the contraints of teamwork	·	·	✓	·	·
• Know how to apply a methodological approach (V cycle)	·	✓	·	·	·

Manager : Yann MAHÉ

Tutorials

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
		2				

Evaluation

One evaluation : *Situation Gpe*

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- Booklet TD 1 du S6 pour les 3A et le booklet S7 pour les 4A
- Rebecca Hughes, 2010, Teaching and researching Speaking, Second Edition
- Jo Sudden, teachinenglish.org website : Role Play article : https://www.teachingenglish.org.uk/professional-development/teachers/planning-lessons-and-courses/articles/role-play

Manager : John KINGSTON

Tutorials

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
		2				

Evaluation

One evaluation : *Situation Gpe*

Bibliography

- Booklet TD 1 du S6 pour les 3A et le booklet S7 pour les 4A
- Rebecca Hughes, 2010, Teaching and researching Speaking, Second Edition
- Jo Sudden, teachinenglish.org website : Role Play article : https://www.teachingenglish.org.uk/professional-development/teachers/planning-lessons-and-courses/articles/role-play

Manager : Carole CHAUSSE

VIP : english and french as a foreign language

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
		15				

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Manager : John KINGSTON

VIP : english and french as a foreign language

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
		15				

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? https://community-courses.memrise.com/community/course/2233959/3a-s1-polytech-nantes-irregular-verbs-meetings/

Manager : John KINGSTON