Teaching program

ETN

Academic year 2023-2024

Ecole polytechnique de Nantes Université

November 13, 2023

Contents

Part I

Tables of teaching units

Semester 5 - unit *ETN 3*

Basis of electronic S5 — ECTS : 10

Manager : GRAZIOTIN Patrice

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Algorithmic and C language	6.25	12	21			15	*0.25*
• Digital Electronic	3.75	22	30			20	*0.3*
• Basis of electronic	6.25	12	9			10	*0.25*
• Tutored Project		2		27		20	*0.2*
TOTAL	16.25	48	60	27	0	65	

Physics S5 — ECTS : 6

Manager : GOULLET Antoine

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electromagnetism	8.75	6				9	*0.2*
• Physics of semiconductors and components	7.5	20.5	9			15	*0.6*
• Guided propagation	5	9	3			8	*0.2*
TOTAL	21.25	35.5	12	0	0	32	

Humanities S5 — ECTS : 8

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Business knowledge and entrepreneurship	3	13.5				4	*0.13*
• Physical education and sport 1		21				2	*0.13*
• Professionnal project 1	1.5	12				4.5	*0.13*
• Sustainable development and social responsability 1	1.5	13.5					*0.13*
• Project management 1	4.5		3			2	*0.13*
• Grammar and professional English 1		40					*0.35*
TOTAL	10.5	100	3	0	0	12.5	

Mathematics S5 — ECTS : 6

Manager : WANG Yide

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Complex analysis	6.25	10.5				8	*0.2*
• Analysis and approximation	8.75	16.5				10	*0.4*
• Basic mathematics for engineers	11.25	11.5				10	*0.4*
TOTAL	26.25	38.5	0	0	0	28	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	74.25	222	75	27	0	137.5	30
Face-to-face sum	398.25						

Semester 6 - unit *ETN 3*

Analog electronic technologies S6 — ECTS : 5

Manager : GOURET Vincent

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electrical energy	7.5	10.5	12			10	*0.3*
• Electronic functions	7.5	13.5	21			20	*0.7*
TOTAL	15	24	33	0	0	30	

Signals and electronic systems S6 — ECTS : 8

Manager : CHARGE Pascal

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Control engineering	3.75	5.5	3			6	*0.1*
• Numerical methodes	3.75	6	15			10	*0.25*
• Probabilities, Statistiques	10	15				10	*0.25*
• Deterministic signals ans linear systems	11.25	15	13.75			15	*0.4*
TOTAL	28.75	41.5	31.75	0	0	41	

Humanities S6 — ECTS : 8

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• History of organizations and Accounting business game	9	10.5	12			5	*0.15*
• Physical education and sport 2		21				2	*0.15*
• Soft skills		7.5					*0.15*
• Socio-economic debates and Tools for shifting		21				10	*0.15*
• Professional Project 2		4.5					*0.05*
• Grammar, Toeic and professional English 2		39	2				*0.35*
TOTAL	9	103.5	14	0	0	17	

Computer technologies S6 — ECTS : 7

Manager : PILLEMENT Sébastien

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Microprocessors	7.5	15.5	27			25	*0.6*
• Computer systems	7.5	9	24			15	*0.4*
TOTAL	15	24.5	51	0	0	40	

Internship 3A

ECTS : 2

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

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	67.75	193.5	129.75	0	0	128	30
Face-to-face sum	391						

Semester 7 - unit *ETN 4*

Humanities S7 — ECTS : 7

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Business analysis	4.5	6				3	*0.15*
• Quality, security and environmental approaches (QSE1)		3	3				*0.1*
• Physical education and sport 3		21				2	*0.1*
• Negotiations	3	7.5				2	*0.1*
• Professional project 3		6				6	*0.1*
• Circular economy	4.5	3				6	*0.1*
• Professional English 3		19	2				*0.2625*
1 opt ▷ Continuous Assessment (bis)							*0.0875*
1 opt ▷ French as a Foreign Language for engineering students		18					*0.0875*
1 opt ▷ Second foreign language - Spanish		18					*0.0875*
1 opt ▷ Second foreign language - Japanese		18					*0.0875*
1 opt ▷ Training for Toeic		18					*0.0875*
TOTAL	12	83.5	5	0	0	19	

Electronic and information processing S7 — ECTS : 8

Manager : DIOURIS Jean-François

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electronic midrange	12.5	22.5	27			30	*0.5*
• Microelectronics	2.5	13.5	9			10	*0.25*
• Random signal processing		13.5	9			10	*0.25*
TOTAL	15	49.5	45	0	0	50	

Computer circuits and systems S7 — ECTS : 9

Manager : LE NOURS Sebastien

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Digital circuit design	3.75	18	18			15	*0.3*
• Object Oriented Programming	0.75	10.5	21			15	*0.3*
• Microprocessor systems	2.5	18	21			20	*0.4*
TOTAL	7	46.5	60	0	0	50	

System Engineering S7 — ECTS : 4

Manager : MAHE Yann

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Electromagnetic compatibility		7.5				8	*0.15*
• Transdisciplinary project I				30		30	*0.85*
TOTAL	0	7.5	0	30	0	38	

Training Pathway S7 ECTS : 2

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• S7-3A intership assessment							*1*
1 opt ▷ Entrepreneurship S7				32			*1*
1 opt ▷ Transition Engineering and Interdisciplinarity S7				32			*1*
1 opt ▷ Research S7				32			*1*
1 opt ▷ Ecological and Societal Transition S7				32			*1*
TOTAL	0	0	0	32	0	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	34	187	110	62	0	157	30
Face-to-face sum	393						

Semester 8 - unit *ETN 4*

Networks and multimedia S8 — ECTS : 3

Manager : RAMSTEIN Gérard

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Databases	0.75	1.5	9			4	*0.3*
• Computer networks	2.5	9	12			10	*0.3*
• Multimedia signals	5	4.5	13.5			12	*0.4*
TOTAL	8.25	15	34.5	0	0	26	

System engineering S8 — ECTS : 6

Manager : MAHE Yann

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Industrialization	12	1				6	*0.15*
• Ecodesign	1.5	2				3	*0*
• Optimisation		7.5	12			12	*0.2*
• Transdisciplinary project II				70		35	*0.65*
TOTAL	13.5	10.5	12	70	0	56	

Humanities S8 — ECTS : 6

Manager : KINGSTON John

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Critical approaches of the firm		9				3	*0.13*
• Quality, security ant environmental approaches (QSE2)		6					*0.13*
• Physical education and sport 4		19.5				2	*0.13*
• Professional Project 4		12				5	*0.13*
• Sustainable development and social responsability 2		9				10	*0.13*
• Intercultural explorations		18					*0.175*
1 opt ▷ Continuous Assessment(bis)							*0.175*
1 opt ▷ French as a Foreign Language for engineering students		18					*0.175*
1 opt ▷ Second foreign language - Spanish		18					*0.175*
1 opt ▷ Second foreign language - Japanese		18					*0.175*
1 opt ▷ Training for Toeic		18					*0.175*
TOTAL	0	91.5	0	0	0	20	

Telecommunication systems S8 — ECTS : 4

Manager : RAZBAN HAGHIGHI Tchanguiz

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Digital communications - foundations and techniques	6.25	15	12			15	*0.5*
• HF electronic	8.75	13.5	15			15	*0.5*
TOTAL	15	28.5	27	0	0	30	

Embedded systems S8 ECTS : 4

Manager : PASQUIER Olivier

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Real time system design	3.75	15				8	*0.4*
• Real time operating systems	3.75	7.5	9			10	*0.3*
• SOpC : FPGA design and programming	3.75	3	9			8	*0.3*
TOTAL	11.25	25.5	18	0	0	26	

Internship 4A ECTS : 5

Manager : MAHE Yann

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

Training Pathway S8 ECTS : 2

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
1 opt ▷ Entrepreneurship S8				32			*1*
1 opt ▷ Transition Engineering and Interdisciplinarity S8				32			*1*
1 opt ▷ Research S8				32			*1*
▷ Ecological and Societal Transition S8				32			*1*
TOTAL	0	0	0	32	0	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	48	171	91.5	102	0	158	30
Face-to-face sum	412.5						

Semester 9 - unit *SCM 5*

Engineering project S9 ECTS : 10

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• S9-4th year Internship Assessment						20	*0.15*
• Engineering project				120			*0.85*
TOTAL	0	0	0	120	0	20	

SCM Option S9 ECTS : 14

Manager : DIOURIS Jean-François

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• C1 : RF systems: circuits and antennas	39		21	12		20	*4*
• S9-C2: Radar	9		6				*1*
• C3 : Digital communications : Radio architectures	24		6			15	*3*
• C4 : Design of connected objects and Autonomy	9		12			15	*2*
• C5 : Design of electronic device from specification to industrialisable prototype			15			6	*1*
• C6 : Telecommunication systems engineering	12		6			10	*1*
• C7 : Data Security	15					10	*1*
• CME: Embedded AI	6					3	*1*
TOTAL	114	0	66	12	0	79	

Humanities S9 ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Designing the tomorrow's management	3	6				3	*0.3*
• Project management 2		15				3	*0.35*
• People and team management		10.5				6	*0.3*
• Professional project 5		12				2	*0.05*
• Training for TOEIC - s9		10					*0*
TOTAL	3	53.5	0	0	0	14	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	117	53.5	66	132	0	113	28
Face-to-face sum	368.5						

Semester 9 - unit *SETR 5*

Engineering project S9 ECTS : 10

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• S9-4th year Internship Assessment						20	*0.15*
• Engineering project				120			*0.85*
TOTAL	0	0	0	120	0	20	

SETR Option S9 ECTS : 14

Manager : PASQUIER Olivier

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• CME: Embedded AI	6					3	*1*
• E1 : Embedded system design	6	18				10	*2*
• E2 : SoC design	4.5	15	9			15	*2*
• E3 : Codesign	9		18			15	*2*
• E4 : Embedded softwares	12		18			15	*2*
• E5 : IoT architecture	10.5		9			10	*1*
• ME1 : Model Driven for Software Engineering	3	3	6			10	*1*
• ME2 : Hardware description languages, reuse and integration	3		12			10	*1*
• ME3 : Real time systems	4.5	1.5	9			5	*1*
• ME4 : Security	6		9			10	*1*
• ME5: Intelligence Artificielle & Embarquée (Partie Pratique)			6			2	*1*
TOTAL	64.5	37.5	96	0	0	105	

Humanities S9 ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Designing the tomorrow's management	3	6				3	*0.3*
• Project management 2		15				3	*0.35*
• People and team management		10.5				6	*0.3*
• Professional project 5		12				2	*0.05*
• Training for TOEIC - s9		10					*0*
TOTAL	3	53.5	0	0	0	14	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	67.5	91	96	120	0	139	28
Face-to-face sum	374.5						

Semester 9 - unit *SMTR 5*

Engineering project S9 — ECTS : 10

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• S9-4th year Internship Assessment						20	*0.15*
• Engineering project				120			*0.85*
TOTAL	0	0	0	120	0	20	

SMTR Option S9 — ECTS : 14

Manager : SAADANE Abdelhakim

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• CME: Embedded AI	6					3	*1*
• M1 : Internet and multimedia	3		12			10	*1*
• M2 : Multimedia standards and services	18		12			15	*2*
• M3 : Open Instruction Set Architecture	3		6			10	*1*
• M4 : IoT and communication technologies	3		12	12			*3*
• M5 : parallel programming on multicore CPUs	6		12				*1*
• M6 : Multimedia and Deep Learning with GPUs	3	3	15			8	*1*
• ME1 : Model Driven for Software Engineering	3	3	6			10	*1*
• ME2 : Hardware description languages, reuse and integration	3		12			10	*1*
• ME3 : Real time systems	4.5	1.5	9			5	*1*
• ME4 : Security	6		9			10	*1*
• ME5: Intelligence Artificielle & Embarquée (Partie Pratique)			6			2	*1*
• M7: Security (Part II)			6				*1*
TOTAL	58.5	7.5	117	12	0	83	

Humanities S9 — ECTS : 4

Course	Lect	Tut	PW	Proj	WP	Asst	*Coef*
• Designing the tomorrow's management	3	6				3	*0.3*
• Project management 2		15				3	*0.35*
• People and team management		10.5				6	*0.3*
• Professional project 5		12				2	*0.05*
• Training for TOEIC - s9		10					*0*
TOTAL	3	53.5	0	0	0	14	

Sum of semester

	Lect	Tut	PW	Proj	WP	Asst	ECTS
Sum	61.5	61	117	132	0	117	28
Face-to-face sum	371.5						

Semester 10 - unit *ETN 5*

end of study internship ECTS : 30

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

Sum of semester

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

Part II

Sheets of courses

Algorithmic and C language

Hours

Lect	Tut	PW	Proj	WP	Asst
6.25	12	21			15

Evaluation

3 evaluations :

- *Ecrit*
- *TPs*
- *TDs*

Outline

1. Introduction to computer science
2. Algorithms
3. Programming bases
4. C language, advanced concepts
5. Computational complexity
6. Récursivity
7. 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	·	·	✓	·	·

Manager : Gérard RAMSTEIN

Analysis and approximation

Hours

Lect	Tut	PW	Proj	WP	Asst
8.75	16.5				10

Evaluation

2 evaluations :

- *Contrôle intermé.*
- *Contrôle final*

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	Asst
11.25	11.5				10

Evaluation

2 evaluations :

- *DS1*
- *DS2*

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. 3. Vector Analysis: Scalar and vector fields, flow, gradient, rotational, divergence, laplacian. 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 and vector analysis 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.	·	·	✓	·	·
• Calculate a rotational, gradient divergence, a partial derivative, a double and curvlinear integral.	·	·	✓	·	·
• Multiply two matrices, invert a matrix, compute the eigenvectors and eigenvalues??, solving a linear system.	·	·	✓	·	·

Manager : Yide WANG

Basis of electronic

Hours

Lect	Tut	PW	Proj	WP	Asst
6.25	12	9			10

Evaluation

2 evaluations :

- *Controle Final*
- *TP*

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

Business analysis

Hours

Lect	Tut	PW	Proj	WP	Asst
4.5	6				3

Evaluation

One evaluation : *Etude de cas*

Bibliography

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

Learning outcomes

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

Manager : Gwenael THOREL

Business knowledge and entrepreneurship

Hours

Lect	Tut	PW	Proj	WP	Asst
3	13.5				4

Evaluation

One evaluation : *Etude de cas*

Bibliography

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

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

? http://www.laurentdehouck.fr/enseignements/histoire-des-idees-sur-les-organisations/

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

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

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

Learning outcomes

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

Manager : Luc OILI

C1 : RF systems: circuits and antennas

Hours

Lect	Tut	PW	Proj	WP	Asst
39		21	12		20

Evaluation

3 evaluations :

- *Manip TP*
- *Projet CAO*
- *Ecrit*

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 specific 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 numériques ; Masson, 2003
3) Henry Mathieu ; Physique des semiconducteurs et composants électroniques ; Masson, 2004.
4) G. Asch ; Les capteurs en instrumentation industrielle ; Dunod, 1999
5) Salvador Mir ; Dispositifs et physique des microsystèmes sur silicium ; Hermès, 2002
6) Eyraud Grange, Ohanessian ; Théorie 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 communications : Radio architectures

Hours

Lect	Tut	PW	Proj	WP	Asst
24		6			15

Evaluation

2 evaluations :

- *DS*
- *TP*

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 nowdays telecommunication systems. Moreover choas based information security techniques and systems are described.

Bibliography

J.G. PROAKIS, "Digital Communications", McGraw-Hill, 4th edition, 2001.

M. RICE, "Digital Communications : A Discrete-Time Approach", Pearson Prentice-Hall, 2009.

Y. WANG, "Récepteurs Optimaux", Cours ETN5/SCM, Polytech'Nantes, 2010.

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	·	✓	·	·	·
• To know how to generate pseudo-chaotic sequences and to estimate their performance	·	·	✓	·	·
• To know how to realize a chaos-based cryptosystem	·	✓	·	·	·

Manager : Pascal CHARGE

C4 : Design of connected objects and Autonomy

Hours

Lect	Tut	PW	Proj	WP	Asst
9		12			15

Evaluation

One evaluation : *Compte Rendu TP*

Goals

This course addresses IOT and connected objects through its applications and its architecture and communication technologies. Middleware aspects are also covered

Prerequisites

Digital communications, microcontrollers, signal processing

Learning outcomes

Learning outcomes	N	A	M	E	O
• Know the application domains of IoT	·	·	✓	·	·
• Know the architecture of the IOT	·	·	✓	·	·
• Know and know how to select a communication protocol for a connected object	·	·	✓	·	·
• Connaître le protocole LORAWAN	·	·	✓	·	·
• Know how to implement the MQTT protocol	·	·	✓	·	·

Manager : Jean-François DIOURIS

C5 : Design of electronic device from specification to industrialisable prototype

Hours

Lect	Tut	PW	Proj	WP	Asst
		15			6

Evaluation

2 evaluations :

- *comte rendu TP*
- *Ecrit*

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 : Telecommunication systems engineering

Hours

Lect	Tut	PW	Proj	WP	Asst
12		6			10

Evaluation

One evaluation : *Soutenance projet*

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

C7 : Data Security

Hours

Lect	Tut	PW	Proj	WP	Asst
15					10

Evaluation

One evaluation : *Synthèse + oral*

Outline

Generalities
- Classical cryptography
- Advanced Encryption Algorithm (AES)
- Various Cipher Block Modes : Symmetric key algorithms
- Chaos-based data security
- Why using chaos to secure information?
- Design of efficient chaotic generators and performance measure
- Design of efficient cryptosystems and performance evaluation
- Design of efficient steganography systems
- Design of efficient Hash Functions and performance evaluation

Goals

This course is dedicated to understanding calssical Cryptography and to design chaos-based cryptography systems.

Chaotic Generators, Cryptosystems, Steganography and Hash Functions.

Bibliography

W. Stallings, « Cryptography and Netwrk Security », Pearson 2014

B. Schneier, « Applied Cryptography »,Wiley 1996

[Lozi, 2012],?Emergence of randomness from chaos?, International Journal of Bifurcation and Chaos, IJBC, Vol. 22, No. 2 (2012) 1250021 (15 pages).

[Masuda et al., 2006], ?Chaotic block ciphers: from theory to practical algorithms?. IEEE Trans on Circuits and Systems-I, vol. 53, no. 6, 2006, pp. 1341-1352.

[El Assad et al. 2014],?Chaos-based Block Ciphers: An Overview?, IEEE, 10th International Conference on Communications, COMM-2014, Bucharest, Romania, May 2014, pp. 23-26. Invited talk

[El Assad, Farajallah, 2016], ?A new Chaos-Based Image Encryption System?. Signal Processing: Image Communication 41, (2016) 144-157.

Learning outcomes

Learning outcomes	N	A	M	E	O
• - To provide principles, theory and methods for designing data security and chaos-based data security.	·	✓	·	·	·
• To be able to design, realize and analyse chaos-based cryptographic systems.	·	✓	·	·	·
• To know applications: Images and videos security ; Internet of Things (IoT) security.	·	✓	·	·	·

Manager : Safwan EL ASSAD

CME: Embedded AI

Hours

Lect	Tut	PW	Proj	WP	Asst
6					3

Evaluation

2 evaluations :

- *QCM*
- *Rapport + eval TP*

Manager : Olivier PASQUIER

Circular economy

Hours

Lect	Tut	PW	Proj	WP	Asst
4.5	3				6

Evaluation

One evaluation : *Diagnostic*

Bibliography

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

Learning outcomes

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

Manager : Chrystèle GONCALVES

Complex analysis

Hours

Lect	Tut	PW	Proj	WP	Asst
6.25	10.5				8

Evaluation

One evaluation : *Ecrit*

Outline

Short recall of the complex numbers
- Holomorphic and harmonic functions
- Conformal mappings
- Integration in the complex plane
- Cauchy's integral theorem
- Laurent series expansion
- Residue theorem
- Integrals of real functions with the residue theorem.

Goals

This course is an important branch of applied mathematics for electronics and information engineers. Many subjects studied in the department ETN use the concepts and tools of complex analysis. It aims to give students an essential basis of the analysis of functions of complex numbers, in order to help the student to follow the courses such as signal processing, telecommunication, ...

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
• Handle Correctly and efficiently operations on complex numbers	·	·	✓	·	·
• Be able to find if a complex function is holomorphic and its properties and the relationship between holomorphic and harmonic functions	·	·	✓	·	·
• Perform conformal transformations, in particular, inversion and homographic transformations	·	·	✓	·	·
• Calculate the integral in the complex plane	·	·	✓	·	·
• Realize integral real valued function by using the residue theorem and the Cauchy's integral theorem, including Fourier transform.	·	✓	·	·	·

Manager : Yide WANG

Computer networks

Hours

Lect	Tut	PW	Proj	WP	Asst
2.5	9	12			10

Evaluation

2 evaluations :

- *Contrôle réseaux*
- *TP réseaux*

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 : Sébastien PILLEMENT

Computer systems

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	9	24			15

Evaluation

2 evaluations :

- *DS*
- *TP*

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 : Sébastien PILLEMENT

Continuous Assessment (bis)

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *CC*

Continuous Assessment(bis)

Hours

Lect Tut PW Proj WP Asst

Evaluation

One evaluation : *CC*

Control engineering

Hours

Lect	Tut	PW	Proj	WP	Asst
3.75	5.5	3			6

Evaluation

One evaluation : *DS*

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

Critical approaches of the firm

Hours

Lect	Tut	PW	Proj	WP	Asst
	9				3

Evaluation

One evaluation : *Exposé*

Bibliography

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

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

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

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

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

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

Learning outcomes

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

Manager : Roland BESSENAY

Databases

Hours

Lect	Tut	PW	Proj	WP	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	·	·	✓	·	·

Manager : Gérard RAMSTEIN

Designing the tomorrow's management

Hours

Lect	Tut	PW	Proj	WP	Asst
3	6				3

Evaluation

One evaluation : *Grille d'évaluation*

Bibliography

Partie don :

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

Recevoir pour donner (Collectif, 2016)

Partie Jeux sérieux :

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

Learning outcomes

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

Manager : Roland BESSENAY

Deterministic signals ans linear systems

Hours

Lect	Tut	PW	Proj	WP	Asst
11.25	15	13.75			15

Evaluation

3 evaluations :

- *Inter*
- *TP*
- *Final*

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.

Characterization of Linear and Time-Invariant Systems

Linear Filtering: Analog Filter Design, FIR Filter Design and IIR Filter Design

Filter Implementation: FIR filter Structures, IIR Filter Structures

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	Asst
3.75	22	30			20

Evaluation

4 evaluations :

- *CR de MP 0.2*
- *CR de TP 0.1*
- *DS 2 (janvier) 0.35*
- *DS 1 (Novembre) 0.35*

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 : Safwan EL ASSAD

Digital circuit design

Hours

Lect	Tut	PW	Proj	WP	Asst
3.75	18	18			15

Evaluation

3 evaluations :

- *Final conc circ*
- *Rapport TP*
- *Contrôle cours*

Outline

1-Introduction to the design of embedded systems
2- Organisation of logic resources in digital circuits
3- Design flow of digital circuits
4- Méthodology for design of electronic circuits
5- Technologies for fabrication of digital circuits
6- Use of hardware description language

Goals

This module aims at putting into practice a methodology for design of digital circuits. This module is also concerned by 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 be able to choose of a technology for implementation of a circuit	·	✓	·	·	·
• To master steps and related tools for designing a circuit	·	·	✓	·	·
• To know principles related to hardware description languages	·	✓	·	·	·

Manager : Sebastien LE NOURS

Digital communications - foundations and techniques

Hours

Lect	Tut	PW	Proj	WP	Asst
6.25	15	12			15

Evaluation

3 evaluations :

- *Final*
- *TP*
- *Inter*

Outline

1. Baseband transmission

? Pulse code modulation (PCM) Waveform types of binary digits (linear, nonlinear, and partial), power spectral density; Inter-symbol interference ISI; Error probability

? Equalization techniques, Nyquist criteria, eye diagram, optimal distribution of the equalization between the transmitter/receiver.

2. Bandpass modulation and demodulation

? Interests, noise in radio communication systems, linear and nonlinear modulations

? General structure of the modulator, constellation diagram, choice of constellation, usual linear modulation-demodulating (MDA, MDP, MDAQ,)

? Equivalent baseband channel, I.S.I, eye diagram, error probability

3. Information theory

* Uncertainty, quantity of information (entropy), rate, efficiency and redundancy of sources and codes, capacity, codes with unique decoding, optimal codes (Fano-Shannon, Huffman)

* Channel coding: Hamming codes, cyclic codes: principle, polynomial generator, coding by division, coding by multiplication, detection of the errors, Circuits of coding-decoding.

Goals

To learn the digital communication processing and techniques

- To be able to analyse and design a digital communication systems in base-band as well as in pass-band channels.

Bibliography

Alain Glavieux, Michel Joindot
« Communications numériques » ; Masson, 1996
Geneviève Baudoin et all
« Radiocommunications numériques/1 » ; Dunod, 2002
John G. Proakis
« Digital communications » ; McGRAW-HILL, 1995
"Communications numériques 1: fondements et techniques"
Safwan El Assad et Dominique Barba
ISTE Editions Ltd 2020, 306 pages
ISBN: 978-1-78405-669-8 (print)
ISBN: 978-1-78406-669-7 (e-book)
"Communications numériques 2: travaux dirigés et pratiques"
Safwan El Assad et Dominique Barba
ISTE Editions Ltd 2020, 317 pages

ISBN: 978-1-78405-670-4 (print)
ISBN: 978-1-78406-670-3 (e-book)
"Digital Communications 1: Fundamentals and Techniques"
Safwan El Assad, Dominique Barba
ISTE/WILEY Ltd 2020, 299 pages
ISBN: 978-1-78630-541-1 (print)
"Digital Communications 2: Directed and Practical Work"
Safwan El Assad, Dominique Barba
ISTE/WILEY Ltd 2020, 310 pages
ISBN: 978-1-78630-542-8 (print)

Prerequisites

Probability and stochastic processes
Deterministic signals, linear systems
Statistics

Learning outcomes

Learning outcomes	N	A	M	E	O
• To know digital modulation techniques for telecommunactions	·	✓	·	·	·
• To know coding techniques	·	✓	·	·	·
• To be able to design digital communications (base band and carrier modulation)	·	✓	·	·	·

Manager : Safwan EL ASSAD

E1 : Embedded system design

Hours

Lect	Tut	PW	Proj	WP	Asst
6	18				10

Evaluation

One evaluation : *Rapport*

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

- Microprocessor systems
  - Real-time systems and operating 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	Asst
4.5	15	9			15

Evaluation

One evaluation : *Rapport*

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 : Sebastien LE NOURS

E3 : Codesign

Hours

Lect	Tut	PW	Proj	WP	Asst
9		18			15

Evaluation

One evaluation : *TP*

Outline

1. Introduction
   2. Current trends in codesign
   3. HW/SW co-verification
   4. Implemantation of HW/SW communications
   5. Platform based design
   6. SystemC
   7. Transaction level modeling
   8. Performance evaluation
   9. Conclusion

Goals

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

Bibliography

A. Jerraya, Conception de haut niveau des systèmes monopuces , Hermes, 2002
D.C. Black, J Donovan, SystemC: From the Ground Up, Springer, 2004
G. Martin, H. Chang, Winning the SoC Revolution, Kluwer Academic Publishers, 2003

Prerequisites

Circuit design, microprocessor systems, object oriented programming

Learning outcomes

Learning outcomes	N	A	M	E	O
• To understand main activities in HW/SW codesign	·	·	✓	·	·
• To use SystemC for the description of a simple architecture	·	✓	·	·	·
• To develop a HW/SW architecture on FPGA	·	·	✓	·	·
• To use TLM for performance evaluation of architectures	·	✓	·	·	·

Manager : Sebastien LE NOURS

E4 : Embedded softwares

Hours

Lect	Tut	PW	Proj	WP	Asst
12		18			15

Evaluation

One evaluation : *Projet*

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

E5 : IoT architecture

Hours

Lect	Tut	PW	Proj	WP	Asst
10.5		9			10

Evaluation

One evaluation : *questionnaire*

Bibliography

JK Peckol, "Embedded systems", Wiley 2019

Learning outcomes

Learning outcomes	N	A	M	E	O
• Architecture of embedded systems	·	·	✓	·	·
• Power management in embedded systems	·	·	✓	·	·

Manager : Olivier PASQUIER

Ecodesign

Hours

Lect	Tut	PW	Proj	WP	Asst
1.5	2				3

Outline

1. Scenario
   2. Examples of eco-desgned products
   3. Environmental impacts
   4. Basic principles of Eco-Design (ISO 14 062)
   5. Eco-tools
   6. Environmental communication

Goals

Understand the objectives of eco-design
Discover its basic principles and tools associated
Implement a simple software

Bibliography

JOLLIET, O. ; SAADÉ, M. ; CRETTAZ, P. (2005). Analyse du cycle de vie : comprendre et réaliser un écobilan, Lausanne, Presses polytechniques et universitaires romandes.

MILLET, D. (dir.) (2003). Intégration de l'environnement en conception, l'entreprise et le développement durable, Paris, Hermès science, Lavoisier.

Prerequisites

Awareness of environmental issues

Learning outcomes

Learning outcomes	N	A	M	E	O
• List the major environmental impacts	✓	·	·	·	·
• List the stages of life cycle analysis	✓	·	·	·	·
• Make an assessment product	·	✓	·	·	·

Manager : Antoine GOULLET

Ecological and Societal Transition S7

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Evaluation*

Manager : Emilie GADOIN

Ecological and Societal Transition S8

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Evaluation*

Manager : Emilie GADOIN

Electrical energy

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	10.5	12			10

Evaluation

2 evaluations :

- *DS (0.7)*
- *TP (0.3)*

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 functioning of power electronic converters	·	✓	·	·	·
• Knowing the main systems of power conversion	·	✓	·	·	·

Manager : Yann MAHE

Electromagnetic compatibility

Hours

Lect	Tut	PW	Proj	WP	Asst
	7.5				8

Evaluation

One evaluation : *DS*

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 MAHE

Electromagnetism

Hours

Lect	Tut	PW	Proj	WP	Asst
8.75	6				9

Evaluation

One evaluation : *Ecrit*

Outline

Introduction to electromagntism and basics of vectorial analysis 1. Electrostatics, Coulomb's law and electric field.

2. Electric Potential
3. conductors capabilities
4. Electrokinetics
5. Basics if magnetostatic

Goals

It aims at strengthening the basics of electricity and electromagnetism. The main objective is to use analytical and local expressions of electromagnetism and to understand the physical phenomena involved. The final purpose is to present Maxwell equations to introduce the propagation teachings.

Bibliography

Electromagnétisme; Paul roux; Ed ellipses (1993)

Prerequisites

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

Learning outcomes

Learning outcomes	N	A	M	E	O
• To use the mathematical formalism, in particular vector analysis, applied to the EM	·	✓	·	·	·
• To solve classical problems of electrostatics	·	·	✓	·	·
• To establish the equation of resistor or capacitor	·	·	✓	·	·
• To describe and solve magnetic phenomena in static problems	·	✓	·	·	·
• To understand Maxwell's equations	✓	·	·	·	·
• Understand the link between local and integral formalism	·	✓	·	·	·

Manager : Antoine GOULLET

Electronic functions

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	13.5	21			20

Evaluation

2 evaluations :

- *DS final (0.5)*
- *Évaluation TP (0.5)*

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	Asst
12.5	22.5	27			30

Evaluation

3 evaluations :

- *Inter (0.2)*
- *Final (0.4)*
- *TP (0.4)*

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	Asst
			120		

Evaluation

One evaluation : *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	·	·	✓	·	·

Entrepreneurship S7

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Evaluation*

Manager : John KINGSTON

Entrepreneurship S8

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Evaluation*

Manager : John KINGSTON

Final project

Hours

Lect	Tut	PW	Proj	WP	Asst

Evaluation

One evaluation : *Note*

Manager : Sebastien LE NOURS

French as a Foreign Language for engineering students

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

French as a Foreign Language for engineering students

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Grammar and professional English 1

Hours

Lect	Tut	PW	Proj	WP	Asst
	40				

Evaluation

2 evaluations :

- *CC*
- *DS*

Grammar, Toeic and professional English 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	39	2			

Evaluation

3 evaluations :

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

Guided propagation

Hours

Lect	Tut	PW	Proj	WP	Asst
5	9	3			8

Evaluation

One evaluation : *Final*

Outline

1. Introduction to propagation - Context: Main applications of microwave and optical
2. What is a plane wave ? - Propagation in an infinite environment
3. Reflection of a plane wave on a conductor plane at normal incidence - Definition of a cavity
4. Reflection of a plane wave on a conductor plane arriving at oblique incidence - Definition of a waveguide
5. Phenomena of reflection / refraction at the interface between two dielectrics
6. Equation and dispersion diagram - Application to waveguides parallel-plane waveguides and metallic rectangular waveguides
7. General method for the study of waveguides - Maps of electric and magnetic fields in a plane metal guide
8. Application to the conception of a rotary joint for surveillance radars

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 ones can propagate in a specific waveguide and their description (TE, TM, TEM classification, n-order modes, 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

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

HF electronic

Hours

Lect	Tut	PW	Proj	WP	Asst
8.75	13.5	15			15

Evaluation

3 evaluations :

- *Final*
- *Inter*
- *Rapport MP*

Outline

1. Introduction
   2. transmission line
   3. Pulse transmission in lines
   4. Smith Chart and impedance matching
   5. Discontinuities
   6. High frequency passive and active circuit design
   7. Mini project on the filter and amplifier design. CAD software using. Caracterisation 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

Learning outcomes

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

Manager : Tchanguiz RAZBAN HAGHIGHI

History of organizations and Accounting business game

Hours

Lect	Tut	PW	Proj	WP	Asst
9	10.5	12			5

Evaluation

One evaluation : *Soutenance + CC*

Learning outcomes

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

Manager : Chrystèle GONCALVES

Industrialization

Hours

Lect	Tut	PW	Proj	WP	Asst
12	1				6

Evaluation

2 evaluations :

- *Examen écrit*
- *Eco-conception*

Outline

Part I Engineering trades, practices and responsibilities
The life cycle of products, ISO 9001
Processes:from industrialization to production, risk management
Design to cost, design to produce, the value analysis
Product logistics, maintenance policy, overall cost, end of life, reliability calculations, obsolescence management,
Organizing projects (WBS / OBS / PBS), planning, role of quality (dedicated / integrated)
?Make/Team/Buy' choices Part II
Introduction Quality, components and insertion ESD, MSD
Brazing

Goals

Understand and control the technical and non technical phases which will then allow to produce mass electronic products and systems meeting the requirements of quality and profitability.

Prerequisites

Basics of industrialization and production Basics of project organization Knowledge of passive and active electronic components

Learning outcomes

Learning outcomes	N	A	M	E	O
• Identify the phases of development of an industrial project	·	·	✓	·	·
• Being able to organize the development of a project	·	✓	·	·	·
• Understand the roles of actors and organizations involved in industrial processes	✓	·	·	·	·
• Know the key equipment manufacturing and control of electronics products	·	✓	·	·	·
• Know the main stages of electronic products manufacturing	·	✓	·	·	·

Manager : Antoine GOULLET

Intercultural explorations

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Internship 3rd year

Hours

Lect Tut PW Proj WP Asst

Evaluation

3 evaluations :

- *convention /CDD*
- *Rapport d'arrivée*
- *questionnaire éval*

Manager : Yann MAHE

M1 : Internet and multimedia

Hours

Lect	Tut	PW	Proj	WP	Asst
3		12			10

Evaluation

One evaluation : *Note mini projet*

Outline

Introduction, Applications Internet / Multimedia, Transport Protocols, and IP Routing Protocol, RTP and RTCP protocols, Quality of Service.

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

Computer Networks (sem.8)

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 : Przemyslaw BAKOWSKI

M2 : Multimedia standards and services

Hours

Lect	Tut	PW	Proj	WP	Asst
18		12			15

Evaluation

2 evaluations :

- *Contrôle*
- *TP*

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 : Open Instruction Set Architecture

Hours

Lect	Tut	PW	Proj	WP	Asst
3		6			10

Evaluation

2 evaluations :

- *Contrôle*
- *TP*

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

Manager : Przemyslaw BAKOWSKI

M4 : IoT and communication technologies

Hours

Lect	Tut	PW	Proj	WP	Asst
3		12	12		

Evaluation

One evaluation : *Notes TP*

Manager : Przemyslaw BAKOWSKI

M5 : parallel programming on multicore CPUs

Hours

Lect	Tut	PW	Proj	WP	Asst
6		12			

Evaluation

One evaluation : *Notes TP*

Outline

1. Introduction
   2. MCU vs DSP
   3. DSP: Software optimization
   4. SIMD concept
   5. ARM-A: optimization using Neon
   6. 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

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

M6 : Multimedia and Deep Learning with GPUs

Hours

Lect	Tut	PW	Proj	WP	Asst
3	3	15			8

Evaluation

One evaluation : *Note*

Outline

High performance architectures. Multimedia processing. GPU architectures. Parallel programming on NVIDIA and CUDA (GPGPU).

Goals

We study High Performance CPU and GPUs and practice parallel programming (oriented multimedia) on GPUs (Nvidia - CUDA).

Bibliography

J.Sanders,E.Kandrot, 'CUDA by example';
P.Bakowski - www.polytech2go.fr

Prerequisites

Microprocessors. Programming with C language.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Understand high-performance processing and instruction sets specific of multimedia processors	✓	·	·	·	·
• Able to analyze the required elements in achieving a sound system	✓	·	·	·	·
• Know how to optimize the performance of a multimedia application	✓	·	·	·	·

Manager : Przemyslaw BAKOWSKI

M7: Security (Part II)

Hours

Lect	Tut	PW	Proj	WP	Asst
		6			

Evaluation

One evaluation : *QCM*

ME1 : Model Driven for Software Engineering

Hours

Lect	Tut	PW	Proj	WP	Asst
3	3	6			10

Evaluation

One evaluation : *Rapport*

Outline

1. UML
   2. Analysis and Object design
   3. Design patterns
   4. software engineering
   5. UML for the embedded systems design

Goals

This course presents the UML modeling language and describes how to integrate UML in software development processes. It defines good practice in software engineering and presents quality approach in software engineering. Sysml and MARTE profiles are introduced for the embedded systems design support.

Bibliography

Bertrand Meyer ; Conception et Programmation orientées objet ; Eyrolles, 2000

Sinan Si Alhir ; Introduction à UML ; O'Reilly, 2005

Pascal Roques , Franck Vallée ; UML2 en action ; Eyrolles, 2004

Richard Basque ; CMMI, un itinéraire éché vers le Capability Maturity Model Intégration; Dunod, 2004

Prerequisites

Object programming, Java language

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowledge of UML language	·	·	·	✓	·
• Object design	·	·	✓	·	·
• use of design patterns	·	·	✓	·	·
• use of modeling tools (e.g. Rational Rose)	·	✓	·	·	·
• Knowledge in software engineering and quality approach	·	·	✓	·	·
• UML profiles use for embedded systems design	·	✓	·	·	·

Manager : Olivier PASQUIER

ME2 : Hardware description languages, reuse and integration

Hours

Lect	Tut	PW	Proj	WP	Asst
3		12			10

Evaluation

One evaluation : *Rapport*

Outline

Introduction to HDL.

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

Goals

We teach how to develop reusable components in HDL and how to use them in a complex system with an 'open source' processor.

Bibliography

P. Ashender: 'VHDL Cookbook';

P.Bakowski - www.polytech2go.fr

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

ME3 : Real time systems

Hours

Lect	Tut	PW	Proj	WP	Asst
4.5	1.5	9			5

Evaluation

2 evaluations :

- *Rapport + eval TP*
- *QCM Linux*

Outline

The first part of this module introduces some advance policies for task scheduling to be able to consider different kind of tasks and to satisfy time constraints (scheduling based on laxity, considering aperiodic tasks, tasks servers, ...). This theoritic aspects are illustrated by solution used for car (OSEK, AUTOSAR) and for real-time programming based on Java language.

The second part of this module deals with Linux operating system for embedded applications. Firstly, basic skills are given to set the operating system as a deterministic system for real-time application. Then labs illustrate possibilities to tune the operating system for a specific platform. Finally an application has to be defined on Linux for this platfom.

Goals

The purpose of this module is to improve knowledge of shceduling policy and specific task sets in embedded and/or real-time applications. Theses concepts are illustrated by a consideration of Linux operating system for embedded and real-time applications. This OS must be first configurated according to a specific platform and then an application has to be developped to use it.

Bibliography

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

P. Ficheux, "Linux embarqué", Eyrolles 2002.

Prerequisites

Multi-task scheduling,

Specificity of rel-time systems,

Operating systems

Learning outcomes

Learning outcomes	N	A	M	E	O
• Scheduling policies for real-time tasks	·	·	·	✓	·
• Linux for embedded applications	·	·	✓	·	·
• Setting Linux for a specific embedded platform	·	✓	·	·	·

Manager : Olivier PASQUIER

ME4 : Security

Hours

Lect	Tut	PW	Proj	WP	Asst
6		9			10

Evaluation

2 evaluations :

- *Cours*
- *TP*

Manager : Maria MENDEZ REAL

ME5: Intelligence Artificielle & Embarquée (Partie Pratique)

Hours

Lect	Tut	PW	Proj	WP	Asst
		6			2

Evaluation

One evaluation : *QCM*

Manager : Olivier PASQUIER

Microelectronics

Hours

Lect	Tut	PW	Proj	WP	Asst
2.5	13.5	9			10

Evaluation

3 evaluations :

- *Final*
- *Inter*
- *TP*

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	Asst
2.5	18	21			20

Evaluation

3 evaluations :

- *cours cartes microp*
- *final cartes microp*
- *projet cartes microp*

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 : Sebastien LE NOURS

Microprocessors

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	15.5	27			25

Evaluation

2 evaluations :

- *DS*
- *TP*

Outline

- General information on systems with micro-processors and micro-controllers
  - Languages and tools (software and hardware)
  - Internal view of a C, 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

- JF WAKERLY ; Digital Design, Principles and practices ; Prentice Hall, 1990
- RH KATZ ; Contemporary logic design ; Benjammin Cummings, 1994

Prerequisites

C Language, VHDL, 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

Multimedia signals

Hours

Lect	Tut	PW	Proj	WP	Asst
5	4.5	13.5			12

Evaluation

One evaluation : *Final*

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

Negotiations

Hours

Lect	Tut	PW	Proj	WP	Asst
3	7.5				2

Evaluation

One evaluation : *Vidéo*

Bibliography

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

Learning outcomes

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

Manager : John KINGSTON

Numerical methodes

Hours

Lect	Tut	PW	Proj	WP	Asst
3.75	6	15			10

Evaluation

3 evaluations :

- *TP*
- *Final*
- *TD*

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	Asst
0.75	10.5	21			15

Evaluation

3 evaluations :

- *DS*
- *Rapport TP*
- *TP*

Outline

1. Introduction to Java language
2. Object-related concepts
3. Inheritance
4. Exceptions
5. Graphical user interfaces and applets

Goals

This course present the essential concepts of object programming as well as the basis of Java language.

Bibliography

Claude Delannoy ; Programmer en Java ; Eyrolles, 2008
Anne Tasso ; Le livre de Java premier langage ; Eyrolles, 2011
Michel Divay ; Java et la programmation objet ; Dunod, 2002

Prerequisites

Algorithms, structural programming, C language.

Learning outcomes

Learning outcomes	N	A	M	E	O
• Knowledge of major principles related to object programming	·	·	✓	·	·
• Knowledge of Java language	·	·	✓	·	·

Manager : Gérard RAMSTEIN

Optimisation

Hours

Lect	Tut	PW	Proj	WP	Asst
	7.5	12			12

Evaluation

3 evaluations :

- *Final*
- *Inter*
- *TP*

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

People and team management

Hours

Lect	Tut	PW	Proj	WP	Asst
	10.5				6

Evaluation

One evaluation : *DS*

Bibliography

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

Learning outcomes

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

Manager : Anouk GREVIN

Physical education and sport 1

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				2

Evaluation

One evaluation : *Contrôle continu*

Learning outcomes

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

Manager : Jérôme BEZIER

Physical education and sport 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				2

Evaluation

One evaluation : *Contrôle continu*

Learning outcomes

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

Manager : Jérôme BEZIER

Physical education and sport 3

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				2

Evaluation

One evaluation : *Contrôle continu*

Learning outcomes

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

Manager : Jérôme BEZIER

Physical education and sport 4

Hours

Lect	Tut	PW	Proj	WP	Asst
	19.5				2

Evaluation

One evaluation : *Contrôle continu*

Learning outcomes

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

Manager : Jérôme BEZIER

Physics of semiconductors and components

Hours

Lect	Tut	PW	Proj	WP	Asst
7.5	20.5	9			15

Evaluation

3 evaluations :

- *Final*
- *intermediaire*
- *TP*

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

Probabilities, Statistiques

Hours

Lect	Tut	PW	Proj	WP	Asst
10	15				10

Evaluation

2 evaluations :

- *Inter*
- *Final*

Outline

Recall of classical probability
- Probability axioms
- Conditional probabilities
- Dependence and independence of events
- Theorem of total probability and Bayes' theorem
- Random variables and vector
- Classical laws of random variable
- Function of a random variable
- Central limit theorem
- Law of large numbers
- Confidence interval with a predefined threshold
- Chi-2 test
- Comparison of two means (homogeneity test)
- Correlation between two populations test
- Student 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 and Student

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
• Handle conditional probability	·	·	✓	·	·
• Apply the binomial, Poisson, hypergeometric geometric and Gaussian laws	·	·	✓	·	·
• Perform conformal transformations, in particular, inversion and homographic transformations. Calculate the moments, in particular the mean and variance of a random variable	·	·	✓	·	·
• Calculate the law of a function of a random variable	·	·	✓	·	·
• Use and apply the central limit theorem. Apply the concept of confidence interval	·	·	✓	·	·
• Calculate the mean, standard deviation from a series sample, and understand their physical meanings	·	·	✓	·	·

Manager : Yide WANG

Professional English 3

Hours

Lect	Tut	PW	Proj	WP	Asst
	19	2			

Evaluation

3 evaluations :

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

Professional Project 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	4.5				

Evaluation

One evaluation : *CV rendu*

Manager : Sylvaine GAUTIER

Professional Project 4

Hours

Lect	Tut	PW	Proj	WP	Asst
	12				5

Evaluation

One evaluation : *Oral*

Outline

Path : 4 sessions of 3h TD

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

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

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

Goals

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

Bibliography

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

Prerequisites

Professionnal project 1 (S5)

Discovery of firms and professions (S6)

Learning outcomes

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

Manager : Sylvaine GAUTIER

Professional project 3

Hours

Lect	Tut	PW	Proj	WP	Asst
	6				6

Evaluation

One evaluation : *Profil linkedin+rdv*

Bibliography

Grant : Givers & Takers TED

Learning outcomes

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

Manager : John KINGSTON

Professional project 5

Hours

Lect	Tut	PW	Proj	WP	Asst
	12				2

Evaluation

One evaluation : *Présence*

Bibliography

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

Learning outcomes

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

Manager : Sylvaine GAUTIER

Professionnal project 1

Hours

Lect	Tut	PW	Proj	WP	Asst
1.5	12				4.5

Evaluation

One evaluation : *Contrôle continu*

Bibliography

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

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

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

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

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

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

- www.16personalities.com

- www.acnv.com

Learning outcomes

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

Manager : Sylvaine GAUTIER

Project management 1

Hours

Lect	Tut	PW	Proj	WP	Asst
4.5		3			2

Evaluation

One evaluation : *DS*

Project management 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	15				3

Evaluation

One evaluation : *Contrôle continu*

Bibliography

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

Learning outcomes

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

Manager : John KINGSTON

Quality, security and environmental approaches (QSE1)

Hours

Lect	Tut	PW	Proj	WP	Asst
	3	3			

Evaluation

One evaluation : *QCM+exercices*

Bibliography

Ressources documentaires disponibles sur madoc :

o Le Code du travail numérique

o Code de l'environnement LEGIFRANCE

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

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

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

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

Learning outcomes

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

Manager : John KINGSTON

Quality, security ant environmental approaches (QSE2)

Hours

Lect	Tut	PW	Proj	WP	Asst
	6				

Evaluation

One evaluation : *QCM+exercices*

Bibliography

Références ou ressources documentaires disponibles sur madoc :

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

Learning outcomes

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

Manager : John KINGSTON

Random signal processing

Hours

Lect	Tut	PW	Proj	WP	Asst
	13.5	9			10

Evaluation

4 evaluations :

- *Test*
- *TP*
- *Final*
- *Evaluation*

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	Asst
3.75	7.5	9			10

Evaluation

2 evaluations :

- *Contrôle écrit*
- *Rapport TP*

Outline

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

Some particular situations in real-time application like crcular 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 rela-time operating system for task scheduling, task synchronisation mutula exclusion and message transfer.

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)	·	·	✓	·	·
• Mutual exclusion difficulties	·	✓	·	·	·

Manager : Olivier PASQUIER

Real time system design

Hours

Lect	Tut	PW	Proj	WP	Asst
3.75	15				8

Evaluation

2 evaluations :

- *Contrôle écrit*
- *Rapport*

Outline

This module firstly exposes theoritical aspects for system design and requirements for a system design methodology. Some design methodology are briefly presented.

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 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

Research S7

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Evaluation*

Manager : Antoine GOULLET

Research S8

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Evaluation*

Manager : Antoine GOULLET

S-8 Intership 4th year

Hours

Lect Tut PW Proj WP Asst

Evaluation

2 evaluations :

- *Rapport sur Madoc*
- *convention / contrat*

Manager : Yann MAHE

S7-3A intership assessment

Hours

Lect Tut PW Proj WP Asst

Evaluation

2 evaluations :

- *Rapport*
- *Soutenance*

Manager : Yann MAHE

S9-4th year Internship Assessment

Hours

Lect	Tut	PW	Proj	WP	Asst
					20

Evaluation

One evaluation : *évaluation du stage*

S9-C2: Radar

Hours

Lect	Tut	PW	Proj	WP	Asst
9		6			

Evaluation

One evaluation : *eval*

Manager : Christophe BOURLIER

SOpC : FPGA design and programming

Hours

Lect	Tut	PW	Proj	WP	Asst
3.75	3	9			8

Evaluation

One evaluation : *projet + contrôle*

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 : Patrick LE CALLET

Second foreign language - Japanese

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - Japanese

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - Spanish

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Second foreign language - Spanish

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Socio-economic debates and Tools for shifting

Hours

Lect	Tut	PW	Proj	WP	Asst
	21				10

Evaluation

One evaluation : *Exposé débat*

Bibliography

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

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

Learning outcomes

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

Manager : Chrystèle GONCALVES

Soft skills

Hours

Lect	Tut	PW	Proj	WP	Asst
	7.5				

Evaluation

One evaluation : *Examen:cas pratique*

Bibliography

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

Learning outcomes

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

Manager : Roland BESSENAY

Sustainable development and social responsability 1

Hours

Lect	Tut	PW	Proj	WP	Asst
1.5	13.5				

Evaluation

One evaluation : *Grille d'évaluation*

Bibliography

- Travaux du GIEC
- Global carbon project

Learning outcomes

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

Manager : Laurence CHARPENTIER

Sustainable development and social responsability 2

Hours

Lect	Tut	PW	Proj	WP	Asst
	9				10

Evaluation

One evaluation : *Soutenance + Rapport*

Bibliography

- Travaux du GIEC
- Global carbon project

Learning outcomes

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

Manager : Laurence CHARPENTIER

Training for Toeic

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Training for Toeic

Hours

Lect	Tut	PW	Proj	WP	Asst
	18				

Evaluation

One evaluation : *CC*

Transdisciplinary project I

Hours

Lect	Tut	PW	Proj	WP	Asst
			30		30

Evaluation

One evaluation : *Soutenance mi-projet*

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 negotiation: MoU
Pre development and specification

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 MAHE

Transdisciplinary project II

Hours

Lect	Tut	PW	Proj	WP	Asst
			70		35

Evaluation

One evaluation : *Rapport, soutenance*

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 MAHE

Transition Engineering and Interdisciplinarity S7

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Evaluation*

Manager : Bruno AUVITY

Transition Engineering and Interdisciplinarity S8

Hours

Lect	Tut	PW	Proj	WP	Asst
			32		

Evaluation

One evaluation : *Evaluation*

Manager : Bruno AUVITY

Tutored Project

Hours

Lect	Tut	PW	Proj	WP	Asst
	2		27		20

Evaluation

3 evaluations :

- *Soutenance*
- *Rapport*
- *Concours*

Outline

1- analysis of rules and requirements elicitation
2- behavioural description and environment delimitation
3- preliminary design and tasks delegating
4- design, realization, integration and tests
5- technical report preparation
6 - race

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. In the end, they write a report, give an oral presentation and each team confront each other in a timed race

Bibliography

documents internes fournis

Prerequisites

1- skills on electricity
2 - basic skill in electronics
3 - basic skill in software
4 - facility with multimeters and oscilloscopes

Learning outcomes

Learning outcomes	N	A	M	E	O
• be able to write a behavioral description (finite state automate)	·	✓	·	·	·
• be able to modelize an analogic function by fitting	·	✓	·	·	·
• be able to structure a report and to give aan oral presentation	·	✓	·	·	·
• be aware of the various stages of a technical project	·	·	✓	·	·
• be aware of the needs of team working	·	·	✓	·	·

Manager : Yann MAHE