

# Teaching program

ETN

Academic year 2020-2021

Ecole polytechnique de l'université de Nantes

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## 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         | 7.5   | 22   | 27 |      |    | 20   | 0.3  |
| • Electrical energy          | 7.5   | 10.5 | 12 |      |    | 10   | 0.25 |
| • Tutored Project            |       | 2    |    | 27   |    | 20   | 0.2  |
| TOTAL                        | 21.25 | 46.5 | 60 | 27   | 0  | 65   |      |

## Physics S5

ECTS : 6

Manager : GOULLET Antoine

| Course                                     | Lect  | Tut | PW | Proj | WP | Asst | Coef |
|--|-------|-----|----|------|----|------|------|
| • Electromagnetism                         | 1.25  | 12  |    |      |    | 9    | 0.2  |
| • Physics of semiconductors and components | 12.5  | 18  | 9  |      |    | 15   | 0.6  |
| • Guided propagation                       | 5     | 9   | 3  |      |    | 8    | 0.2  |
| TOTAL                                      | 18.75 | 39  | 12 | 0    | 0  | 32   |      |

## Social sciences S5

ECTS : 8

| Course  | Lect | Tut   | PW | Proj | WP | Asst | Coef |
|---|------|-------|----|------|----|------|------|
| • Grammar and professional English 1                  |      | 40    |    |      |    |      | 0.35 |
| • Person : Physical education and sport 1             |      | 19.5  |    |      |    | 2    | 1    |
| • Person : my relation to others                      |      | 12.5  |    |      |    | 6    | 1    |
| • Organization : understanding organizations          |      | 15    |    |      |    | 6    | 1    |
| • Society : history of organizations and epistemology |      | 15    |    |      |    | 3    | 1    |
| • Methodology : decipher information skills !         |      | 16.5  |    |      |    |      | 1    |
| TOTAL   | 0    | 118.5 | 0  | 0    | 0  | 17   |      |

## 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      | 10    | 16.5 |    |      |    | 10   | 0.4  |
| • Basic mathematics for engineers | 11.25 | 11.5 |    |      |    | 10   | 0.4  |
| TOTAL                             | 27.5  | 38.5 | 0  | 0    | 0  | 28   |      |



## Sum of semester

|                  | Lect | Tut   | PW | Proj | WP | Asst | ECTS |
|------------------|------|-------|----|------|----|------|------|
| Sum              | 67.5 | 242.5 | 72 | 27   | 0  | 142  | 30   |
| Face-to-face sum | 409  |       |    |      |    |      |      |

# Semester 6 - unit *ETN 3*

## Analog electronic technologies S6

ECTS : 6

Manager : *GOURET Vincent*

| Course                 | Lect  | Tut  | PW | Proj | WP | Asst | Coef |
|------------------------|-------|------|----|------|----|------|------|
| • Basis of electronic  | 5     | 10.5 | 9  |      |    | 10   | 0.3  |
| • Electronic functions | 8.75  | 15   | 21 |      |    | 20   | 0.7  |
| TOTAL                  | 13.75 | 25.5 | 30 | 0    | 0  | 30   |      |

## Signals and electronic systems S6

ECTS : 9

Manager : *CHARGE Pascal*

| Course                                     | Lect  | Tut | PW    | Proj | WP | Asst | Coef |
|--|-------|-----|-------|------|----|------|------|
| • Control engineering                      | 3.75  | 5.5 | 3     |      |    | 6    | 0.1  |
| • Numerical methodes                       | 7.5   | 4.5 | 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                                      | 32.5  | 40  | 31.75 | 0    | 0  | 41   |      |

## Social sciences S6

ECTS : 8

| Course                                      | Lect | Tut  | PW | Proj | WP | Asst | Coef |
|---|------|------|----|------|----|------|------|
| • Person : Physical education and sport 2   |      | 19.5 |    |      |    | 2    | 1    |
| • Person : interpersonal skills             |      | 7.5  |    |      |    | 7.5  | 1    |
| • Organization : Business Simulation 1      |      | 28   |    |      |    |      | 1    |
| • Society : Socio-economic debating         |      | 12   |    |      |    | 12   | 1    |
| • Methodology : Project management 1        |      | 8    |    |      |    | 5    | 1    |
| • Grammar, ToEIC and professional English 2 |      | 39   | 2  |      |    |      | 0.35 |
| TOTAL                                       | 0    | 114  | 2  | 0    | 0  | 26.5 |      |

## Computer technologies S6

ECTS : 7

Manager : *PILLEMENT Sébastien*

| Course             | Lect | Tut  | PW | Proj | WP | Asst | Coef |
|--------------------|------|------|----|------|----|------|------|
| • Microprocessors  | 7.5  | 18.5 | 24 |      |    | 25   | 0.6  |
| • Computer systems | 7.5  | 9    | 24 |      |    | 15   | 0.4  |
| TOTAL              | 15   | 27.5 | 48 | 0    | 0  | 40   |      |

## Sum of semester

|                  | Lect  | Tut | PW     | Proj | WP | Asst  | ECTS |
|------------------|-------|-----|--------|------|----|-------|------|
| Sum              | 61.25 | 207 | 111.75 | 0    | 0  | 137.5 | 30   |
| Face-to-face sum | 380   |     |        |      |    |       |      |

# Semester 7 - unit *ETN 4*

## Social sciences S7

ECTS : 8

| Course  | Lect | Tut  | PW | Proj | WP | Asst | Coef   |
|---|------|------|----|------|----|------|--------|
| • Professional English 3                                |      | 19   | 2  |      |    |      | 0.2625 |
| • Sport 3   |      | 19.5 |    |      |    | 2    | 0.15   |
| • Project management                                    |      | 10.5 |    |      |    | 10.5 | 0.1    |
| • Marketing and Business Intelligence                   | 3    | 10.5 |    |      |    | 10.5 | 0.1    |
| • Safety Health at Work                                 |      | 10.5 |    |      |    | 5    | 0.1    |
| • Business Simulation 1                                 |      |      |    | 24   |    | 2    | 0.2    |
| 1 opt { ▷ Continuous Assessment (bis)                   |      |      |    |      |    |      | 0.0875 |
| ▷ French as a Foreign Language for engineering students |      | 18   |    |      |    |      | 0.0875 |
| ▷ Second foreign language - German                      |      | 18   |    |      |    |      | 0.0875 |
| ▷ Second foreign language - Chinese                     |      | 18   |    |      |    |      | 0.0875 |
| ▷ Second foreign language - Spanish                     |      | 18   |    |      |    |      | 0.0875 |
| ▷ Second foreign language - Japanese                    |      | 18   |    |      |    |      | 0.0875 |
| ▷ Training for Toeic                                    |      | 18   |    |      |    |      | 0.0875 |
| TOTAL   | 3    | 88   | 2  | 24   | 0  | 30   |        |

## Electronic and information processing S7

ECTS : 10

Manager : *DIOURIS Jean-François*

| Course                     | Lect  | Tut  | PW | Proj | WP | Asst | Coef |
|----------------------------|-------|------|----|------|----|------|------|
| • Electronic midrange      | 13.75 | 21   | 27 |      |    | 30   | 0.5  |
| • Microelectronics         | 3.75  | 13.5 | 9  |      |    | 10   | 0.25 |
| • Random signal processing | 7.5   | 12   | 9  |      |    | 10   | 0.25 |
| TOTAL                      | 25    | 46.5 | 45 | 0    | 0  | 50   |      |

## Computer circuits and systems S7

ECTS : 8

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 | 12    | 21 |      |    | 15   | 0.3  |
| • Microprocessor systems      | 2.5  | 18.25 | 21 |      |    | 20   | 0.4  |
| TOTAL                         | 7    | 48.25 | 60 | 0    | 0  | 50   |      |

## System Engineering S7

ECTS : 4

Manager : *MAHE Yann*

| Course                          | Lect | Tut | PW | Proj | WP | Asst | Coef |
|---------------------------------|------|-----|----|------|----|------|------|
| • Electromagnetic compatibility | 5    | 7.5 |    |      |    | 8    | 0.15 |
| • Transdisciplinary project I   |      |     |    | 30   |    | 30   | 0.85 |
| TOTAL                           | 5    | 7.5 | 0  | 30   | 0  | 38   |      |

## International students integration

Manager : GOULLET Antoine

| Course                    | Lect | Tut | PW | Proj | WP | Asst | Coef |
|---------------------------|------|-----|----|------|----|------|------|
| • Digital circuits design |      |     | 6  |      |    |      | 1    |
| • Electronic midranges    |      |     | 6  |      |    |      | 1    |
| TOTAL                     | 0    | 0   | 12 | 0    | 0  | 0    |      |

## Sum of semester

|                  | Lect   | Tut    | PW  | Proj | WP | Asst | ECTS |
|------------------|--------|--------|-----|------|----|------|------|
| Sum              | 40     | 190.25 | 119 | 54   | 0  | 168  | 30   |
| Face-to-face sum | 403.25 |        |     |      |    |      |      |

# Semester 8 - unit *ETN 4*

## Networks and multimedia S8

ECTS : 4

Manager : RAMSTEIN Gérard

| Course               | Lect  | Tut | PW   | Proj | WP | Asst | Coef |
|----------------------|-------|-----|------|------|----|------|------|
| • Databases          | 0.75  | 1.5 | 9    |      |    | 4    | 0.3  |
| • Computer networks  | 5     | 9   | 12   |      |    | 10   | 0.3  |
| • Multimedia signals | 7.5   | 4.5 | 13.5 |      |    | 12   | 0.4  |
| TOTAL                | 13.25 | 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                 | 6.25  | 7.5  | 9  |      |    | 12   | 0.2  |
| • Transdisciplinary project II |       |      |    | 70   |    | 35   | 0.65 |
| TOTAL                          | 19.75 | 10.5 | 9  | 70   | 0  | 56   |      |

## Social sciences - S8

ECTS : 7

| Course   | Lect | Tut  | PW | Proj | WP | Asst | Coef  |
|--|------|------|----|------|----|------|-------|
| • Communicating on the workplace / Intercultural communication | 3    | 10.5 |    |      |    | 5    | 0.15  |
| • Quality approach and problem solving                         |      | 10.5 |    |      |    | 10.5 | 0.1   |
| • Sport 4  |      | 19.5 |    |      |    | 2    | 0.15  |
| • Opening courses 2  | 10.5 |      |    |      |    | 10.5 | 0.1   |
| • Professional Project 2 : professional project presentation   |      |      |    | 13.5 |    | 2.5  | 0.15  |
| • Intercultural explorations                                   |      | 18   |    |      |    |      | 0.175 |
| 1 <sub>opt</sub> { ▷ Continuous Assessment(bis)                |      |      |    |      |    |      | 0.175 |
| ▷ French as a Foreign Language for engineering students        |      | 18   |    |      |    |      | 0.175 |
| ▷ Second foreign language - German                             |      | 18   |    |      |    |      | 0.175 |
| ▷ Second foreign language - Chinese                            |      | 18   |    |      |    |      | 0.175 |
| ▷ Second foreign language - Spanish                            |      | 18   |    |      |    |      | 0.175 |
| ▷ Second foreign language - Japanese                           |      | 18   |    |      |    |      | 0.175 |
| ▷ Training for ToEIC   |      | 18   |    |      |    |      | 0.175 |
| TOTAL  | 13.5 | 76.5 | 0  | 13.5 | 0  | 30.5 |       |

## Telecommunication systems S8

ECTS : 4

Manager : RAZBAN HAGHIGHI Tchanguiz

| Course  | Lect  | Tut   | PW | Proj | WP | Asst | Coef |
|---|-------|-------|----|------|----|------|------|
| • Digital communications - foundations and techniques | 11.25 | 14.25 | 12 |      |    | 15   | 0.5  |
| • HF electronic                                       | 10    | 15    | 15 |      |    | 15   | 0.5  |
| TOTAL   | 21.25 | 29.25 | 27 | 0    | 0  | 30   |      |

## Embedded systems S8

ECTS : 4

Manager : PASQUIER Olivier

| Course                               | Lect  | Tut  | PW | Proj | WP | Asst | Coef |
|--------------------------------------|-------|------|----|------|----|------|------|
| • Real time system design            | 5     | 16.5 |    |      |    | 8    | 0.4  |
| • Real time operating systems        | 5     | 7.5  | 9  |      |    | 10   | 0.3  |
| • SOpC : FPGA design and programming | 3.75  | 3    | 9  |      |    | 8    | 0.3  |
| TOTAL                                | 13.75 | 27   | 18 | 0    | 0  | 26   |      |

## Internship 4th Year

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    |      |

## Sum of semester

|                  | Lect   | Tut    | PW   | Proj | WP | Asst  | ECTS |
|------------------|--------|--------|------|------|----|-------|------|
| Sum              | 81.5   | 158.25 | 88.5 | 83.5 | 0  | 168.5 | 30   |
| Face-to-face sum | 411.75 |        |      |      |    |       |      |

# Semester 9 - unit *SCM 5*

## Engineering project S9

ECTS : 10

| Course                | Lect | Tut | PW | Proj | WP | Asst | Coef |
|-----------------------|------|-----|----|------|----|------|------|
| • Engineering project |      |     |    | 120  |    |      | 1    |
| TOTAL                 | 0    | 0   | 0  | 120  | 0  | 0    |      |

## SCM Option S9

ECTS : 14

Manager : *DIOURIS Jean-François*

| Course  | Lect | Tut | PW | Proj | WP | Asst | Coef |
|---|------|-----|----|------|----|------|------|
| • C1 : RF systems: circuits and antennas            | 54   |     | 15 |      |    | 20   | 4    |
| • S9-C2: Radar                                      | 9    |     | 6  |      |    |      | 1    |
| • C3 : Digital communications : Radio architectures | 18   |     | 6  |      |    | 15   | 3    |
| • C4 : Connected objects and wireless networks      | 12   |     | 9  |      |    | 15   | 2    |
| • C5 : Power consumption and power management       | 6    |     | 6  |      |    | 6    | 1    |
| • C6 : Telecommunication systems engineering        | 12   |     | 6  |      |    | 10   | 1    |
| • C7 : Data Security                                | 15   |     |    |      |    | 10   | 1    |
| • CME: Embedded AI                                  | 6    |     |    |      |    | 3    | 1    |
| TOTAL   | 132  | 0   | 48 | 0    | 0  | 79   |      |

## Social Sciences S9

ECTS : 6

| Course                                     | Lect | Tut  | PW  | Proj | WP | Asst | Coef |
|--|------|------|-----|------|----|------|------|
| • Training for TOEIC - s9                  |      |      |     |      |    |      | 1    |
| • Work analysis                            |      | 12   |     |      |    | 4    | 1    |
| • Managing people                          |      | 10.5 |     |      |    | 10.5 | 1    |
| • Negotiation                              |      | 6    | 4.5 |      |    | 10.5 | 1    |
| • Professional project 3 : skills passport |      |      |     | 12   |    | 3    | 1    |
| • Business Simulation 2                    | 20.5 |      |     |      |    | 10   | 1    |
| • Sociology of innovation                  | 4.5  |      |     |      |    | 4.5  | 1    |
| TOTAL                                      | 25   | 28.5 | 4.5 | 12   | 0  | 42.5 |      |

## Sum of semester

|                  | Lect | Tut  | PW   | Proj | WP | Asst  | ECTS |
|------------------|------|------|------|------|----|-------|------|
| Sum              | 157  | 28.5 | 52.5 | 132  | 0  | 121.5 | 30   |
| Face-to-face sum | 370  |      |      |      |    |       |      |

# Semester 9 - unit *SCM-CP*

## CP Social sciences S9

ECTS : 4

| Course                    | Lect | Tut  | PW  | Proj | WP | Asst | Coef |
|---------------------------|------|------|-----|------|----|------|------|
| • Work analysis           |      | 12   |     |      |    | 4    | 0.35 |
| • Managing people         |      | 10.5 |     |      |    | 10.5 | 0.3  |
| • Negotiation             |      | 6    | 4.5 |      |    | 10.5 | 0.3  |
| • Sociology of innovation | 4.5  |      |     |      |    | 4.5  | 0.05 |
| TOTAL                     | 4.5  | 28.5 | 4.5 | 0    | 0  | 29.5 |      |

## SCM Option S9 CP

ECTS : 14

Manager : *DIOURIS Jean-François*

| Course  | Lect | Tut | PW | Proj | WP | Asst | Coef |
|---|------|-----|----|------|----|------|------|
| • C5 : Connected objects                            |      |     | 6  | 9    |    | 10   | 1    |
| • C1 : RF systems: circuits and antennas            | 54   |     | 15 |      |    | 20   | 4    |
| • S9-C2: Radar                                      | 9    |     | 6  |      |    |      | 1    |
| • C3 : Digital communications : Radio architectures | 18   |     | 6  |      |    | 15   | 3    |
| • C4 : Connected objects and wireless networks      | 12   |     | 9  |      |    | 15   | 2    |
| • C6 : Telecommunication systems engineering        | 12   |     | 6  |      |    | 10   | 1    |
| • C7 : Data Security                                | 15   |     |    |      |    | 10   | 1    |
| • CME: Embedded AI                                  | 6    |     |    |      |    | 3    | 1    |
| TOTAL   | 126  | 0   | 48 | 9    | 0  | 83   |      |

## Engineering projet S9 CP

ECTS : 12

| Course                | Lect | Tut | PW | Proj | WP | Asst | Coef |
|-----------------------|------|-----|----|------|----|------|------|
| • Engineering project |      |     |    | 120  |    |      | 1    |
| TOTAL                 | 0    | 0   | 0  | 120  | 0  | 0    |      |

## Sum of semester

|                  | Lect  | Tut  | PW   | Proj | WP | Asst  | ECTS |
|------------------|-------|------|------|------|----|-------|------|
| Sum              | 130.5 | 28.5 | 52.5 | 129  | 0  | 112.5 | 30   |
| Face-to-face sum | 340.5 |      |      |      |    |       |      |



# Semester 9 - unit *SETR 5*

## Engineering project S9

ECTS : 10

| Course                | Lect | Tut | PW | Proj | WP | Asst | Coef |
|-----------------------|------|-----|----|------|----|------|------|
| • Engineering project |      |     |    | 120  |    |      | 1    |
| TOTAL                 | 0    | 0   | 0  | 120  | 0  | 0    |      |

## 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 |      |    | 30   | 2    |
| • E4 : Embedded softwares                                     | 12   |      | 18 |      |    | 15   | 2    |
| • E5 : IoT architecture                                       | 10.5 |      | 9  |      |    | 10   | 1    |
| • ME1 : Model Driven for Software Engineering                 | 6    | 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    |
| TOTAL   | 67.5 | 37.5 | 90 | 0    | 0  | 118  |      |

## Social Sciences S9

ECTS : 6

| Course                                     | Lect | Tut  | PW  | Proj | WP | Asst | Coef |
|--|------|------|-----|------|----|------|------|
| • Training for TOEIC - s9                  |      |      |     |      |    |      | 1    |
| • Work analysis                            |      | 12   |     |      |    | 4    | 1    |
| • Managing people                          |      | 10.5 |     |      |    | 10.5 | 1    |
| • Negotiation                              |      | 6    | 4.5 |      |    | 10.5 | 1    |
| • Professional project 3 : skills passport |      |      |     | 12   |    | 3    | 1    |
| • Business Simulation 2                    | 20.5 |      |     |      |    | 10   | 1    |
| • Sociology of innovation                  | 4.5  |      |     |      |    | 4.5  | 1    |
| TOTAL                                      | 25   | 28.5 | 4.5 | 12   | 0  | 42.5 |      |

## Sum of semester

|                  | Lect | Tut | PW   | Proj | WP | Asst  | ECTS |
|------------------|------|-----|------|------|----|-------|------|
| Sum              | 92.5 | 66  | 94.5 | 132  | 0  | 160.5 | 30   |
| Face-to-face sum | 385  |     |      |      |    |       |      |

# Semester 9 - unit *SETR-CP*

## CP Social sciences S9

ECTS : 4

| Course                    | Lect | Tut  | PW  | Proj | WP | Asst | Coef |
|---------------------------|------|------|-----|------|----|------|------|
| • Work analysis           |      | 12   |     |      |    | 4    | 0.35 |
| • Managing people         |      | 10.5 |     |      |    | 10.5 | 0.3  |
| • Negotiation             |      | 6    | 4.5 |      |    | 10.5 | 0.3  |
| • Sociology of innovation | 4.5  |      |     |      |    | 4.5  | 0.05 |
| TOTAL                     | 4.5  | 28.5 | 4.5 | 0    | 0  | 29.5 |      |

## SETR Option S9 CP

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 |      |    | 30   | 2    |
| • E4 : Embedded softwares                                     | 12   |      | 18 |      |    | 15   | 2    |
| • E5 : IoT architecture                                       | 10.5 |      | 9  |      |    | 10   | 1    |
| • ME1 : Model Driven for Software Engineering                 | 6    | 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    |
| TOTAL   | 67.5 | 37.5 | 90 | 0    | 0  | 118  |      |

## Engineering projet S9 CP

ECTS : 12

| Course                | Lect | Tut | PW | Proj | WP | Asst | Coef |
|-----------------------|------|-----|----|------|----|------|------|
| • Engineering project |      |     |    | 120  |    |      | 1    |
| TOTAL                 | 0    | 0   | 0  | 120  | 0  | 0    |      |

## Sum of semester

|                  | Lect  | Tut | PW   | Proj | WP | Asst  | ECTS |
|------------------|-------|-----|------|------|----|-------|------|
| Sum              | 72    | 66  | 94.5 | 120  | 0  | 147.5 | 30   |
| Face-to-face sum | 352.5 |     |      |      |    |       |      |

# Semester 9 - unit *SMTR 5*

## Engineering project S9

ECTS : 10

| Course                | Lect | Tut | PW | Proj | WP | Asst | Coef |
|-----------------------|------|-----|----|------|----|------|------|
| • Engineering project |      |     |    | 120  |    |      | 1    |
| TOTAL                 | 0    | 0   | 0  | 120  | 0  | 0    |      |

## 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                                   | 18   |     | 12  |      |    | 15   | 2    |
| • M3 : Multimedia services                                    | 9    |     | 9   |      |    | 10   | 2    |
| • M4 : IoT and communication technologies                     | 3    |     | 12  | 12   |    |      | 2    |
| • 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                 | 6    | 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    |
| TOTAL   | 67.5 | 7.5 | 108 | 12   | 0  | 81   |      |

## Social Sciences S9

ECTS : 6

| Course                                     | Lect | Tut  | PW  | Proj | WP | Asst | Coef |
|--|------|------|-----|------|----|------|------|
| • Training for TOEIC - s9                  |      |      |     |      |    |      | 1    |
| • Work analysis                            |      | 12   |     |      |    | 4    | 1    |
| • Managing people                          |      | 10.5 |     |      |    | 10.5 | 1    |
| • Negotiation                              |      | 6    | 4.5 |      |    | 10.5 | 1    |
| • Professional project 3 : skills passport |      |      |     | 12   |    | 3    | 1    |
| • Business Simulation 2                    | 20.5 |      |     |      |    | 10   | 1    |
| • Sociology of innovation                  | 4.5  |      |     |      |    | 4.5  | 1    |
| TOTAL                                      | 25   | 28.5 | 4.5 | 12   | 0  | 42.5 |      |

## Sum of semester

|                  | Lect | Tut | PW    | Proj | WP | Asst  | ECTS |
|------------------|------|-----|-------|------|----|-------|------|
| Sum              | 92.5 | 36  | 112.5 | 144  | 0  | 123.5 | 30   |
| Face-to-face sum | 385  |     |       |      |    |       |      |

# Semester 9 - unit *SMTR-CP*

## CP Social sciences S9

ECTS : 4

| Course                    | Lect | Tut  | PW  | Proj | WP | Asst | Coef |
|---------------------------|------|------|-----|------|----|------|------|
| • Work analysis           |      | 12   |     |      |    | 4    | 0.35 |
| • Managing people         |      | 10.5 |     |      |    | 10.5 | 0.3  |
| • Negotiation             |      | 6    | 4.5 |      |    | 10.5 | 0.3  |
| • Sociology of innovation | 4.5  |      |     |      |    | 4.5  | 0.05 |
| TOTAL                     | 4.5  | 28.5 | 4.5 | 0    | 0  | 29.5 |      |

## SMTR Option S9 CP

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                                   | 18   |     | 12  |      |    | 15   | 2    |
| • M3 : Multimedia services                                    | 9    |     | 9   |      |    | 10   | 2    |
| • M4 : IoT and communication technologies                     | 3    |     | 12  | 12   |    |      | 2    |
| • 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                 | 6    | 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    |
| TOTAL   | 67.5 | 7.5 | 108 | 12   | 0  | 81   |      |

## Engineering projet S9 CP

ECTS : 12

| Course                | Lect | Tut | PW | Proj | WP | Asst | Coef |
|-----------------------|------|-----|----|------|----|------|------|
| • Engineering project |      |     |    | 120  |    |      | 1    |
| TOTAL                 | 0    | 0   | 0  | 120  | 0  | 0    |      |

## Sum of semester

|                  | Lect  | Tut | PW    | Proj | WP | Asst  | ECTS |
|------------------|-------|-----|-------|------|----|-------|------|
| Sum              | 72    | 36  | 112.5 | 132  | 0  | 110.5 | 30   |
| Face-to-face sum | 352.5 |     |       |      |    |       |      |

# Semester 10 - unit *ETN 5 CP*

## End of study internship

ECTS : 28

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

## CP Social sciences S10

ECTS : 2

| Course                | Lect | Tut | PW | Proj | WP | Asst | Coef |
|-----------------------|------|-----|----|------|----|------|------|
| • Experience feedback | 24   |     |    |      |    |      | 1    |
| TOTAL                 | 24   | 0   | 0  | 0    | 0  | 0    |      |

## Sum of semester

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

## Part II

# Sheets of courses

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# Algorithmic and C language

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 6.25 | 12  | 21 |      |    | 15   |

## Evaluation

3 evaluations :

- *Ecrit*
- *eval TPs*
- *TP*

## 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            | . | . | ✓ | . | . |
| • Knowledge 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*

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# Analysis and approximation

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
| 10   | 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



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## Basic mathematics for engineers

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### 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 curvilinear integral.                           | . | . | ✓ | . | . |
| • Multiply two matrices, invert a matrix, compute the eigenvectors and eigenvalues??, solving a linear system.                    | . | . | ✓ | . | . |

*Manager : Yide WANG*

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# Basis of electronic

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
| 5    | 10.5 | 9  |      |    | 10   |

## Evaluation

2 evaluations :

- *Ctrlle final (0.7)*
- *Ctrlle aléat TP (0.3)*

## 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.
- 6- Appendix: cooling electronic devices, technology of passive devices.

## 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 & Neiryck - Théorie 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 : Patrice GRAZIOTIN*

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# Business Simulation 1

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      |     |    | 24   |    | 2    |

## Evaluation

One evaluation : *Soutenance + CC*

## Goals

Put into practice teachings " HES " in a global approach of the company by integrating its various economic, commercial, financial, human dimensions.

Understand the link between these dimensions.

Understand the enterprise by using a concrete case.

## Prerequisites

accounting and economics

## Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • to implement the theoretical concepts Economics and management which were taught in the 3rd year                      | . | ✓ | . | . | . |
| • managing a virtual enterprise by integrating the different dimensions of the company, in a team and in a limited time | ✓ | . | . | . | . |

*Manager : Chrystèle GONCALVES*

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## Business Simulation 2

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 20.5 |     |    |      |    | 10   |

### Evaluation

One evaluation : *Contrôle continu*

### Outline

Management of a virtual company in competitive environment. Taking of decisions, from the production organisation until the marketing.

Realization of specific works at the same time as the decisions of management :

- Strategic presentation of the company
- Dashboards
- Negotiation...

### Goals

Synthesize and put into practice teachings " HES " in a global approach of the company in international environment by integrating its various economic, commercial, financial, human and societal dimensions, into a perspective of sustainable development. Use on a concrete case tools and methods such as project management, dashboards, negotiation ...

### Bibliography

Celles des cours précédents.

### Prerequisites

All the courses HES of 3rd and 4th year, in particular the simulation of the business management of 4th year.

### Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • Report its work under an appropriate shape.   | • | • | ✓ | • | • |
| • Manage projects in team in an allotted time.  | • | • | ✓ | • | • |
| • Manage a virtual company by integrating all the dimensions into a perspective of sustainable development. | • | ✓ | • | • | • |
| • Know how to set up simple dashboards.   | • | ✓ | • | • | • |
| • Know how to practise a commercial negotiation.  | • | ✓ | • | • | • |

*Manager : Jacques MOREAU*

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## C1 : RF systems: circuits and antennas

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 54   |     | 15 |      |    | 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 manufacturing 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*

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## C3 : Digital communications : Radio architectures

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 18   |     | 6  |      |    | 15   |

### Evaluation

3 evaluations :

- *Ecrit*
- *Rapport TP*
- *Ecrit 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
6. Generation of pseudo-chaotic sequences : Logistic map, PWLCM, Skew tent map, Frey and El Assad generators. Effects of the finite precision and measure of chaotic orbits. Performance of generated sequences.
7. Design and implementation of symmetric chaos-based crypto-systems : Substitution and permutation functions, and linear mixing functions. Performance of cryptosystems. Cryptographic modes (ECB, CBC, CFB, CTR, OFB) and error propagation.

### Goals

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



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## C4 : Connected objects and wireless networks

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 12   |     | 9  |      |    | 15   |

### Evaluation

One evaluation : *Ecrit*

### Goals

The objective is the practical study of a wireless sensor network based on a Linux embedded platform

### Prerequisites

Basic knowlewdge on Linux, C coding and networks.

### Learning outcomes

| Learning outcomes  | N | A | M | E | O |
|--|---|---|---|---|---|
| • Configuration of an embedded Linux kernel for an acquisition application | • | • | ✓ | • | • |
| • Configuration of a WIFI link for an acquisition application              | • | • | ✓ | • | • |
| • Use of a Linux embedded platform for an acquisition application          | • | • | ✓ | • | • |

*Manager : Jean-François DIOURIS*

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## C5 : Connected objects

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      |     | 6  | 9    |    | 10   |

### Evaluation

One evaluation : *Soutenance projet*

### Outline

1) Choice of the subject, discussion on the statement of work, specification (3h). 2) Developpement (12h). 3) Oral presentation and demonstration (3h)

### Goals

The objective is the implementation of a signal processing algorithm on a Digital Signal Processor (DSP) using the following approach: firstly, the algorithm is defined to satisfy the statement of work and then tested using matlab and implemented on a DSP board.

### Prerequisites

Basic knowledge on DSP, signal processing, C programming language

### Learning outcomes

| Learning outcomes                                  | N | A | M | E | O |
|--|---|---|---|---|---|
| • Design of a signal processing algorithm          | . | . | ✓ | . | . |
| • Coding of a signal processing algorithm on a DSP | . | . | ✓ | . | . |
| • Use of a DSP development tool                    | . | . | ✓ | . | . |

Manager : *Jean-François DIOURIS*

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## C5 : Power consumption and power management

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 6    |     | 6  |      |    | 6    |

### Evaluation

2 evaluations :

- *Ecrit*
- *Rapport TP*

### 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

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## C6 : Telecommunication systems engineering

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### 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 - Artech 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

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## C7 : Data Security

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### 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 classical Cryptography and to design chaos-based cryptography systems.

Chaotic Generators, Cryptosystems, Steganography and Hash Functions.

### Bibliography

- W. Stallings, « Cryptography and Network 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

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## CME: Embedded AI

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 6    |     |    |      |    | 3    |

### Evaluation

One evaluation : *Rapport + eval TP*

*Manager : Olivier PASQUIER*

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# Communicating on the workplace / Intercultural communication

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
| 3    | 10.5 |    |      |    | 5    |

## Evaluation

One evaluation : *Contrôle continu*

## Outline

The sessions will alternate lectures, practical exercises, simulations, collective debriefing.

10,5 hours in groups will be dedicated to Communication at work, and 2,5 hours of lecture to Intercultural communication.

## Goals

To discover the various facets of business communication.

To learn how to observe interpersonal or group communication situations, to analyse them and to adjust one's communication style.

To be able to express oneself in public.

To present the challenges and the major principles of the intercultural communication.

## Bibliography

La communication en entreprise, J-P. Lehnisch, PUF, coll. Que sais-je ?, 2011

Comment leur dire... La process communication, G. Collignon, Inter-Editions, 2010

## Prerequisites

Minimal knowledge on companies.

## Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • To be able to distinguish the different forms of communication in business              | ✓ | · | · | · | · |
| • To be able to observe and analyze a communication situation                             | · | ✓ | · | · | · |
| • To be able to understand the effect of one's communication style and to adjust it       | · | ✓ | · | · | · |
| • To be able to express oneself in public   | · | ✓ | · | · | · |
| • To understand the stakes connected to the intercultural communication                   | ✓ | · | · | · | · |
| • To know the main theories, the models and the tools of analysis of the interculturalism | ✓ | · | · | · | · |

Manager : Anouk GREVIN

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# Complex analysis

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## 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*

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# Computer networks

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 5    | 9   | 12 |      |    | 10   |

## Evaluation

2 evaluations :

- *Contrôle réseaux (1)*
- *TP réseaux (0.5)*

## 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. | · | ✓ | · | · | · |

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# Computer systems

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## 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

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## Continuous Assessment (bis)

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### Hours

Lect Tut PW Proj WP Asst

### Evaluation

One evaluation : *CC*

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## Continuous Assessment(bis)

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### Hours

Lect Tut PW Proj WP Asst

### Evaluation

One evaluation : *CC*

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# Control engineering

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## 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 discrete time domain
4. Design of discrete 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 know 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 discrete time domain   | · | ✓ | · | · | · |

*Manager : Pascal CHARGE*

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# Databases

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## 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*

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## Deterministic signals and linear systems

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### 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 Massachusetts, 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*

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# Digital Electronic

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## Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 7.5  | 22  | 27 |      |    | 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 : Patrice GRAZIOTIN*

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# Digital circuit design

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## 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*

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# Digital communications - foundations and techniques

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## Hours

| Lect  | Tut   | PW | Proj | WP | Asst |
|-------|-------|----|------|----|------|
| 11.25 | 14.25 | 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

## 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*

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## E1 : Embedded system design

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### 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 theoretical 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 performances 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         | . | . | . | ✓ | . |
| • Define hardware and software architectures for an embedded system | . | . | ✓ | . | . |
| • Know basics about sytem safety and reliability                    | ✓ | . | . | . | . |

Manager : Olivier PASQUIER

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## E2 : SoC design

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### 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 methodology
5. Use of VHDL for 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 electronic, 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*



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## E3 : Codesign

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 9    |     | 18 |      |    | 30   |

### Evaluation

One evaluation : *TP*

### Outline

1. Introduction
2. Current trends in codesign
3. HW/SW co-verification
4. Implementantation 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*

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## E4 : Embedded softwares

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### 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 programming 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

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## E5 : IoT architecture

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 10.5 |     | 9  |      |    | 10   |

### Evaluation

One evaluation : *questionnaire*

*Manager : Sébastien PILLEMENT*

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# Ecodesign

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 1.5  | 2   |    |      |    | 3    |

## Outline

1. Scenario
  2. Examples of eco-designed 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. ; CRETZAZ, 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*

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# Electrical energy

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
| 7.5  | 10.5 | 12 |      |    | 10   |

## Evaluation

2 evaluations :

- *DS (coef 0.7)*
- *Moyenne 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' - 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

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# Electromagnetic compatibility

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 5    | 7.5 |    |      |    | 8    |

## Evaluation

One evaluation : *DS (coef 1)*

## 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*

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# Electromagnetism

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 1.25 | 12  |    |      |    | 9    |

## Evaluation

One evaluation : *Ecrit*

## Outline

Introduction to electromagnetism 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*

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## Electronic functions

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 8.75 | 15  | 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. Neirynek, 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. Vatasco, H. Sinnreich, St. Gavet, R. Stere & R. Piringer, circuits à semi-conducteurs dans l'industrie, 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*



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# Electronic midrange

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## Hours

|       |     |    |      |    |      |
|-------|-----|----|------|----|------|
| Lect  | Tut | PW | Proj | WP | Asst |
| 13.75 | 21  | 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 : *Tchangviz RAZBAN HAGHIGHI*

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## Engineering project

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### 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  | • | • | ✓ | • | • |

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## Experience feedback

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 24   |     |    |      |    |      |

### Evaluation

One evaluation : *Validé / non validé*

*Manager : Maud BEAUTRAIS SATTLER*

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## Final project

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### Hours

Lect Tut PW Proj WP Asst

### Evaluation

One evaluation : *Note*

*Manager : Sebastien LE NOURS*

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## French as a Foreign Language for engineering students

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 18  |    |      |    |      |

### Evaluation

One evaluation : *CC*

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## 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*

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## Grammar, Toeic and professional English 2

---

### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 39  | 2  |      |    |      |

### Evaluation

3 evaluations :

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



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# Guided propagation

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## 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

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## HF electronic

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 10   | 15  | 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. Characterisation 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 treat impedance matching using Smith chart            | · | · | ✓ | · | · |
| • Know to treat design of high frequency circuits               | · | · | ✓ | · | · |

Manager : *Tchangviz RAZBAN HAGHIGHI*

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# Industrialization

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## 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*

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## Intercultural explorations

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 18  |    |      |    |      |

### Evaluation

One evaluation : *CC*

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## M1 : Internet and multimedia

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### 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](http://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 : Przemysław BAKOWSKI*

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## M2 : Multimedia standards

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 18   |     | 12 |      |    | 15   |

### Evaluation

One evaluation : *Contrôle*

### 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 principles and standards | . | . | ✓ | . | . |
| • Understand audio compression standards   | . | ✓ | . | . | . |
| • Understand principles of JPEG2000  | . | ✓ | . | . | . |
| • Know video signal, digital and analog formats  | . | ✓ | . | . | . |
| • Know principles of motion estimation in the context of video compression                           | . | ✓ | . | . | . |
| • Know video compression standards   | . | ✓ | . | . | . |

Manager : Vincent RICORDEL

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## M3 : Multimedia services

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 9    |     | 9  |      |    | 10   |

### Evaluation

One evaluation : *Contrôle*

### Outline

VoIP, VoD, Streaming Vidéo: Architectures, Protocols

Mobile Services: Architecture of Mobile Networks, Mobile Terminal, Services

Mobile TV: Broadcast, Unicast, Standards

Audio/Video Transcoding: Use Case, Quality, Codecs, Containers, Low Level APIs

Digital TV: Architectures, Standards, Coding/ Multiplexing, PES, MPEG2-TS

### Goals

1. Describe Multimedia Services (Video Streaming, VoD, VoIP, Video and Audio Conferences) and understand their constraints,
2. Present main standards (H72X, JPEG2000, H26X, MPEG1-2-4),
3. Present Architectures (hardware and software) of Multimedias Systems,

### Bibliography

1. Rogelio Martinez Perea "Internet Multimedia Communications using SIP" Editions Elsevier 2008
2. Y.Bouguen, E. Hardouin, F.X. Wolff "LTE et les réseaux 4G" Ed, Eyrolles 2011
3. P. Havaldar and G. Medioni "Multimedia Systems: Algorithms, Standards and Industry Practices" Editions Course Technology, 2010

### Prerequisites

"Deterministic Signals and Linear Systems"

"Random Signals"

"Digital Communications"

"Multimedia Signals"

### Learning outcomes

| Learning outcomes                              | N | A | M | E | O |
|--|---|---|---|---|---|
| • Specify and use SIP Protocol                 | . | . | ✓ | . | . |
| • Present the whole chain of digital TV        | . | . | . | ✓ | . |
| • Develop tools for analyzing MPEG-2 TS Layer  | . | . | ✓ | . | . |
| • Describe the architecture of mobile networks | . | ✓ | . | . | . |
| • Develop tools for audio/video transcoding    | . | . | ✓ | . | . |

Manager : Abdelhakim SAADANE

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## M4 : IoT and communication technologies

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 3    |     | 12 | 12   |    |      |

### Evaluation

One evaluation : *Notes TP*

*Manager : Przemyslaw BAKOWSKI*



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## M5 : parallel programming on multicore CPUs

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### 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](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.qrc00011/QRC0001\\_UAL.pdf](http://infocenter.arm.com/help/topic/com.arm.doc.qrc00011/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

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## 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](http://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*

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# ME1 : Model Driven for Software Engineering

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 6    | 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 : Sébastien PILLEMENT

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## 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](http://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*

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## ME3 : Real time systems

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### 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 theoretic 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 platform.

### 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

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## ME4 : Security

---

### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 6    |     | 9  |      |    | 10   |

### Evaluation

2 evaluations :

- *Cours (coef 0.3)*
- *TP (coef 0.7)*

*Manager : Maria MENDEZ REAL*

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# Managing people

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 10.5 |    |      |    | 10.5 |

## Evaluation

One evaluation : *Examen*

## Outline

The sessions will alternate lectures, practical exercises, simulations, collective debriefing.

## Goals

To understand the role of a manager and the paradoxes of management, main management issues, individual and organisational behavior.

To prepare oneself to leadership positions.

## Bibliography

Management, l'essentiel des concepts et des pratiques, S. Robbins, D. DeCenzo, M. Coulter, Ed. Pearson.

Manager, les meilleures pratiques du management, M. Barabel, O. Meier, Dunod.

Management et leadership, C. Dejoux, Dunod, coll. Les topos.

## Prerequisites

Minimal knowledge on companies.

Team working experience in a professional context.

## Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • To be able to analyze human or managerial issues and to draw conclusions for action | · | ✓ | · | · | · |
| • To be able to identify the management style adapted to a situation                  | ✓ | · | · | · | · |
| • To know the main theoretical currents in organization theory                        | ✓ | · | · | · | · |

*Manager : Anouk GREVIN*

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# Marketing and Business Intelligence

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## Hours

| Lect | Tut  | PW | Proj | WP | Asst |
|------|------|----|------|----|------|
| 3    | 10.5 |    |      |    | 10.5 |

## Evaluation

One evaluation : *Examen*

## Outline

### 1 - The Marketing approach

From needs to proposals

Place of the Marketing in a company

Evolutions of the Marketing, value creation, ICTS, CRM, one to one ...

### 2 - The Strategic Marketing

Corporate strategies, strategic diagnostics (swot, Porter, life cycle, BCG ...)

Marketing strategies, segmentation, targeting, positioning, innovation...

MIS, techniques of studies, market study: demand, offers, environment

### 3. The operational marketing

Marketing Mix, Product, Place, Promotion, Price

4. Conference Economic Intelligence : stakes and main functions of the economic intelligence and methodology of the watch

## Goals

Present the approach marketing, heart of the activity of the company, which concerns all the functions of the company, in term of value creation and satisfaction of the needs for the customer. Present the stakes, the strategic aspects and the main operational levers.

Introduction to business intelligence.

## Bibliography

G. Armstrong, P Kotler ; « Principes de Marketing » ; Pearson Education - Mercator; "Mercator"; Dunod. Dernières éditions.

Audigier M., Coulon G., Rassat P. : « L'intelligence économique » - Economica

## Prerequisites

General knowledge of the company and its functions. Introduction in the economy and the management.

## Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • Understand the role and the place of the approach and the function Marketing within the firm.                   | ✓ | . | . | . | . |
| • Join the role, the stakes and the methodologies of the marketing initiative into a professional approach.       | ✓ | . | . | . | . |
| • Know the main generic strategies of a company allowing it to build a concurrentiel long-lasting advantage.      | ✓ | . | . | . | . |
| • Know the techniques of studies and be able to validate an initiative of simple study.                           | ✓ | . | . | . | . |
| • Know the main operational levers Product, Place, Promotion, Price, in term of means of action, stakes and role. | ✓ | . | . | . | . |



*Manager : Luc OILI*

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## Methodology : Project management 1

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      | 8   |    |      |    | 5    |

### Evaluation

One evaluation : *DS*

### Bibliography

- HEAGNEY, Joseph. Fundamentals of project management. Amacom, 2016
- BOURGEOIS, Jean-Paul. Gestion de projet. Ed. Techniques Ingénieur, 1997

### Learning outcomes

| Learning outcomes | N | A | M | E | O |
|-------------------|---|---|---|---|---|
| • TPN-2           | ✓ | . | . | . | . |
| • TPN-4           | . | ✓ | . | . | . |
| • TPN-7           | ✓ | . | . | . | . |
| • TPN-12          | ✓ | . | . | . | . |
| • TPN-15          | ✓ | . | . | . | . |
| • TPN-16          | ✓ | . | . | . | . |

*Manager : John KINGSTON*

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## Methodology : decipher information skills !

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### Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 16.5 |    |      |    |      |

### Evaluation

One evaluation :  $DS + CC$

### Bibliography

- François-Bernard Huyghe, Fake News, VA press, « Influence et conflits », 2019

### Learning outcomes

| Learning outcomes | N | A | M | E | O |
|-------------------|---|---|---|---|---|
| • TPN-1           | . | ✓ | . | . | . |
| • TPN-2           | . | ✓ | . | . | . |
| • TPN-3           | . | ✓ | . | . | . |
| • TPN-7           | ✓ | . | . | . | . |
| • TPN-12          | ✓ | . | . | . | . |
| • TPN-13          | ✓ | . | . | . | . |
| • TPN-21          | . | ✓ | . | . | . |

Manager : Cédric LAIR

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# Microelectronics

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
| 3.75 | 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 Dimitrijevic; 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

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# Microprocessor systems

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## Hours

| Lect | Tut   | PW | Proj | WP | Asst |
|------|-------|----|------|----|------|
| 2.5  | 18.25 | 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 interruptions

## 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 Dictionary, 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*

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# Microprocessors

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
| 7.5  | 18.5 | 24 |      |    | 25   |

## Evaluation

2 evaluations :

- *DS*
- *CR*

## Outline

8 bits microprocessors

- Architecture of microprocessors
- machine cycles
- Instructions sets
- Exploitation of peripheral devives, interrupt structures
- Architecture and technology of memory devices
- Mise en oeuvre des périphériques usuels
- Architecture of 8 bits Microcontrollers
- Developpement tools, programmation langages

## Goals

To handle architecture and operational principle of processors. Theoretical concepts are expressed practically through exercises and implemented through a concrete example (a 8 bits processor board)

## 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 : *Eric FRIOT*

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# Multimedia signals

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## Hours

|      |     |      |      |    |      |
|------|-----|------|------|----|------|
| Lect | Tut | PW   | Proj | WP | Asst |
| 7.5  | 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



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# Negotiation

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## Hours

|      |     |     |      |    |      |
|------|-----|-----|------|----|------|
| Lect | Tut | PW  | Proj | WP | Asst |
|      | 6   | 4.5 |      |    | 10.5 |

## Evaluation

One evaluation : *DS + vidéo*

## Outline

- 1 - Argumentation
- 2 - Negotiation and management of conflicts
  - 2.1 - Introduction to the system negotiation
  - 2.2 - Strategies of negotiation
  - 2.3 - Technical and tactical of negotiation
  - 2.4 - Main theoretical currents

## Goals

Make sensitive the pupils in theories, techniques and stakes in the contemporary management in resituant in a historical perspective. Give them the theoretical and practical bases of the negotiation with various partners of the engineer to advance projects, take out of situations of blocking or manage conflicts.

## Bibliography

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

## Prerequisites

General knowledge of companies.  
Interpersonal communication in companies

## Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • Know the theories, the strategies, the tactics and the techniques of negotiation, in particular the reasoned negotiation. | · | ✓ | · | · | · |
| • Be able to analyze and prepare a situation of negotiation.  | · | ✓ | · | · | · |

*Manager : Jacques MOREAU*

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# Numerical methodes

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 7.5  | 4.5 | 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

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# Object Oriented Programming

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 0.75 | 12  | 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*

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## Opening courses 2

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 10.5 |     |    |      |    | 10.5 |

### Evaluation

One evaluation : *Contrôle continu*

*Manager : Chrystèle GONCALVES*

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# Optimisation

---

## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 6.25 | 7.5 | 9  |      |    | 12   |

## Evaluation

3 evaluations :

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

## Outline

1) Introduction 2) Optimization without constraint 3) Optimization of a stochastic function 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

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## Organization : Business Simulation 1

---

### Hours

Lect Tut PW Proj WP Asst  
28

### Evaluation

One evaluation : *Soutenance + CC*

### Learning outcomes

| Learning outcomes | N | A | M | E | O |
|-------------------|---|---|---|---|---|
| • TPN-1           | . | ✓ | . | . | . |
| • TPN-2           | . | ✓ | . | . | . |
| • TPN-4           | . | ✓ | . | . | . |
| • TPN-5           | . | ✓ | . | . | . |
| • TPN-7           | . | ✓ | . | . | . |
| • TPN-12          | . | ✓ | . | . | . |
| • TPN-13          | . | ✓ | . | . | . |
| • TPN-14          | . | ✓ | . | . | . |

*Manager : Chrystèle GONCALVES*

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## Organization : understanding organizations

---

### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      | 15  |    |      |    | 6    |

### Evaluation

One evaluation : *DS + étude de cas*

### Bibliography

- A. de Baynast, J. Lendrevie, J. Levy - Mercator ; tout le marketing à l'ère digitale ! (Dunod. Dernières éditions)
- F. Canard - Management de la qualité ; vers un management durable (Gualino LExtenso Editions)
- H. 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 édition) (Ed. Pearson)

### Learning outcomes

| Learning outcomes | N | A | M | E | O |
|-------------------|---|---|---|---|---|
| • CTI-07          | ✓ | . | . | . | . |
| • TPN-4           | ✓ | . | . | . | . |
| • TPN-5           | ✓ | . | . | . | . |

*Manager : Luc OILI*

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## Person : Physical education and sport 1

---

### Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 19.5 |    |      |    | 2    |

### Evaluation

One evaluation : *CC*

### Learning outcomes

| Learning outcomes | N | A | M | E | O |
|-------------------|---|---|---|---|---|
| • TPN-3           | ✓ | . | . | . | . |
| • TPN-7           | ✓ | . | . | . | . |
| • TPN-12          | ✓ | . | . | . | . |
| • TPN-19          | ✓ | . | . | . | . |

*Manager : Jérôme BEZIER*



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## Person : Physical education and sport 2

---

### Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 19.5 |    |      |    | 2    |

### Evaluation

One evaluation :  $DS + CC$

### Learning outcomes

| Learning outcomes | N | A | M | E | O |
|-------------------|---|---|---|---|---|
| • TPN-3           | ✓ | . | . | . | . |
| • TPN-7           | ✓ | . | . | . | . |
| • TPN-12          | ✓ | . | . | . | . |
| • TPN-19          | ✓ | . | . | . | . |

*Manager : Jérôme BEZIER*

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## Person : interpersonal skills

---

### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      | 7.5 |    |      |    | 7.5  |

### Evaluation

One evaluation :  $DS + CC$

### Learning outcomes

| Learning outcomes | N | A | M | E | O |
|-------------------|---|---|---|---|---|
| • TPN-5           | ✓ | . | . | . | . |
| • TPN-6           | ✓ | . | . | . | . |
| • TPN-7           | ✓ | . | . | . | . |
| • TPN-12          | ✓ | . | . | . | . |
| • TPN-13          | ✓ | . | . | . | . |
| • TPN-20          | ✓ | . | . | . | . |
| • TPN-21          | ✓ | . | . | . | . |

*Manager : Anouk GREVIN*

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## Person : my relation to others

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### Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 12.5 |    |      |    | 6    |

### Evaluation

One evaluation :  $DS + CR$

### Bibliography

Ces contenus empruntent beaucoup de notions de base à des approches comme l'analyse transactionnelle (AT), la communication non-violente (CNV), le life coaching, la programmation neuro-linguistique (PNL).

Pour aller plus loin, on pourra consulter avec profit :

- 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](http://www.16personalities.com)
- [www.acnv.com](http://www.acnv.com)

### Learning outcomes

| Learning outcomes | N | A | M | E | O |
|-------------------|---|---|---|---|---|
| • TPN-7           | ✓ | . | . | . | . |
| • TPN-12          | ✓ | . | . | . | . |
| • TPN-13          | ✓ | . | . | . | . |
| • TPN-19          | ✓ | . | . | . | . |
| • TPN-20          | ✓ | . | . | . | . |
| • TPN-21          | ✓ | . | . | . | . |

Manager : Maud BEAUTRAIS SATTLER

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# Physics of semiconductors and components

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 12.5 | 18  | 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

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# Probabilities, Statistiques

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## 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*

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## Professional English 3

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 19  | 2  |      |    |      |

### Evaluation

3 evaluations :

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

---

## Professional Project 2 : professional project presentation

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      |     |    | 13.5 |    | 2.5  |

### Evaluation

One evaluation : *Contrôle continu*

### Outline

Path : 4 sessions of 3h TD

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

2 / My professional 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

Professional project 1 (S5)

Discovery of firms and professions (S6)

### Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • Formalize and build their own professional project                | . | . | ✓ | . | . |
| • Present themselves professionally : introduction, skills, project | . | ✓ | . | . | . |
| • Updated Resume  | . | ✓ | . | . | . |

*Manager : Maud BEAUTRAIS SATTLER*



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## Professional project 3 : skills passport

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      |     |    | 12   |    | 3    |

### Evaluation

One evaluation : *Examen*

### Outline

1 / Day skills (7.5 h TD)

Course within six thematic workshops (12 to 15 students maximum) in connection with the assessment of skills and seeking their first job.

Production of a paper on key competencies.

2 / Job interview simulation platform (3h TD)

Job Interviews for the last training (speed dating) with business partners Polytech'Nantes

### Goals

Achieve an end-of course student appraisal to help the student:

- To find an internship study linked with his professional project
- To stand in front of a future recruiter with realism about his skills.

### Bibliography

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

### Prerequisites

Professional Project 2 : Professional project presentation

### Learning outcomes

| Learning outcomes  | N | A | M | E | O |
|--|---|---|---|---|---|
| • Produce a skill assessment                                       | . | ✓ | . | . | . |
| • Present themselves professionally: introduction, skills, project | . | . | ✓ | . | . |

*Manager : Maud BEAUTRAIS SATTLER*

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# Project management

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 10.5 |    |      |    | 10.5 |

## Evaluation

One evaluation : *Examen*

## Outline

1 / Introduction:

Project Definition - Project Management - Specifications of a project - Project Types

2 / Stakeholders:

Instances of project, categories of actors, roles and borders - gouvernance project - the project leader missions

3 / The project life cycle

The phasing of the project and its steps (the emergence - set up - implementation - evaluation )

For each phase: objectives, operations, deliverables, tools

4 / Methods and tools of project management (with exercises)

Block diagram, work and responsibilities - Project Planning and Resource Management - Project Dashboard - Risk Management (FMEA)

5 / Communication and changes management (Basic)

Communication Plan - Impact analysis and changes management sheet

## Goals

Provide basic knowledge of project management allowing students to understand the different types of projects, stakeholders and bodies, project methodology (phasing, decisions, methods and tools) in order to prepare them to take responsibility in a simple project or to contribute to the creation of a more complex project (internship and / or transversal project and / or student project)

## Bibliography

Le dictionnaire de management de projet - AFITEP (5e édition), AFNOR ,Paris, impr 2010

La conduite de projet, Hugues Marchat, Editions d'Organisation, Paris, juillet 2008

Le Kit du Chef de projet, Hugues Marchat, Livres outils - Editions d'organisation, Paris, 2010

## Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • Know and apply the methods and tools of traditional project management, understand their context of use, their advantages and limitations         | . | ✓ | . | . | . |
| • Plan a mission according to project method : distinguish purpose / objectives / means, plan action, anticipate major risks, evaluate the outputs. | . | ✓ | . | . | . |
| • Identify stakeholders in a project and understand their respective roles towards the project.   | . | ✓ | . | . | . |
| • Pilot a project = know the responsibilities of a project leader   | ✓ | . | . | . | . |

*Manager : John KINGSTON*

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# Quality approach and problem solving

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 10.5 |    |      |    | 10.5 |

## Evaluation

One evaluation : *Contrôle continu*

## Outline

1 / Origins and forms of quality management:

Product quality - Quality system - quality project - management systems - ISO 9001 - process approach - opening trades on standards

2 / Principles of organization based on the process approach:

Typology of processes - Mapping - Organizational Interfaces

3 / approach and tools useful to the engineer:

QQQQCP - 5M - Flowchart - Methods of analysis and problem solving

4 / What is he an engineer involved in a quality approach?

Decollaboration direct objects with a quality manager - topics that relate directly to the engineer

## Goals

- Open to students issues, forms and tools of quality management
  - Know the "commun" tools quality approach
  - Encourage collaboration among future engineers and quality managers who hire enterprises

## Bibliography

"Maîtriser les processus de l'entreprise - Guide opérationnel" - Michel CATTAN, Nathalie IDRISSE, Patrick KNOCKAERT, 3 édition, Editions d'Organisation

"Méthodes et outils pour résoudre un problème" 45 outils pour améliorer la performance de votre organisation - Alain-Michel CHAUVET, 3 édition, DUNOD

## Prerequisites

- Discover the world of entreprise through an internship and / or project
  - Ability to project in the engineering profession  
(see Module Discovery trades and entreprise 3rd year)

## Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • Understand the organization of a company in a point of view "process" | ✓ | · | · | · | · |
| • Handle "commun" tools quality through analysis and problem solving    | · | ✓ | · | · | · |
| • Know the principles of continuous improvement                         | ✓ | · | · | · | · |

Manager : Cédric LAIR

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# Random signal processing

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 7.5  | 12  | 9  |      |    | 10   |

## Evaluation

3 evaluations :

- *Test*
- *TP*
- *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. Spectral estimation 7. Detection

## Goals

The objective is to present to the students the random signal 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 theory

## 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 characteristic of a random signal | . | . | ✓ | . | . |

Manager : Jean-François DIOURIS

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# Real time operating systems

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## Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 5    | 7.5 | 9  |      |    | 10   |

## Evaluation

One evaluation : *Evaluation Orale*

## Outline

This module introduces main specific properties of real-time systems. It then 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 circular deadlock, resource competition and priority inversion are presented.

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

## Goals

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

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# Real time system design

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## Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
| 5    | 16.5 |    |      |    | 8    |

## Evaluation

One evaluation : *Contrôle conception*

## Outline

This module firstly exposes theoretical 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 technological 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

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## S9-C2: Radar

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
| 9    |     | 6  |      |    |      |

### Evaluation

One evaluation : *eval (coef 1)*

*Manager : Christophe BOURLIER*

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## SOpC : FPGA design and programming

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### 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 mutimedia algorithms on FPGA                               | . | ✓ | . | . | . |
| • FPGA design workflow (synthesis, implementation, analysis tools)      | . | . | ✓ | . | . |

*Manager : Patrick LE CALLET*



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## Safety Health at Work

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### Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 10.5 |    |      |    | 5    |

### Evaluation

One evaluation : *Contrôle continu*

### Outline

General information on occupational risks (defined AT / MP / risks / hazards, pricing, direct and indirect costs, statistics, internal and external actors)

Regulatory framework Law 1991 - prevention principles, guidelines, laws, decrees,

Penal and civil responsibility: roles and responsibilities of an engineer in the prevention of occupational risks, delegation of power

Different hazards and their sources in company

Evaluation of occupational hazards applied to a work situation, risks document

Definition and implementation of preventive and / or corrective actions

Work accident : mechanisms, analysis

### Bibliography

[www.inrs.fr](http://www.inrs.fr)

sites des carsat

[www.legifrance.gouv.fr](http://www.legifrance.gouv.fr)

code permanent hygiène et sécurité

<http://www.travailler-mieux.gouv.fr/>

### Learning outcomes

| Learning outcomes   | N | A | M | E | O |
|---|---|---|---|---|---|
| • Know their rights and obligations under the internship and future employment                                | · | ✓ | · | · | · |
| • Identify the risks of infringement with the health on a workstation and propose adapted prevention measures | · | ✓ | · | · | · |
| • Know the regulations relative to the hygiene and the safety at work   | ✓ | · | · | · | · |
| • Prepare the student to think of an issue of health and safety at work to apprehend in its future projects   | · | ✓ | · | · | · |

Manager : Cédric LAIR

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## Second foreign language - Chinese

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 18  |    |      |    |      |

### Evaluation

One evaluation : *CC*

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## Second foreign language - Chinese

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 18  |    |      |    |      |

### Evaluation

One evaluation : *CC*

---

## Second foreign language - German

---

### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 18  |    |      |    |      |

### Evaluation

One evaluation : *CC*

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## Second foreign language - German

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 18  |    |      |    |      |

### Evaluation

One evaluation : *CC*

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## 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*

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## Second foreign language - Spanish

---

### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 18  |    |      |    |      |

### Evaluation

One evaluation : *CC*



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## Second foreign language - Spanish

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### Hours

| Lect | Tut | PW | Proj | WP | Asst |
|------|-----|----|------|----|------|
|      | 18  |    |      |    |      |

### Evaluation

One evaluation : *CC*

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## Society : Socio-economic debating

---

### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      | 12  |    |      |    | 12   |

### Evaluation

One evaluation : *DS + exposé débat*

### Bibliography

- 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-1           | . | ✓ | . | . | . |
| • TPN-2           | . | ✓ | . | . | . |
| • TPN-3           | . | ✓ | . | . | . |
| • TPN-8           | ✓ | . | . | . | . |
| • TPN-9           | ✓ | . | . | . | . |
| • TPN-10          | . | ✓ | . | . | . |
| • TPN-11          | ✓ | . | . | . | . |

Manager : Chrystèle GONCALVES

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## Society : history of organizations and epistemology

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      | 15  |    |      |    | 3    |

### Evaluation

One evaluation : *DS + CR*

### Bibliography

- Henry Mintzberg, 1982, Structure et dynamique des organisations (Éd. D'Organisation)
  - Jean-Charles Asselain, 2007, Histoire des entreprises et approches globales. Quelles convergences ? Dans Revue économique 2007/1 (Vol. 58), pages 153 à 172
  - Thomas Piketty, 2013, Le Capital au XXIe siècle, Le Seuil, coll. « Les Livres du nouveau monde », 5 septembre 2013, 976 p.
  - Marlyse Pouchol, 2006, La pensée de l'économie chez Galbraith, Innovations, (n23), pp 9 à 30.

### Learning outcomes

| Learning outcomes | N | A | M | E | O |
|-------------------|---|---|---|---|---|
| • CTI-07          | ✓ | . | . | . | . |
| • TPN-5           | ✓ | . | . | . | . |
| • CTI-10          | ✓ | . | . | . | . |
| • TPN-10          | ✓ | . | . | . | . |

*Manager : Marc BIDAN*

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## Sociology of innovation

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
| 4.5  |     |    |      |    | 4.5  |

### Evaluation

One evaluation : *CR écrit*

### Outline

Innovation (organization, development, industrial property, project's driving (steering)).

### Goals

Global definition "Innovation". Acquire knowledges : the innovation global process. Create a project (non-existent product) (team)

### Bibliography

Créativité et Innovation Tayeb Louafa et Francis-Luc Perret (éditions presse polytechniques et universitaires romandes).

La boîte à outils de l'innovation de Géraldine Benoit-Vervantes (éditions Dunod).

### Prerequisites

None

### Learning outcomes

| Learning outcomes  | N | A | M | E | O |
|--|---|---|---|---|---|
| • Being able to organise and lead an innovation global process | ✓ | · | · | · | · |

*Manager : Dominique PECAUD*

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## Sport 3

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### Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 19.5 |    |      |    | 2    |

### Evaluation

One evaluation : *Contrôle continu*

### Learning outcomes

| Learning outcomes  | N | A | M | E | O |
|--|---|---|---|---|---|
| • Capacité à prendre des initiatives, mise en action, adaptation à un contexte et/ou consigne (dans un contexte nouveau) | . | . | ✓ | . | . |
| • Favoriser l'équilibre physique et psychique des élèves   | . | . | ✓ | . | . |
| • Etre capable de travailler en équipe, de communiquer et d'établir des relations de confiance et d'entraide             | . | ✓ | . | . | . |
| • Résister au stress et évacuer les tensions liées aux études  | . | . | ✓ | . | . |

Manager : Jérôme BEZIER

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## Sport 4

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### Hours

|      |      |    |      |    |      |
|------|------|----|------|----|------|
| Lect | Tut  | PW | Proj | WP | Asst |
|      | 19.5 |    |      |    | 2    |

### Evaluation

One evaluation : *Contrôle continu*

### Learning outcomes

| Learning outcomes  | N | A | M | E | O |
|--|---|---|---|---|---|
| • Capacité à prendre des initiatives, mise en action, adaptation à un contexte et/ou consigne (dans un contexte nouveau) | . | . | ✓ | . | . |
| • Favoriser l'équilibre physique et psychique des élèves   | . | . | ✓ | . | . |
| • Etre capable de travailler en équipe, de communiquer et d'établir des relations de confiance et d'entraide             | . | ✓ | . | . | . |
| • Résister au stress et évacuer les tensions liées aux études  | . | . | ✓ | . | . |

Manager : Jérôme BEZIER

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## Training for Toeic

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### 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*



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## Transdisciplinary project I

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### 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 Memorandum 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, intredisciplinary, 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*

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## Transdisciplinary project II

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      |     |    | 70   |    | 35   |

### Evaluation

One evaluation : *Rapport et 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 Memorandum 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, intredisciplinary, 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*

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# Tutored Project

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## 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 an oral presentation    | • | ✓ | • | • | • |
| • be aware of the various stages of a technical project             | • | • | ✓ | • | • |
| • be aware of the needs of team working                             | • | • | ✓ | • | • |

*Manager : Philippe GUYONNET*

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## Work analysis

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### Hours

|      |     |    |      |    |      |
|------|-----|----|------|----|------|
| Lect | Tut | PW | Proj | WP | Asst |
|      | 12  |    |      |    | 4    |

### Evaluation

One evaluation : *Contrôle continu*

### Bibliography

Cf liste des ressources mises à disposition des étudiants pour répondre aux questions, entre autre :

- J'ai très mal au travail - Christophe Desjours - Octobre 2011 (Interviews Youtube)
- Management Humain, Taskin L. et Dietrich A., De Boeck Supérieur, 2016
- L'évaluation du travail à l'épreuve du réel : critique des fondements de l'évaluation, 1995
- L'acteur et le système, Michel Crozier, Erhard Friedberg, Points (dernière édition 2014)

### Learning outcomes

|     | N | A | M | E | O |
|-----|---|---|---|---|---|
| • 1 | . | ✓ | . | . | . |
| • 2 | . | ✓ | . | . | . |

*Manager : Anouk GREVIN*