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# ENGINEERING PROGRAMME

2022-2023

Year 2 / Year 3

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Specialisation option  
**Product Engineering**

OD IPROD

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PROGRAMME SUPERVISOR

Matthieu RAUCH



ENGINEERING - OD IPROD

# Autumn Semester

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Course unit	ECTS Credits	Track	Course code	Title
UE 73 / 93	12	Core course	CMMO CONCEPT MOMAQ USAGES	Choice of Materials and their Deployment Product Design Product modelling and development Product use
UE 74 / 94	13	Core course	CONFORM P1IPROD PLANEX PROCOM RAPMA	Production compliance and stability Project 1 Design of Experiments - DOE Programming control machines and objects Rapid Manufacturing

# Spring Semester

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Course unit	ECTS Credits	Track	Course code	Title
UE 103 / 83	14	Core course	DESIN HACOPG P2IPROD PROCD SYPRO	Industrial Design Costing, purchasing and pricing Project 2 Processes Production system

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

# Choice of Materials and their Deployment [CMMO]

*LEAD PROFESSOR(S): Jérôme FRIANT / Matthieu RAUCH*

### Objectives

Learn the properties of several materials and their applications

### Course contents

Material properties and characteristics to define which will be the most adapted for a defined application

Material/Process selection approaches. Ashby Method

Design/Prototype manufacturing mini-project to understand the knowledge required and have a clear vision of the scope of the product engineering specialization

### Course material

### Assessment

Collective assessment: EVC 1 (coefficient 0.5)  
EVC 2 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	8 hrs	10 hrs	14 hrs	0 hrs	0 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

# Product Design [CONCEPT]

LEAD PROFESSOR(S): Jean-François PETIOT

### Objectives

Present the different stages of the design process for industrial products.  
Present the tools and methods used for user centered products design, integrating environmental aspects.  
Outline methods for innovation and creativity.  
Machine elements - dimensionning

### Course contents

Functional product analysis  
- functional diagram  
- functional specifications  
- internal functional analysis

Decision making  
- multicriteria decision making  
- the AHP method  
- the ELECTRE method  
- vote aggregation

Design management and Design thinking  
- user centered specifications  
- creativity and usage situations - TRIZ method  
- prototyping and user-tests

Machine Elements  
Dimensioning calculations  
- shafts  
- bearings  
- clutch and brakes  
- gear and gearbox

Collaborative design  
- the DELTA DESIGN serious game

### Course material

Systèmes Mécaniques - Aublin et coll. DUNOD  
Eppinger & Ulrich Product design and development. Third edition Mc Graw Hill.  
La conception industrielle de produits. Hermès Science, Lavoisier, 2008

### Assessment

Collective assessment: EVC 1 (coefficient 0.25)

Individual assessment: EVI 1 (coefficient 0.75)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	14 hrs	16 hrs	0 hrs	0 hrs	2 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

# Product modelling and development [MOMAQ]

*LEAD PROFESSOR(S): Jean-Yves HASCOËT*

### Objectives

Within the framework of concurrent engineering, this course allows students to acquire a body of knowledge from product design to manufacture via virtual prototyping.

### Course contents

1. Product Definition  
Management of new product development - Product methods and development tools
2. Fast product development: rapid prototyping, additive manufacturing
3. Knowledge Engineering  
Capitalise on know-how - Advanced CAD/CAM systems  
Integration of production constraints in design (DFM, DFA)
4. Data Management  
Product data management, PDM Integration - Product structure management  
Databases, DBMS - Product data exchanges.

### Course material

- Machine à commande numérique, B. MERY, Hermès
- CADAM Theory and Practice, I. Zeid, Mc Graw-Hill
- Surface Modeling for CadCam, BK. Choi, Elsevier
- Fundamentals of Computer Integrated Manufacturing, A.L. Foston, CL Smith, T. Au, Prentice Hall
- La CFAO Concevoir et produire autrement, F. Piquet, JP Poitou, JC Tass, Nathan
- NC Machine Programming and Software Design, CH Chang, MA Melkanoff, Prentice Hall
- Lecture and tutorial notes.

### Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	10 hrs	4 hrs	16 hrs	0 hrs	2 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

### Product use [USAGES]

*LEAD PROFESSOR(S): Catherine MICHEL*

#### Objectives

- To understand the principle of design thinking
- To understand the links between users, needs and products.
- To explain the interdependencies between design and marketing.
- To raise student awareness of the importance of listening to customers in product design.
- To present methods and tools to capture customer voice and transform it into product specifications which incorporate users' real needs.
- To present methods and tools used in product design: concurrent engineering - value analysis - TRIZ theory
- To develop creativity

#### Course contents

- Uses / Trends
- Design Thinking
- Development / Innovation methodology
- Collaboration
- Prototyping / Testing / Validation

#### Course material

G.Delafoillie Analyse de la valeur,  
 C.Petitdemange Créer et Développer vos produits,

#### Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	10 hrs	20 hrs	0 hrs	0 hrs	2 hrs



## ENGINEERING - OD IPROD

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

# Production compliance and stability [CONFORM]

*LEAD PROFESSOR(S): Hervé THOMAS*

### Objectives

To acquire the skills to master parts compliance and stabilization of the production process.

### Course contents

Understand part dimensioning,  
 Know how to generate a manufacturing process,  
 Know how to generate and analyse computer-aided manufacturing trajectories,  
 Know how to generate and analyse computer-aided maintenance trajectories,  
 Analyze and stabilize the machining process,  
 Implement quality tools in the production process.

### Course material

### Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	8 hrs	8 hrs	16 hrs	0 hrs	0 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

### Project 1 [P1IPROD]

*LEAD PROFESSOR(S): Matthieu RAUCH*

#### Objectives

Product development project in a real-life situation with an external client.

The objective of this project is to apply the concepts studied throughout the courses to an industrial environment and to develop practicality as well as an ability to work in teams.

#### Course contents

Students are divided into groups either to lead an independent project, or to work in competition on the same project.

#### Course material

#### Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	1	0 hrs	0 hrs	0 hrs	32 hrs	0 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

# Design of Experiments - DOE [PLANEX]

LEAD PROFESSOR(S): Jean-François PETIOT

### Objectives

Provide the students with tools and methods for the experimental study of systems:

- Understand the effect of factors on a response
- model and predict a response according to experimental factors
- optimize a response and carry out a robust design

### Course contents

General presentation

- DOE (the design of experiments approach)
- illustration: Hotelling's Experiment
- notion of design space

Full factorial designs:  $2^k$

- two factor design example: fuel consumption of a vehicle
- three factor design
- Example with 5 factors
- Matrix of experiments

Fractional factorial designs:  $2^{k-p}$

- fractional designs
- Alias theory
- computation of contrasts

Statistics and DOE

- Analysis of variance
- Multiple linear regression
- modelling of experimental data
- order of experiments

Response surface modelling

- optimal designs
- optimality criteria (D-Optimality)
- modelling - responses - optimisation

DACE - design analysis of computer experiments

- LHS and OSF designs

The Taguchi robust approach

3 Tutorials( 4h) on Excel and MODDE

Project (8h) on the optimization of a system with the DOE approach

### Course material

Gilles et Marie-Christine SADO. Les plans d'expérience. AFNOR Technique

Jacques GOUPY, Lee Creighton. Introduction aux plans d'expériences. DUNOD

Méthodologie Expérimentale. Baléo, Bourges, Courcoux, Faur-Brasquet, Le Cloirec. Editions TEC &DOC

Droesbeke J-J, Fine J, Saporta G. Plans d'expériences. Applications à l'entreprise. Editions TECHNIP.  
 Jacques GOUPY, Plans d'expériences pour surfaces de réponse. DUNOD  
 Maurice PILLET. Introduction aux plans d'expériences par la méthode TAGUCHI. EO.Sup.

### Assessment

Collective assessment: EVC 1 (coefficient 0.3)

Individual assessment: EVI 1 (coefficient 0.7)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	10 hrs	20 hrs	0 hrs	0 hrs	2 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

# Programming control machines and objects [PROCOM]

*LEAD PROFESSOR(S): Matthieu RAUCH*

### Objectives

Designing and integrating mecatronic aspects in product development  
Introduction to smart objects

### Course contents

Network architectures, sensors, mecatronic (CM)  
electronics platforms programming, realisation of sensors/platform systems (TD, TP)  
Microproject based on use cases

### Course material

### Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	8 hrs	16 hrs	8 hrs	0 hrs	0 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

# Rapid Manufacturing [RAPMA]

*LEAD PROFESSOR(S): Jean-Yves HASCOËT*

### Objectives

The objective of this course is to propose the methods and tools to be implemented within the framework of Computer Aided Manufacturing with Numerical Control Machine-Tools

### Course contents

1. Evaluate the industrial situation of Rapid Manufacturing
  2. Define the setup of Rapid Manufacturing in a CadCam Context: High Speed Machining, Incremental Sheet Forming
  3. Tutorial.
- From a designer specification we will set up High Speed Machining: Reception of the design specifications, Setup of the reverse engineering, Generation of the multi axe trajectories, High Speed Machining on Parallel Kinematic Machine, Comparison with an ISF process, Additive Manufacturing

### Course material

Machine à Commande Numérique, B. Méry, Hermès  
 CadCam Theory and Practice, I. Zeid, Mc Graw-Hill  
 Surface Modeling for CadCam, BK. Choi, Elsevier  
 Fundamentals of Computer Integrated Manufacturing, A.L. Foston, C.L. Smith, T. Au, Prentice Hall  
 La CFAO- Concevoir et produire autrement, F. Piquet, JP Poitou, JC Tasse Nathan  
 NC Machine Programming and Software Design, C.H. Chang, M.A. Melkanoff, Prentice Hall  
 Lecture and tutorial notes.

### Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	8 hrs	8 hrs	16 hrs	0 hrs	0 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

# Industrial Design [DESIN]

*LEAD PROFESSOR(S): Jean-François PETIOT*

### Objectives

Present the three main values that drive industrial product development: technical values, usage values, communication values.

To learn tools and methods to control connotative aspects of products

To acquire the necessary skills to understand the actions of industrial designers, their added value in a design project, and organize their activities in a design project team.

### Course contents

Lectures:

Semiology - design theory

Gestalt theory, semiotics, mood boards, constraints and creativity

Conjoint analysis for product design.

Communication via graphic design

Tutorials:

Design exercises - communication on trends by product

Conjoint analysis tutorial

Group design project

### Course material

Danielle QUARANTE. Eléments de design industriel. 3ième Edition. Polytechnica. 2001.

EGER A., BONNEMA M., LUTTERS E., VAN DER VOORT M. Product Design. Eleven International Publishing, 2013.

### Assessment

Collective assessment: EVC 1 (coefficient 0.5)  
EVC 2 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	8 hrs	20 hrs	4 hrs	0 hrs	0 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

# Costing, purchasing and pricing [HACOPG]

*LEAD PROFESSOR(S): Catherine MICHEL*

### Objectives

Understand the economic dimension of value chains.

### Course contents

- Purchasing
- Costing
- Pricing
- Negotiation

### Course material

### Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	8 hrs	22 hrs	0 hrs	0 hrs	2 hrs



## ENGINEERING - OD IPROD

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

### Project 2 [P2IPROD]

*LEAD PROFESSOR(S): Matthieu RAUCH*

#### Objectives

Product development project in a real-life situation with an external client.  
The objective of this project is to apply the concepts studied throughout the courses to an industrial environment and to develop practicality as well as an ability to work in teams.

#### Course contents

Students are divided into groups either to lead an independent project, or to work in competition on the same project.

#### Course material

#### Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	2	0 hrs	0 hrs	0 hrs	48 hrs	0 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

### Processes [PROCD]

*LEAD PROFESSOR(S): Jérôme FRIANT*

#### Objectives

Know the different methods of manufacturing associated to materials  
 Increase knowledge of conventional methods and new ways of manufacturing.  
 Impact of their choice on the design, manufacture and consideration of the product life cycle

#### Course contents

Approach for material / process selection. Ashby Plots.  
 Development of a specific program based on the method of learning by problem and by project.  
 Foundry processes, forging, stamping, automated welding, cutting, and automated boiler making.  
 Extension to other methods

#### Course material

#### Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	4 hrs	8 hrs	20 hrs	0 hrs	0 hrs

## ENGINEERING - OD IPROD

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

# Production system [SYPRO]

LEAD PROFESSOR(S): Hervé THOMAS

### Objectives

Acquire Knowledge on the main types of production of a product from its design to delivery. Understand the normative or regulatory constraints, the business organizations for flow management and production optimization. (from needs to workshop locations).

### Course contents

- production and flows
- forecast customer demand, stocks and data management
- needs, capacity, loads
- Flows optimization : workshop location, flows simulation

### Course material

### Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	8 hrs	16 hrs	8 hrs	0 hrs	0 hrs