ENGINEERING PROGRAMME

2023-2024
Year 2 / Year 3

Specialisation option
Product Engineering

OD IPROD

PROGRAMME SUPERVISOR
Matthieu RAUCH

Autumn Semester

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

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

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	14 hrs	10 hrs	0 hrs	0 hrs

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 & Ullrich 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

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 CADCAM 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

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

Course material

G.Delafollie 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

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

Project 1 [P1IPROD]

LEAD PROFESSOR(S): Matthieu RAUCH

Objectives

Real-life product development project with a customer from outside the school.
The aim of this project is to apply the concepts learned in class to an industrial case study, and to develop practical skills and the ability to work as part of a team.

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

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: 2k
- two factor design example: fuel consumption of a vehicle
- three factor design
- Example with 5 factors
- Matrix of experiments

Fractional factorial designs: 2k-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

Programming control machines and objects [PROCOM]

LEAD PROFESSOR(S): Matthieu RAUCH

Objectives

Design and integrate mecatronic aspects in product development.
Introduction to smart objects.

Course contents

Review of network architecture, sensors and mechatronics principles (lectures)
Programming of electronic boards, construction of sensor/board systems (tutorials and lab work)
Micro-projects on command and control 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

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

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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 exercices - 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

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

Project 2 [P2IPROD]

LEAD PROFESSOR(S): Matthieu RAUCH

Objectives

Real-life product development project with a customer from outside the school.
The aim of this project is to apply the concepts learned in class to an industrial case study, and to develop practical skills and the ability to work as part of a team.

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

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

Processes [PROCD]

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

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