

SHAKE THE FUTURE.



ENGINEERING PROGRAMME

SPECIALISATION

PRODUCT ENGINEERING
AUTUMN SEMESTER

PEOPLE, PRODUCT AND ORGANISATIONS

PRODUCT ENGINEERING, ENGINEERING PROGRAMME SPECIALISATION
AUTUMN SEMESTER

Professor: Catherine MICHEL

Objectives

Understand the different processes within industrial companies in particular.
Understand the role of an engineer within an organisation.

Course contents

Upon completion of the course students are expected to:

- Fully understand the product lifecycle
- Be able to analyse and model an organisation
- Be aware of people-related issues within an organisation
- Understand how projects are run within an organisation.

Course material

Keywords

Product lifecycle, organisation theory, company models, ERP, people-related issues

Links with other programmes

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French | 3 | 8 hrs | 20 hrs | 4 hrs | 0 hrs |

PRODUCT DESIGN

AUTUMN SEMESTER – PRODUCT ENGINEERING, ENGINEERING SPECIALISATION

Professor: 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.

Course contents

Functional product analysis

- functional diagram
- functional specifications
- internal functional analysis

Design management and Design thinking

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

DSM (Design Structure Matrix) formalism

- DSM and WTM

Machine Elements

Dimensioning calculations

- shafts
- bearings

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

Keywords

Functional analysis, value analysis, DSM formalism, eco-conception, dimensioning, innovation.

Links with other programmes

Customer satisfaction and quality management. Industrial Design.

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French | 3 | 10 hrs | 16 hrs | 4 hrs | 0 hrs |

PRODUCT MODELLING AND DEVELOPMENT

AUTUMN SEMESTER – PRODUCT ENGINEERING, ENGINEERING SPECIALISATION

Professor: 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.

Keywords

Numerical Modeling, Models, CadCam, Manufacturing, Engineering, Rapid Prototyping, Additive manufacturing, Design, Integrated, Data Management, concurrent engineering.

Links with other programmes

This course, within the framework of concurrent engineering, is directly linked to the courses in design, production techniques, production systems and concurrent engineering.

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO | PROJECT |
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| French | 3 | 12 hrs | 0 hrs | 20 hrs | 0 hrs |

PRODUCT USE

AUTUMN SEMESTER – PRODUCT ENGINEERING, ENGINEERING SPECIALISATION

Professor: Emilie POIRSON

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 the 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

- Industrial testimony of implementation of design thinking tools
- Definition of needs
- Customer satisfaction - interviews, focus groups, satisfaction survey
- CEM: Market in design - Kano method - Multi-picking method
- QFD: Quality Function Deployment
- Experimental design theory

Course material

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

Keywords

Needs, customer oriented design, Kano, design process, solution evaluation, Design thinking

Links with other programmes

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French | 3 | 12 hrs | 14 hrs | 6 hrs | 0 hrs |

DESIGN OF EXPERIMENTS - DOE

AUTUMN SEMESTER – PRODUCT ENGINEERING, ENGINEERING SPECIALISATION

Professor: 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

Course contents

General presentation – Examples

- DOE (the design of experiments approach)
- illustration: Hotellings 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

Statistical process control - SPC

Tutorial and project on Excel and MODDE

Course material

Multi-criteria decision-making methods (AHP, Electre), multi-objective optimisation (Pareto), Metaheuristics, data visualisation

Keywords

Gilles and 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.

Links with other programmes

Probability and Statistics

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French | 3 | 10 hrs | 20 hrs | 0 hrs | 0 hrs |

PROJECT 1

AUTUMN SEMESTER – PRODUCT ENGINEERING, ENGINEERING SPECIALISATION

Professor: Matthieu RAUCH

Objectives

Product development project in a real-life situation with a professional customer.

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 competitively on the same project.

Course material

Keywords

Teamwork, Industrial project, Professional development, Product Development

Links with other programmes

All the courses of the Product Engineering specialisation.

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French | 1 | 0 hrs | 0 hrs | 0 hrs | 32 hrs |

ADVANCED DESIGN

AUTUMN SEMESTER – PRODUCT ENGINEERING, ENGINEERING SPECIALISATION

Professor: Jean-François PETIOT

Objectives

Raise student awareness of the consideration of human factors in the design of a system.
Understand how to integrate product / user interactions in design.

Define requirements and user constraints, adjusting product and work requirements to human capacity to reduce stress. Design products, machinery, equipment and facilities for maximum efficiency, precision and safety.

Present tools and methods for:

- the definition of requirements and user constraints, adjustment of product and work requirements to human capacity to reduce stress.
- Adapt the environment (lighting, air conditioning, noise, etc.) to the physical needs of man.
- the decision in a multicriteria context for product design or the control of value chain.

Course contents

Know user constraints and how to translate these constraints into specifications.

Implement a perceived design quality approach.

Be able to design a product or a workstation adapted to the user.

Consider ergonomic constraints.

Implement a customised product approach, within the bounds of economic profitability.

Needs Engineering: tools and methods.

Workstation ergonomics. Integration of ergonomic constraints.

Product customization.

Multicriteria decision making

- pairwise comparisons
- AHP method (Analytic Hierarchy Process)
- ELECTRE method
- Preferences aggregation

Course material

Saaty, Thomas L. Fundamentals of Decision Making and Priority Theory with the Analytic Hierarchy Process (1994). Pittsburgh: RWS. ISBN 0-9620317-6-3. A thorough exposition of the theoretical aspects of AHP.

Roy, B.: 1985, Méthodologie multicritère daide à la décision, Economica

Keywords

Physical and cognitive ergonomomy, Inclusive design, Multicriteria decision making

Links with other programmes

Product Design

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| French | 3 | 12 hrs | 14 hrs | 4 hrs | 0 hrs |

MATERIALS AND PROCESSES

AUTUMN SEMESTER – PRODUCT ENGINEERING, ENGINEERING SPECIALISATION

Professor: 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

Keywords

Links with other programmes

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO | PROJECT |
|----------|--------------|----------|-----------|--------|---------|
| French | 3 | 4 hrs | 8 hrs | 20 hrs | 0 hrs |

PRODUCTION COMPLIANCE AND STABILITY

AUTUMN SEMESTER – PRODUCT ENGINEERING, ENGINEERING SPECIALISATION

Professor: 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

Keywords

manufacturing process, machining, tolerancing, tridimensional metrology, quality control, compliance.

Links with other programmes

Product Design and Development, Rapid Manufacturing

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO | PROJECT |
|----------|--------------|----------|-----------|--------|---------|
| French | 3 | 8 hrs | 8 hrs | 16 hrs | 0 hrs |