Course guide
240652 - 240652 - Engineering of the Product

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 758 - EPC - Department of Project and Construction Engineering.
Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
Academic year: 2022  ECTS Credits: 4.5  Languages: Catalan

LECTURER

Coordinating lecturer: Joaquim Lloveras Macià
Others:

PRIOR SKILLS

Basic knowledge of mechanical engineering or electrical and electronics, or materials, or chemical processes

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEM2. Knowledge on mechanical, electronic, chemical and biologic behaviour of materials, and capacity to apply this behaviour into design, calculation and modelling of aspects of elements, components and equipment.
CETI9B. Capacity to analyse, design, simulating and optimising processes and products.
CE15. Basic knowledge of industrial production systems.

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.

TEACHING METHODOLOGY

The classes will have the first part of summarized explanations, this theory applies to the second part of the class will be tutoring the work group was preparing engineering design of an innovative product.
Students will form working groups between 4 to 6 students, trying to integrate different specialties, choose a theme and work with the approval of the teacher.
Work engineering design of a product will be presented (oral and written), groups of students by mid course and end of the course.
We promote the questions between groups.
LEARNING OBJECTIVES OF THE SUBJECT

General objective
Students learn and practice how to focus and development of engineering product design, with emphasis on product innovation, especially in the conceptual design phase.

Specific Objectives
- Knowledge of lifecycle product engineering in relation with the Ecodesign.
- The actions that lead to have a conceptual design directed.
- The tasks for a conceptual design defined.
- The analysis to have a viable conceptual design.
- Knowledge of Patents.
- Aspects of the detailed design and prototyping.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group</td>
<td>45,0</td>
<td>40.00</td>
</tr>
<tr>
<td>Self study</td>
<td>67,5</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 112.5 h

CONTENTS

1. Lifecycle of a product in relation with the Ecodesign.

Description:
The life cycle of a product begins with the individual obtaining the materials that compose and ends with its scrapping. The Ecodesign tries to minimize the environmental impact throughout the product life cycle.

Specific objectives:
Giving an overview of life cycles by analyzing each of them.
Prepare the main concepts and design phases of a design project.
Prepare to apply concepts further analysis of the life cycle of the product, to Ecodesign.

Related activities:
Examples of lifecycles.

Related competencies:
CEM2. Knowledge on mechanical, electronic, chemical and biologic behaviour of materials, and capacity to apply this behaviour into design, calculation and modelling of aspects of elements, components and equipment.
CE15. Basic knowledge of industrial production systems.

Full-or-part-time: 1h 30m
Practical classes: 1h 30m
## 2. Actions to have a conceptual design directed

**Description:**
The first step for a conceptual design of product innovation is to work towards the innovation. So, aspects that can be innovated are search, for example to implement new features, or new materials, or new automation.
Are applied creativity techniques, or TRIZ, and provide several ideas for alternative solutions.
State of Art and industrial property are searched.
Finally, to define a basic architecture of the product and its functions will obtain the conceptual design directed, and then move to another stage where further development and analysis of the chosen solution for product innovation.

**Specific objectives:**
Search aspects of innovation.
Using creative techniques.
Find product information and similar patents.
Functional requirements.

**Related activities:**
Internet search in databases of patents.
Creativity sessions to innovate the product.
If appropriate, prepare surveys, collect information and analyze it.

**Related competencies:**
CEM2. Knowledge on mechanical, electronic, chemical and biologic behaviour of materials, and capacity to apply this behaviour into design, calculation and modelling of aspects of elements, components and equipment.
CE15. Basic knowledge of industrial production systems.

**Full-or-part-time:** 3h
Practical classes: 3h

## 3. Tasks to achieve a conceptual design defined.

**Description:**
Already obtained the direction of conceptual design where it is headed the new product, several actions are made to define the conceptual design. Will apply different methodologies to mature design as: Ecodesign, User Centered Design, Ergonomics, Safety design, Simplification of design.

**Specific objectives:**
Ecodesign: MET Matrix, and Ecoperfil Ecoindicators.
Concepts of User Centered Design
Concepts of Ergonomics
Safe design: cause-effect diagram, Failures tree (FTA). Hazop. FMEA.
Simplification of design

**Related activities:**
Working sessions of group discussion of solutions or improvements.

**Related competencies:**
CE15. Basic knowledge of industrial production systems.
CETI9B. Capacity to analyse, design, simulating and optimising processes and products.
02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.

**Full-or-part-time:** 5h
Practical classes: 5h
4. Activities to have a viable conceptual design

**Description:**
All stages of design are recurrent and interactive, but there is a final stage of analysis of the feasibility of the design concept defined above, which analyzes the advantages and disadvantages that the innovated product has, as well as their viabilities: technical and normative, economic, environmental and social, before moving on to the next phase of detailed design.

At this stage (or in other), to watch the behavior of the product is made a virtual modeling, or a manual physical prototype, or by 3D printers, to help to define the final product and its technical feasibility.

The following phases of product design will be explained.

**Specific objectives:**
- Concepts of viabilities: technical and normative, economic, environmental and social.
- Modelling.

**Related activities:**
- Making a virtual model, or physical of product or a part of it, in its case, with a 3D printer.

**Related competencies:**
- CE15. Basic knowledge of industrial production systems.
- CETI9B. Capacity to analyse, design, simulating and optimising processes and products.

**Full-or-part-time:** 3h
Practical classes: 3h

5. Drafting of a patent

**Description:**
Having overcome the three phases of conceptual design, before the detailed design can proceed with drafting a patent of the product innovation. Protecting intellectual property is needed to capitalize on designs developed.

The same task of drafting a patent obliges to specify and refine the invention also helps to find more alternative solutions.

Will make a basic patent drafting of innovated product.

**Specific objectives:**
- Better understand as they are the patents.
- Learn how to write a patent.

**Related activities:**
- Schematic drawings of the product, and patent drafting.

**Related competencies:**
- CE15. Basic knowledge of industrial production systems.
- CETI9B. Capacity to analyse, design, simulating and optimising processes and products.

**Full-or-part-time:** 2h 30m
Practical classes: 2h 30m
ACTIVITIES

**First design**

**Description:**
This is the first documentation of the work group to be submitted towards half course.
Will define conceptual design of product innovation.

**Specific objectives:**
To develop personal skills of creativity and rationality in design to product innovation.
To develop teamwork skills and expression of it.
Have knowledges of the process of product design.

**Material:**
Written documentation (paper and digital)
Slides of the presentation (digital)

**Delivery:**
It will consist of a presentation of a written text with indicated sections and an oral presentation of the same, where each student will present in about 5 minutes a part of the work of the group, so all the students of the group will give a whole vision of the work.
At the end of the oral presentation of each group, the lecturer and other groups will make assessments of the work presented and questions.

**Related competencies:**
CETI9B. Capacity to analyse, design, simulating and optimising processes and products.
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

**Full-or-part-time:** 15h
Laboratory classes: 15h

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**Final design**

**Description:**
It is the final documentation of the work group.
Analyze feasibility of a first conceptual design of the product innovated and will write the patent.
In its case, will present a computer model, or prototype made manually, or by 3D printer.

**Specific objectives:**
To develop teamwork skills and expression of it.
Knowledges of the process of product design. Drawing solutions.
Knowledges of patents.
Prototyping.

**Material:**
Written documentation (paper and digital)
Slides of the presentation (digital)
Computer model or Prototype, if necessary.

**Delivery:**
The final written documentation will be presented according to the indicated sections.
There will be an oral presentation of the work, where each student will present in about 5 minutes a part of the work of the group, so all the students of the group will give a overall view of the work. At the end of the oral presentation of each group, the lecturer and other groups will make assessments of the work presented and questions.
Will be delivered the model or prototype.

**Full-or-part-time:** 15h
Laboratory classes: 15h
GRADING SYSTEM

If approved by course, the final grade will be:
\[ Nc = 0.5 \, Ngr + 0.5 \, Nind \]
The student's grade will be made in case of the final exam:
\[ Nef \, Nfae = 0.6 + 0.4 \, Nc \]

where:
- \( Nc \) = Course grade
- \( Ngr \) = Note group, obtained \( Npr2 = 0.6 + 0.2Npr1 + 0.2 \, Npfo \)
- \( Npr2 \) = Note of the final document
- \( Npr1 \) = Note of the previous document (half course)
- \( Npfo \) = Note of group of the final oral presentation

\[ Nind = \text{single note, obtained} = 0.6 \, Nvp + 0.4 \, Npoi \]
- \( Nvp \) = Note of teacher assessment of student work and assistance
- \( Npoi \) = Note of individual oral presentation
- \( Nfae \) = Note of final exam
- \( Nef \) = Note of final exam

EXAMINATION RULES.

Presentations of written documentation:
- The first documentation of the work will be presented to middle course.
- The final documentation will be submitted a week before the end of the course.

Oral Presentations:
- Students will make two oral presentations about 5 minutes each, half year and end of the course, which will expose part of their job presented with the group, so that all the students in the group to give an overall view of job.
- At the end exposure of each group, the teacher and other groups will evaluate work presented and questions.
- Assessed the quality of the final presentation, each individual participation and the whole group.

Final written or reevaluation exam:
- Each exam question will be noted his highest score.
- The maximum duration of the examination will be one hour and a half.
- It is evaluated concision in the responses.
- It is not allowed to have notes or electronic devices.
- The teacher will attend only the questions related to the clarification of the text of the questions.

BIBLIOGRAPHY

Basic:

Complementary:

RESOURCES

Hyperlink:
- http://www.ihobe.net/Publicaciones/Listado.aspx?idMenu=750e07f4-11a4-40da-840c-0590b91bc032. Resource
- http://www.triz40.com/TRIZ_GB. Resource