240AU312 - Rapid Prototyping

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering
Academic year: 2017
Degree: MASTER'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2012). (Teaching unit Optional)
ECTS credits: 3
Teaching languages: Catalan

Teaching staff

Coordinator: - IRENE BUJ CORRAL
Others: To be defined

Opening hours

Timetable: To be defined

Prior skills

Knowledge of usual manufacturing processes.
Knowledge of 3D drawing softwares.

Requirements

There are no requisites.

Degree competences to which the subject contributes

Specific:
1. Integrate easily to interdisciplinary and creative technical team of any company in the automotive sector, research center or laboratory tests
3. Conceptualize engineering models, apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems
4. Develop ability to solve problems that are unfamiliar, incompletely defined, considering the possible methods of solution, including the most innovative, selecting the most appropriate, and correcting implementation, evaluating different design solutions.

Generic:
6. Develop independent learning skills to maintain and enhance the powers of Automotive Engineering, to allow the continued development of the profession.
8. Adapt to changes, being able to apply new and advanced technologies and other relevant processes, initiative and entrepreneurship

Teaching methodology

Two hours of class are planned every week. As a general trend, first on will correspond to classes in which the teacher provides concepts and knowledge, alternated with visits to the workshop to observe in situ different machines and the manufacturing process of the prototypes (MD.2-Lecture). Second hour will correspond to development by the students of a project for obtaining the prototype of an internal mechanism of a car, by means of a fused deposition modelling machine (FDM) (MD.4-Cooperative learning and MD.5-Project, problem and case-based learning).

Learning objectives of the subject

Two hours of class are planned every week. As a general trend, first on will correspond to classes in which the teacher provides concepts and knowledge, alternated with visits to the workshop to observe in situ different machines and the manufacturing process of the prototypes (MD.2-Lecture). Second hour will correspond to development by the students of a project for obtaining the prototype of an internal mechanism of a car, by means of a fused deposition modelling machine (FDM) (MD.4-Cooperative learning and MD.5-Project, problem and case-based learning).
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General objective:
To assess and to know how to select the most appropriate rapid prototyping technology depending on the function of the prototypes to be obtained.

Specific objectives:
- To understand additive manufacturing.
- To assess advantages and disadvantages of different rapid prototyping technologies.
- To have tools to choose the most appropriate rapid prototyping technology in each case.
- To know other applications of rapid prototyping, such as rapid tooling or rapid manufacturing.
- To know advanced rapid prototyping technologies.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Total learning time: 75h</th>
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<tbody>
<tr>
<td>Hours large group:</td>
<td>0h</td>
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<tr>
<td>Hours medium group:</td>
<td>18h</td>
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<tr>
<td>Hours small group:</td>
<td>9h</td>
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<tr>
<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td>Self study:</td>
<td>48h</td>
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## Content

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<tr>
<th>Introduction</th>
<th>Learning time: 8h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Guided activities: 2h</td>
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<td>Self study: 4h</td>
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**Description:**
Presentation of the subject. Methodology. Introduction to prototyping technologies. Necessity for the obtention of prototypes.

**Related activities:**
Explanation of the project. Briefing. Examples of internal mechanisms of the vehicle to be selected.

**Specific objectives:**
To identify the concept of rapid prototyping.

<table>
<thead>
<tr>
<th>Technologies for rapid manufacturing of prototypes</th>
<th>Learning time: 16h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
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<tr>
<td></td>
<td>Guided activities: 4h</td>
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<td>Self study: 8h</td>
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</tbody>
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**Description:**
Description of following technologies: stereolithography (STL), fused deposition modelling (FDM), selective laser sintering (SLS) and use of silicone rubber moulds. Main advantages and disadvantages of each technology. Application of each technology in the automotive industry.

**Related activities:**
Visit to CIM Centre Foundation. Selecting the subject for the project. Obtaining a sketch of the mechanism. Showing the CAD design of the chosen mechanism. CAD validation and green light to printing. Assembly and presentation of the mechanisms from 3D printed parts.

**Specific objectives:**
To identify advantages and disadvantages of different rapid prototyping technologies.
To select most appropriate rapid prototyping technology in each case.
## Selection of most appropriate technology

**Learning time:** 4h  
Theory classes: 1h  
Guided activities: 1h  
Self study : 2h

**Description:**  
Criteria for selecting most appropriate technology among the studied ones, taking into account function of the prototypes, material, geometry, etc. Examples of parts from the automotive industry.

**Related activities:**  
Review of design from results obtained in the first design step.

**Specific objectives:**  
To have tools for choosing the most suitable rapid prototyping technology in each case.

## Rapid tooling and rapid manufacturing

**Learning time:** 8h  
Theory classes: 2h  
Guided activities: 2h  
Self study : 4h

**Description:**  
Study of the rapid tooling and rapid manufacturing technologies.

**Related activities:**  
Validation of CAD design and green light to the second printing operation of the mechanism. Assembly and presentation of the mechanism from 3D printed parts.

**Specific objectives:**  
To identify other applications of rapid prototyping, such as rapid tooling and rapid manufacturing.

## Future trends

**Learning time:** 8h  
Theory classes: 2h  
Guided activities: 2h  
Self study : 4h

**Description:**  
Future trends in rapid prototyping, such as improvements in finish operations and sharing of designs.

**Related activities:**  
Preparation of the project presentation.

**Specific objectives:**  
To describe advanced technologies of rapid prototyping.
### Planning of activities

| CONFERENCES | Hours: 2h  
Guided activities: 2h |
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<td><strong>Description:</strong></td>
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</table>
Lecture from a representative person from a company related to rapid prototyping. |
| **Specific objectives:** |  
To compare theoretical knowledge with applied knowledge of a company related to rapid manufacturing. |

| VISITS | Hours: 2h  
Guided activities: 2h |
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<td><strong>Description:</strong></td>
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Visit to a company where rapid prototyping operations are performed. |
| **Specific objectives:** |  
To compare theoretical knowledge to applied knowledge from a company that performs rapid prototyping. |

| PRESENTATION OF THE PROJECT | Hours: 2h  
Laboratory classes: 2h |
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<td><strong>Description:</strong></td>
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Presentation of the project carried out by the students during the semester. |
| **Descriptions of the assignments due and their relation to the assessment:** |  
Written report and presentation with slides. |
| **Specific objectives:** |  
To show the result of the project for 3D printing of an internal mechanisms of a vehicle. |

### Qualification system

Qualification will have 3 parts: qualification of the partial exam, qualification of the final exam and qualification of the project. In the exams mainly theoretical knowledge will be assessed (IE.1-Written exam). Regarding the project both its development and its final result will be evaluated, as well as oral presentation and written report (IE.4-Formal reports, IE.5-Oral presentations, IE.6-Valoration of group work).

\[
NF = 0.4 \cdot NT + 0.6 \cdot \text{Max}[NEF; 0.67 \cdot NEF + 0.33 \cdot NEP]
\]

*NF* = Final qualification  
*NEP* = Partial exam qualification  
*NEF* = Final exam qualification  
*NT* = Report qualification

### Regulations for carrying out activities

In the exams it will not be possible to read any document.
Bibliography

Complementary:


Others resources: