Degree competences to which the subject contributes

Specific:
CEMEI02. Knowledge and ability to project, calculate and design integrated manufacturing systems.

CEEMEC3. Use the design tools CAD/CAM/CAE, the numerical simulation CFD and the dynamic simulation for the design and advanced calculation of facilities and fluid dynamic systems.

Learning methodology

Learning methodology is based on five kinds of activities: Classes, Computer Laboratory, Metrology Laboratory, Manufacturing Workshop and Semestral Work. In the classes, the teacher introduces the subject, provides concepts and knowledge, and by means of practical exercises or application examples, helps to understand the content. In some classes exercises or problems are proposed to be solved at home, which help to consolidate knowledge. Computer Laboratory will be used to introduce use and application of some software that helps manufacturing parts or simulating manufacturing processes. In the Metrology Laboratory use and application of computer assisted measurement and verification instruments and machines will be introduced. In the Manufacturing Workshop use and application of different kinds of numerical control machines will be introduced. At the end of the laboratory and workshop sessions the students in groups will have to answer a set of questions about taught knowledge in the corresponding session. And, throughout the semester, the students, organized in groups, will prepare a semestral work based on research and information analysis about a subject, from which in the end they will have to write a report and do a PowerPoint presentation in order to explain the subject to their class colleagues.

Learning objectives of the subject

General objective: The general objective of the subject is to provide students with knowledge and capabilities that are necessary to identify, evaluate, compare and select most appropriate elements that allow integrating manufacturing systems. Basically computer assisted elements used for manufacturing, which allow their integration, are treated.

Specific objectives: See specific objectives and programmed activities of each lesson.
### Study load

<table>
<thead>
<tr>
<th>Description</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time</td>
<td>75h</td>
<td>100%</td>
</tr>
<tr>
<td>Hours large group</td>
<td>17h</td>
<td>22.67%</td>
</tr>
<tr>
<td>Hours small group</td>
<td>10h</td>
<td>13.33%</td>
</tr>
<tr>
<td>Guided activities</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study</td>
<td>48h</td>
<td>64.00%</td>
</tr>
</tbody>
</table>
Content

<table>
<thead>
<tr>
<th>1. Numerical Control (NC) Machines</th>
<th>Learning time: 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 8h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study: 10h</td>
</tr>
</tbody>
</table>

**Description:**

**Related activities:**
Advanced programming with NC exercises. Laboratory class 1 to see the manufacture of parts programmed with NC and different NC Machines in the Manufacturing Technology Workshop of ETSEIB and in CIM Centre Foundation (UPC).

**Specific objectives:**
To provide students with knowledge and skills required to identify, evaluate, compare and select: basic elements that characterize numerical control machines, functions and features of CNC programming, applications and possibilities of numerical controls, and type of machinery where it can be applied.

<table>
<thead>
<tr>
<th>3. Assembly systems</th>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study: 4h</td>
</tr>
</tbody>
</table>

**Description:**
Lay-out of assembly systems, rigid or random transport systems, rigid and flexible assembly systems

**Related activities:**
Application exercises.

**Specific objectives:**
To provide students with knowledge and skills required to identify, evaluate, compare and select: functions and possibilities of transport systems.
## 2. Computer Aided Manufacturing (CAM)

**Learning time:** 15h  
Theory classes: 6h  
Self study: 9h

**Description:**
Introduction. Concepts. Types of CAM programs. Generation of NC programs using a CAM program. Other types of CAM programs to simulate metal sheet forming, forging, casting, plastic injection, etc.

**Related activities:**
Exercises with MasterCam in the Computer Laboratory. Manufacture of workpieces in the Manufacturing Technology Workshop of ETSEIB.

**Specific objectives:**
To provide students with knowledge and skills required to identify, evaluate, compare and select: functions and possibilities of CAM programs for generating numerical control programs, as well as functions and possibilities of CAM programs for simulating manufacturing processes.

## 4. Flexible Manufacturing

**Learning time:** 10h  
Theory classes: 4h  
Self study: 6h

**Description:**

**Related activities:**
Application exercises.

**Specific objectives:**
To provide students with knowledge and skills required to identify, evaluate, compare and select: functions and possibilities of different elements that allow automated flexible manufacturing.

## 5. Computer Integrated Manufacturing (CIM)

**Learning time:** 6h  
Theory classes: 2h  
Self study: 4h

**Description:**

**Related activities:**
View videos on the topic.

**Specific objectives:**
To provide students with knowledge and skills required to identify, evaluate, compare and select: functions and possibilities of different elements that allow computer integrated manufacturing.
Qualification is based on four types of evaluations: a partial test, a final exam, evaluation of laboratory and workshop sessions, and evaluation of the semestral work. In the partial test and the final exam theoretical and practical knowledge from the classes as well as application knowledge from the rest of the sessions are assessed. Laboratory and workshop sessions are evaluated from the questionnaire that the students will fill in at the end of every class, taking into account understanding degree, clear writing and presentation of the answers. In the class work, both the report, regarding content, structure, clearness and presentation, as well as the oral presentation to the colleagues, with help of PowerPoint, with content and clearness of the slides as well as quality of oral presentation will be evaluated.

Algorithm for calculation of final mark is:

\[ N_{\text{final}} = 0.1 \cdot N_{\text{LT}} + 0.1 \cdot N_{\text{TC}} + 0.8 \cdot \max \left[ N_{\text{EF}}; 0.63 \cdot N_{\text{EF}} + 0.4 \cdot N_{\text{PP}} \right] \]

with:
- \( N_{\text{LT}} \): Qualification of Laboratory and Workshop Sessions.
- \( N_{\text{TC}} \): Qualification of Semestral Work.
- \( N_{\text{EF}} \): Qualification of Final Exam.
- \( N_{\text{PP}} \): Qualification of Partial Test.

Reevaluation:
Reevaluation exam assesses all theory and exercises content of the course. Mark obtained in the reevaluation exam \( N_{\text{ER}} \) will substitute marks \( N_{\text{PP}} \) of the Partial Test and \( N_{\text{EF}} \) of the Final Exam.

\[ N_{\text{final}} = 0.1 \cdot N_{\text{LT}} + 0.1 \cdot N_{\text{TC}} + 0.8 \cdot N_{\text{ER}} \]

In order to go to reevaluation exam it is necessary, at least, to have attended one final exam of the subject during the same academic year.

### Regulations for carrying out activities

Rules for tests and exams:
Nothing can be taken either to the theory part nor to the exercises part of exams.
Bibliography

Basic:

Complementary:

Others resources:
Audiovisual material
Sistemas Integrados de Fabricación. Apuntes
Sistemas Integrados de Fabricación: Material docente preparado por el equipo de profesores de la asignatura.