220234 - Printing and Converting Technologies of Paper Products

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 714 - ETP - Department of Textile and Paper Engineering
Academic year: 2018
Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: Oriol Cusola Aumedes

Degree competences to which the subject contributes

Specific:


CEEBIOFIB3. Ability to develop new types of paper or paper products according to their specifications and specific technical applications.

CEEBIOFIB2. Ability to analyze and evaluate the physical, mechanical and optical properties about specific fibrous materials (biomaterials, core and paper).

CB10. Improve self-learning capacity

CG04-MEI. Perform research, development and innovation in products, processes and methods.

CE16-MEI. Ability to manage research, development and technological innovation.

Teaching methodology

The subject comprises theoretical lectures, laboratory exercises and visits to factories. In the laboratory sessions, the students, in guided small groups, will become acquainted with the laboratory equipment and techniques used to assess paper printability.

Learning objectives of the subject

To acquire a general knowledge of the graphic and converting industries. To understand conventional and digital printing processes, and the technical requirements of paper and other media used by various printing systems. To be able to relate the characteristics and problems of ink rheology, and ink-paper relationships in theoretical and practical terms. To know the foundation of the major paper transformation operations and the characteristics of the resulting products, with special emphasis on graphic product binding and corrugated board manufacturing. To become acquainted with the pre-printing process.
## Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 30h 24.00%</th>
<th>Hours small group: 15h 12.00%</th>
<th>Self study: 80h 64.00%</th>
</tr>
</thead>
</table>
# Content

<table>
<thead>
<tr>
<th>Unit 1. Introduction to the graphic industry</th>
<th>Learning time: 2h</th>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 1h</td>
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<table>
<thead>
<tr>
<th>Unit 2. A rough approach to printing systems</th>
<th>Learning time: 4h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 1h</td>
</tr>
<tr>
<td>A rough approach to printing systems. Conventional printing systems. NIP or digital printing systems. Characteristics.</td>
<td>Laboratory classes: 1h</td>
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<tr>
<td><strong>Related activities:</strong></td>
<td>Self study: 2h</td>
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<thead>
<tr>
<th>Unit 3. Ink rheology</th>
<th>Learning time: 8h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Ink rheology. Definition of viscosity. Newtonian and non-Newtonian fluids. Types of fluids according to rheological behaviour. Rheological properties of printing inks.</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td><strong>Related activities:</strong></td>
<td>Self study: 4h</td>
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<tr>
<td>Experimental laboratory work: Rheological study of an offset ink.</td>
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</table>
### Unit 4. Screens and screening

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

**Description:**  

**Related activities:**  
Experimental laboratory work: Ink-paper interactions. IGT smoothness/roughness.

### Unit 5. Use of inks in printing systems

**Learning time:** 10h  
Theory classes: 2h  
Laboratory classes: 2h  
Self study : 6h  

**Description:**  
Characteristics of the inks used by each type of printing system. Ink formulations. Physical properties. Factors influencing ink stability.

**Related activities:**  
Experimental laboratory work: Ink-paper interactions. IGT penetration index.

### Unit 6. Colorimetry

**Learning time:** 18h  
Theory classes: 3h  
Laboratory classes: 1h  
Self study : 14h  

**Description:**  

**Related activities:**  
Experimental laboratory work: Ink-paper interactions. IGT picking (with IGT oils and graduated tack inks).
## 220234 - Printing and Converting Technologies of Paper Products

<table>
<thead>
<tr>
<th>Unit 7. Offset printing</th>
<th>Learning time: 20h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 5h</td>
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<tr>
<td></td>
<td>Laboratory classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study: 14h</td>
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</tbody>
</table>

**Description:**

**Related activities:**
Experimental laboratory work: Ink?paper interactions. IGT repainting.

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<tr>
<th>Unit 8. Flexography</th>
<th>Learning time: 13h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Laboratory classes: 2h</td>
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<td>Self study: 9h</td>
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**Description:**

**Related activities:**
Experimental laboratory work: Determination of surface free energies in an offset printing plate.

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<tr>
<th>Unit 9. Rotogravure</th>
<th>Learning time: 7h</th>
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<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 5h</td>
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</table>

**Description:**
# 220234 - Printing and Converting Technologies of Paper Products

**Unit 10. Inkjet printing**

**Learning time:** 11h  
- Theory classes: 2h  
- Laboratory classes: 2h  
- Self study: 7h

**Description:**  
Operational foundation of inkjet machines. Classification of inkjet printing technologies. The two major technologies: continuous inkjet printing and drop-on-demand printing. The two major drop-on-demand types: piezoelectric printing and thermal printing. Physics of inkjet printing. A summary of the characteristics of inkjet printing inks.

**Related activities:**  
Visits to factories. Visits to graphic factories intended to help students become acquainted with the industrial reality of printing processes.

## Unit 11. Other printing systems. Inkjet printing media

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

**Description:**  
Other conventional printing systems including screen printing and tampon printing, and other digital printing systems such as electrophotography, ionography and toner jet printing.

## Unit 12. Binding

**Learning time:** 11h  
- Theory classes: 3h  
- Self study: 8h

**Description:**  
Each student's overall mark will be the sum of the individual marks obtained in the following assessment events:

- Activity 1 (Evaluation of knowledge acquisition through written exams). Mid-term exam: 30%
- Activity 2 (Evaluation of practical activities from written reports and oral presentations). Practical activities: 30%
- Activity 3 (Evaluation of guided activities and exercises). Exercise solving: 10%
- Activity 4 (Evaluation of knowledge acquisition through written exams). End-of-term exam: 30%

The unsatisfactory result in the midterm exam (Activity 1) may be redirected by a written test on the day set for the final exam (Activity 4). Students who didn't assist at the midterm exam (Activity 1) or with a grade lower than 5.0 in the midterm exam (Activity 1) can access this test. The grade obtained in the redirected test will replace the initial grade as long as it is higher.

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.

If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

**Bibliography**

**Basic:**


