



## Course guides

# 220234 - 220234 - Printing and Converting Technologies of Paper Products

**Last modified:** 29/05/2020

**Unit in charge:** Terrassa School of Industrial, Aerospace and Audiovisual Engineering  
**Teaching unit:** 714 - ETP - Department of Textile and Paper Engineering.

**Degree:** MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Optional subject).

**Academic year:** 2020    **ECTS Credits:** 5.0    **Languages:** Catalan, Spanish

### LECTURER

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**Coordinating lecturer:** Oriol Cusola Aumedes

**Others:**

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CEG1-MEI. Extension of some specific technology areas such as Materials Science and Metallurgical Engineering, Construction Engineering, Systems Engineering, Automation and Computer Engineering, Electrical Engineering, Electronics Engineering, Mechanical Engineering, Chemical Engineering, Textile and Paper, Statistics and Operations Research, Graphic Expression in Engineering, Physics and Nuclear Engineering, Language and Systems, Heat Engines, Applied Mathematics, Fluid Mechanics and Turbo machines, Business Administration, Engineering Design, Strength of Materials and Structures, Aerospace Engineering.

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

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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

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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

Type	Hours	Percentage
Self study	80,0	64.00
Hours small group	15,0	12.00
Hours large group	30,0	24.00

**Total learning time:** 125 h

## CONTENTS

### Unit 1. Introduction to the graphic industry

**Description:**

Introduction to the Spanish and international graphic sectors. Future prospects. A brief retrospect. Terminology. Production flow in the graphic sector. Broad classification of graphic systems.

**Full-or-part-time:** 2 h

Theory classes: 1h

Self study : 1h

### Unit 2. A rough approach to printing systems

**Description:**

A rough approach to printing systems. Conventional printing systems. NIP or digital printing systems. Characteristics.

**Related activities:**

Experimental laboratory work: Printability simple tests. Assessing paper roughness with Microcontour. Assessing penetration in porometric inks. Picking resistance as measured with the Dennison's wax test.

**Full-or-part-time:** 4 h

Theory classes: 1h

Laboratory classes: 1h

Self study : 2h

### Unit 3. Ink rheology

**Description:**

Ink rheology. Definition of viscosity. Newtonian and non-Newtonian fluids. Types of fluids according to rheological behaviour. Rheological properties of printing inks.

**Related activities:**

Experimental laboratory work: Rheological study of an offset ink.

**Full-or-part-time:** 8 h

Theory classes: 2h

Laboratory classes: 2h

Self study : 4h



#### Unit 4. Screens and screening

**Description:**

Screening in printing systems. Screen geometry. Definition of lineature and resolution. AM and FM screens. Digital production of screen dots. Grey levels.

**Related activities:**

Experimental laboratory work: Ink?paper interactions. IGT smoothness/roughness.

**Full-or-part-time:** 8 h

Theory classes: 2h

Laboratory classes: 2h

Self study : 4h

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

**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.

**Full-or-part-time:** 10 h

Theory classes: 2h

Laboratory classes: 2h

Self study : 6h

#### Unit 6. Colorimetry

**Description:**

Definition of colour. Physiological aspects of colour. Appearance attributes of colour. Colour trivariance. Additive and subtractive synthesis. The RGB system. The CIE XYZ1931 system. Metamerism. Illuminants. The CIE L\*a\*b\*1976 system. Colour difference ('E).

**Related activities:**

Experimental laboratory work: Ink-paper interactions. IGT picking (with IGT oils and graduated tack inks).

**Full-or-part-time:** 18 h

Theory classes: 3h

Laboratory classes: 1h

Self study : 14h

#### Unit 7. Offset printing

**Description:**

Foundation. Relationship between SdM and ink, emulsion. Elements of the inking unit, wetting unit and printing group/unit. Ink transfer. Phenomena occurring in nipping zones.

**Related activities:**

Experimental laboratory work: Ink?paper interactions. IGT repainting.

**Full-or-part-time:** 20 h

Theory classes: 5h

Laboratory classes: 1h

Self study : 14h



### Unit 8. Flexography

**Description:**

Operational foundation. Inking units. Characteristics and fabrication systems of flexographic clichés. Problems arising from poor insulation. Fabrication, structure, geometry and operational foundation of anilox rings. Regulation of machine pressure. Band guiding and winding tension. Types of flexographic machines and their configurations.

**Related activities:**

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

**Full-or-part-time:** 13 h

Theory classes: 2h

Laboratory classes: 2h

Self study : 9h

### Unit 9. Rotogravure

**Description:**

Operational foundation and structure of a typical printing unit. Features of the process speed. Rotogravure cylinders: structure, fabrication and cell geometry. Characteristics of prints and their defects. Ink transfer and electrostatically assisted transfer. Rotogravure blades: geometry, assembly and pressure regulation.

**Full-or-part-time:** 7 h

Theory classes: 2h

Self study : 5h

### Unit 10. Inkjet printing

**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.

**Full-or-part-time:** 11 h

Theory classes: 2h

Laboratory classes: 2h

Self study : 7h

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

**Description:**

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

**Full-or-part-time:** 4 h

Theory classes: 2h

Self study : 2h



### Unit 12. Binding

**Description:**

Types of binding. Binding nomenclature: trimming, creasing, gathering, milling, die cutting, gluing, folding, laminating and stitching. Soft bookbinding systems: gathering, jogging, milling, spine formation, spine and side gluing, cover preparation, casing-in, backing, trimming and stacking. Hardback bookbinding. Textblock preparation systems: gathering, jogging, stitching, endpapering, spine gluing, backlining, backing, trimming. Casing-in process: warming, rounding, backing process, headbanding, side gluing, casing-in, pressing and backing, jacketing, stacking and other operations.

**Full-or-part-time:** 11 h

Theory classes: 3h

Self study : 8h

### Unit 13. Corrugated board

**Description:**

Manufacture of corrugated cardboard: Types of corrugated cardboard, component parts and waves. Adhesives. Corrugator. Corrugated board transformation.

**Related activities:**

Experimental laboratory work: Compressive strength of corrugated paper and its components Testing: FCT -Flat Crush Test-, ECT - Edge Crush Test-, RCT -Ring Crush Test-, CMT -Concora Medium Test-.

**Full-or-part-time:** 9 h

Theory classes: 3h

Laboratory classes: 2h

Self study : 4h

## GRADING SYSTEM

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:**

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- Kipphan, Helmut. Handbook of print media : technologies and production methods. Berlin ; New York: Springer, 2001. ISBN 3540673261.
- Ek, Monica; Gellerstedt, Göran; Henriksson, Gunnar. Pulp and paper chemistry and technology. Berlin: De Gruyter, cop. 2009. ISBN 9783110213454.
- Söderhelm, Liva; Levlin, Jan-Erik. Pulp and paper testing. Helsinki: Fapet Oy, 1999. ISBN 9525216179.