Course guide
205506 - 205506 - Processes to Improve the Physicomechanical Properties of Paper

Last modified: 11/04/2025

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 717 - DEGD - Department of Engineering Graphics and Design.

Degree: MASTER'S DEGREE IN PAPER AND GRAPHICS TECHNOLOGY (Syllabus 2020). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: Coordinador: Blanca Roncero

Others: Silvia Galea Martínez

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
MUTPIG-CE2. To be able to analyse and apply the main unit operations and manufacturing process systems involved in the field of the degree.
MUTPIG-CE5. To be able to select and evaluate the most suitable auxiliary products for the processes and the development of new material properties in the paper and graphic manufacturing processes.
MUTPIG-CE6. To be able to analyze and evaluate theoretically and experimentally the structural, physical-mechanical and optical properties of materials in the paper and graphic field.
MUTPIG-CE7. To be able to develop papers, supports or other paper products based on the specifications to be met and their specific technical applications.

Generical:
MUTPIG-CG4. Carrying out research, development and innovation in the field of paper and graphic technologies.
MUTPIG-CG5. Technically and economically manage projects, companies and technology centers in the field of paper and graphic technologies.

Transversal:
CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Basic:
CB06. Manage original concepts in research projects.
CB09. Improve technical communication of results.

TEACHING METHODOLOGY

The teaching methodology is divided into three parts:
• Face-to-face sessions of exposition– participation of the contents and exercises.
• Face-to-face sessions of laboratory work.
• Autonomous study work and exercises and/or activities.
In the exposition-participation sessions of the contents, the teachers will introduce the theoretical bases of the subject, concepts, methods and results, illustrating them with suitable examples and requesting, if necessary, the carrying out of exercises to facilitate their understanding.
In the laboratory work sessions, the teacher will guide the student in the application of the theoretical concepts to carry out the experimental practices, fostering critical reasoning at all times. Activities will be proposed that the student solves in the classroom and outside the classroom, to favor contact and use of the basic tools necessary to carry out the practices.
The students, autonomously, have to work on the material provided by the teachers and the result of the practice-problem sessions to assimilate and fix the concepts. The teachers will provide a study plan and follow-up activities (ATENEA).

LEARNING OBJECTIVES OF THE SUBJECT

After completing the course, the student must:

Being able to understand the theoretical and practical aspects of the refining, recycling and biorefining operations of lignocellulosic fibers; evaluate the influence on the different structural and mechanical properties of paper products; relate the variables of the operations with the effects on the properties of the final product; solve physical-chemical aspects related to the manufacturing processes of paper products and how these influence the final properties of the product.

STUDY LOAD

Type	Hours	Percentage
Self study	80,0	64.00
Hours small group	45,0	36.00

Total learning time: 125 h

CONTENTS

Section 1: Refining Process

Description:
Principle of refining. Effects of refining. Primary effects. Secondary effects. Interrelation of the effects of refining. Effect on the structural and physical-mechanical properties of fibers and papers.

Related activities:
Theory classes, laboratory sessions

Full-or-part-time: 35h
Laboratory classes: 15h
Self study : 20h

Section 2: Recycling Process

Description:
Principle of the recycling process. Disintegration of recycled paper. Characteristics of recycled fiber. Properties of recycled paper.

Related activities:
Theory classes, laboratory sessions

Full-or-part-time: 27h
Laboratory classes: 9h
Self study : 18h

Section 3: Biorefining process

Description:
Principle of the biorefining process. Type of enzymes used in this process. Effect of biorefining on the structural and physical-mechanical properties of fibers and papers.

Related activities:
Theory classes, laboratory sessions

Full-or-part-time: 18h
Laboratory classes: 6h
Self study : 12h

Section 4: Functional and Control Additives

Description:
Functional additives: Sizing agents. Wet strength agents. Dry strength agents. Dyes and pigments. Classification. Mechanisms. Influence on paper physicochemistry. Influence on the properties of the papers. Control additives: retention agents. Mechanism. Classification. Influence on the electrokinetic potential. Minimization of the consumption of chemical products. Other additives.

Related activities:
Theory classes, laboratory sessions

Full-or-part-time: 27h
Laboratory classes: 9h
Self study : 18h

Section 5: Surface Treatments

Description:
Surface sizing: Introduction. Chemical products. "Size-press". Paper properties.
Coating: Introduction. Purpose. Processes. Pigments. Binding agents. Other products. Influence on the properties of the papers. Rheological properties of the coating preparation.

Related activities:
Theory classes, laboratory sessions

Full-or-part-time: 18h
Laboratory classes: 6h
Self study : 12h

ACTIVITIES

Activity 1: Theory Classes

Description:
Exposition of the contents of the course following a participatory expository class model. The course has been organized into 5 thematic topics and within these topics there are different subjects, as shown in the sections presented in the contents of this guide.

Full-or-part-time: 64h
Self study: 45h
Laboratory classes: 19h

Activity 2: Laboratory sessions

Description:
Laboratory sessions:
1. Refining using different refining equipment
2. Refining curve and paper characterization
3. Recycling of the refined samples and characterization of the papers
4. Evaluation of the recovery of the properties of recycled fibers
5. Biorefining with different enzymes and paper characterization
6. Application of wet strength and sizing additives and evaluation of properties
7. Application of retention agents to a fibrous suspension, evaluation of their effectiveness in the dynamic jar
8. Preparation of a coating sauce. Analysis of its rheology. Coated paper. Properties of coated papers.

For each of the practices carried out, the student will have to submit an individual report. To pass the course, it is a necessary condition to attend the laboratory sessions and present the corresponding reports.

Full-or-part-time: 55h
Self study: 35h
Laboratory classes: 20h

Activity 3: Partial exam

Description:
Carrying out the partial exam of the course

Full-or-part-time: 3h
Laboratory classes: 3h

Activity 4: Final exam

Description:
Carrying out the final exam of the course

Full-or-part-time: 3h
Laboratory classes: 3h

GRADING SYSTEM

The global mark of the course (NG) will be the result of the following calculation:

NG= 0.25 x EV1P (Partial) + 0.40 x EV1F (Final) + 0.35 x EV2

Where:

EV1 Mark obtained in the written or oral individual knowledge control tests (partial and final exam)
EV2 Mark obtained in the evaluation of practical work through deliverable reports (activity 2)

The unsatisfactory results of the first EV1P (Partial) may be redirected on the date set for the final exam EV1F (Final), by means of a written test. Students who have not taken the first part or with a grade lower than 5.0 in the first part will be able to access this test. The qualification of this re-driving test will be between 0 and 10 and will replace the evaluable EV1P test as long as it is higher.

For those students who meet the requirements and take the reassessment exam, the reassessment exam score will replace the grades from all EV1P and EV1F assessment acts and the EV2 qualifications will be maintained. If the final grade after the revaluation is less than 5.0, the initial grade will be replaced only if it is higher. If the final grade after the reassessment is greater than or equal to 5.0, the final grade of the course will be approved 5.0.

The reports of the technical work resulting from the practical activities will be carried out individually and in writing. It is a necessary condition to pass the subject to carry out laboratory practices and present the corresponding reports.

BIBLIOGRAPHY

Basic:
- Apunts del professorat dipositats a ATENEA.
- Ek, Monica; Gellerstedt, Göran; Henriksson, Gunnar. Pulp and paper chemistry and technology. Berlin: De Gruyter, cop. 2009. ISBN 9783110213430.
- Cátedra de Tecnología Papelera; CIPAGRAF. Los productos químicos auxiliares en la industria papelera. Terrassa: UPC. ETSIIT, 1984. ISBN 8460033767.
- Cátedra de Tecnología Papelera; CIPAGRAF. El encolado del papel. Terrassa: UPC. ETSIIT, 1985. ISBN 846003903X.

Complementary:
- Smook, Gary A. Handbook for pulp & paper technologists. 3rd ed. Vancouver [etc.]: Angus Wilde, cop. 2002. ISBN 0969462859.
- Gottschling, Gottfried; Pakarinen, Heikki. Recycled fiber and deinking. Helsinky: Fapet Oy, cop. 2000. ISBN 9525216071.
- Kocurek, Michael J;. Leask, Ray A. Pulp and paper manufacture. 3rd ed. Montreal: Joint Textbook Committee of the Paper Industry of the United States and Canada, 1983-1993. ISBN 091989304X.