Course guides
220230 - 220230 - Physical Characterization of Biomaterials and Paper Products

Last modified: 29/05/2020

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 INDUSTRIAL ENGINEERING (Syllabus 2013). (Optional subject).

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

LECTURER

Coordinating lecturer: Roncero Vivero, Maria Blanca

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Ability to analyze, implement and project the main unitary operations and systems which compose manufacturing processes of fibrous materials (biomaterials, core and paper).
2. Ability to analyze and evaluate the physical, mechanical and optical properties about specific fibrous materials (biomaterials, core and paper).
3. Ability to develop new types of paper or paper products according to their specifications and specific technical applications.
4. Ability to select and evaluate various sources of vegetable fibers suitable for the manufacture of fibrous materials (biomaterials, pulp and paper) with certain technical characteristics.

TEACHING METHODOLOGY

The teaching methodology is divided into three parts:
- Lectures presenting the subject content.
- Practical sessions
- Independent learning (self-study) and solving exercises by the students.
In lectures teachers introduce fundamentals of the subject, concepts and methods, illustrated with suitable examples to facilitate their understanding.
The practical sessions involve activities experimental practices in laboratory.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student should:

Having the theoretical knowledge related to the properties and technological characteristics of the paper and composites, it studied as a fibrous physical structure.

Having the knowledge and skills to analyze, plan and design the processes for evaluating the physical-mechanical and optical properties of the fiber materials (pulp, paper, biomaterials and composite materials) from the theoretical and practical properties.

Having the knowledge and skills to perform the verification and control of facilities, processes and systems whose purpose is the evaluation of biomaterials and paper.

STUDY LOAD

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

Total learning time: 125 h

CONTENTS

Unit 1: Characteristics of paper as fibrous structure.

Description:
Paper as fibrous structure . Fiber and fibrous structure. Sheet formation: sides of the paper; machine and cross direction. Fiber orientation. Types of paper.

Full-or-part-time: 6h
Theory classes: 2h
Self study : 4h

Unit 2: Basic properties of the paper.

Description:
Basis weight, thickness, bulk density, factors affecting the density ratio between the density and other properties of the sheet.

Related activities:
Experimental laboratory practices: Anisotropy of the paper. Basis weight. Thickness. Density and specific volume.

Full-or-part-time: 9h
Theory classes: 2h
Laboratory classes: 1h
Self study : 6h

Unit 3: Porous structure of the paper. Fluid flow through the paper.

Description:
Porous structure of the paper. Surface and internal porosity. Characterization of the porous structure of the paper. Pore size distribution. Influencing factors. As porosity. Relationship between the porosity and other properties of the sheet.
Fluid flow through the paper. Permeability measurement.

Related activities:
Experimental laboratory practices: Determination of air permeability of the papers. Air leakage methods (Bekk, Bendtsen and Gurley).

Full-or-part-time: 14h
Theory classes: 3h
Laboratory classes: 2h
Self study : 9h

Unit 4: Llisor i Rugositat.

Description:
Measurement of smoothness. Factors affecting smoothness.

Related activities:
Experimental laboratory practices: Determination of smoothness of the papers. Air leakage methods (Bekk, Bendtsen and Gurley). Determination of the coefficients of static and dynamic friction.

Full-or-part-time: 5h
Theory classes: 1h
Laboratory classes: 1h
Self study : 3h

Unit 5: Interactions between the paper and moisture.

Description:
Interactions between paper and moisture. Dimensional stability. Factors affecting the dimensional stability. Hysteresis effect. Papers requiring dimensional stability. Characteristics that affect sheet dimensional stability. Anisotropy in dimensional stability. Wavy (Curl and cockling).

Full-or-part-time: 11h
Theory classes: 3h
Self study : 8h

Unit 6: Strength properties of the paper

Description:
Stress-strain relationship. Tensile strength and strecht. Factors affecting the tensile strength. Wet tensile strength. Tensile elastic modulus. Tensile energy absorption (TEA). Zero-span tensile. Z direction paper strength. Compressive behavior. Bursting strength. Factors affecting bursting strength. Tearing resistance. Internal tearing resistance. Factors affecting tearing resistance. Folding endurance. Factors affecting folding endurance.
Stiffness. Factors affecting stiffness. Flexural elastic modulus.

Related activities:
Experimental laboratory practices: stress-strain rheograms . Determination of tensile strength and strecht: machine direction (MD) and cross direction (CD) anisotropies. Evaluation of tensile elastic modulus. Bursting strength. Tearing resistance. Folding endurance. Determination of static bending resistance (Taber) and resonance method (Kodak).

Full-or-part-time: 41h
Theory classes: 9h
Laboratory classes: 7h
Self study : 25h

(ENG) Tema 7: Propietats òptiques del paper.

Description:
Optical properties: introduction and definitions. Color perception. Radiant energy sources. Illuminants. Reflectance factors. Measurement of reflectance. Colorimeters and spectrophotometers. Tristimulus values. Colour matching functions. Spaces CIE L * a * b * and CIE L * C * h. Color measurement. Brightness and Whiteness. Factors influencing Brightness and Whiteness. Fluorescence. Opacity. Factors influencing the opacity. Gloss. Factors influencing gloss. Kubelka-Munk coefficients (light scattering and light absorption). Radiation transfer into diffuser means: Application to the optical properties of paper.

Related activities:
Experimental laboratory practices: Determination of brightness, whiteness, opacity, fluorescence and color with a spectrophotometer. Gloss determination.

Full-or-part-time: 39h
Theory classes: 10h
Laboratory classes: 4h
Self study : 25h

GRADING SYSTEM

The final mark depends on the following evaluative acts:
- Activity 1 (midterm exam): 35%
- Activity 2 (Evaluation of laboratory practice through individual written reports and oral presentations): Evaluation of practical activities: 30%
- Activity 3 (final exam): 35%
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 3). 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:
- Professors de l'assignatura. Apunts lliurats pel professorat.
- Niskanen, Kaarlo (ed.). Paper physics. Helsinky: Fapet Oy, c1998. ISBN 9525216160.
- Ek, M.; Gellerstedt, G.; Henriksson, G. (eds.). Pulp and paper chemistry and technology. Berlin: De Gruyter, cop. 2009. ISBN 9783110213454.

Complementary:
- Levlin, J.E.; Söderhjelm, L (eds.). Pulp and paper testing. Helsinki: Fapet Oy, 1999. ISBN 9525216179.
- Astals, Francesc. Análisis de las propiedades del papel. Barcelona: Tecnoteca, DL 2002. ISBN 8486219396.