Course guide
205511 - 205511 - Biotechnology Applied to Paper Processes

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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). (Optional subject).

Academic year: 2025 **ECTS Credits:** 3.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: Cristina Valls

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
MUTPIG-CG1. Applying mathematical, analytical, scientific, instrumental and technological knowledge, related to the field of paper and graphic technologies.
MUTPIG-CG2. Projecting, calculating and designing products and processes, related to the field of paper and graphic technologies.
CG3. Lead, plan and supervise multidisciplinary teams.
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.
MUTPIG-CG6. Applying the necessary legislation in the exercise of functions related to Paper Technology.

Basic:
CB06. Manage original concepts in research projects.
CB07. Student capacity to use their knowledge in new and multidisciplinary situations.
CB08. Generate decision from incomplete information assuming its social and ethical responsibilities.
CB09. Improve technical communication of results.
CB10. Improve self-learning capacity

TEACHING METHODOLOGY

The teaching methodology is divided into three parts:
- Face-to-face presentation sessions - participation in the contents and carrying out exercises.
- Face-to-face laboratory work sessions.
- Autonomous work of study and realization of exercises and activities.

In the exhibition sessions -participation of the contents, the teaching staff will introduce the theoretical bases of the subject, concepts, methods and results illustrating them with convenient examples and requesting, if necessary, the realization of exercises to facilitate their understanding.
In the laboratory work sessions, the teacher will guide the students in the application of the theoretical concepts for the resolution of experimental assemblies, basing at all times the critical reasoning. Activities to be solved by students in the classroom and outside the classroom will be proposed, in order to favor the contact and use of the basic tools necessary for the realization of an instrumentation system.
The student, autonomously, must work on the material provided by the teachers and the result of the work-problem sessions in order to assimilate and fix the concepts. Teachers will provide a study and activity monitoring plan (ATENEA).

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student must:
- Know the theoretical and practical bases on biotechnology applied to paper processes, as well as their environmental aspects.
- Know the different points of the paper process where biotechnology can be applied.
- Have knowledge about the application of enzymes in the bleaching, refining, and recycling of paper as well as at different points in the paper process.
- Have knowledge about the biomodification of lignocellulosic fibers.
- Know the new trends in biotechnology applied to the paper industry.
- Have knowledge of the different possibilities provided by the use of biotechnological methods in the improvement and / or obtaining of new processes and paper products.
- Have the knowledge to prepare technological reports with the conclusions drawn from their own experimentation.
- Know how to manage innovation in processes for obtaining cellulose fibers

STUDY LOAD

Type	Hours	Percentage
Hours small group	27,0	36.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Module 1: Introduction to Biotechnology. Enzymes applied to the paper industry

Description:
Biotechnological processes. Microorganisms and enzymes. Properties of enzymes applied in the paper industry.

Related activities:
Theory classes, laboratory practicals

Full-or-part-time: 19h
Laboratory classes: 7h
Self study : 12h

Module 2: Application of enzymes in pulp bleaching

Description:
Effect of oxidative enzymes on pulp bleaching.
Effect of hydrolytic enzymes on improving bleaching.

Related activities:
Theory classes, laboratory practicals

Full-or-part-time: 25h
Laboratory classes: 9h
Self study : 16h

Module 3: Application of enzymes in refining, paper recycling and other paper processes

Description:
Effect of different enzymes (cellulases, amylases, esterases, lacase-mediator system, etc ...) on the refining and recycling of paper.
Biotechnological and enzymatic processes that can be applied in different parts of the paper industry: retting, wood debarking, pitch removal, mechanical biopulping, etc ...

Related activities:
Theory classes, laboratory practicals

Full-or-part-time: 14h
Laboratory classes: 5h
Self study : 9h

Module 4: Biomodification of lignocellulosic fibers

Description:
Obtaining paper fibers and papers with antimicrobial, antioxidant, hydrophobic activity, wet strength, etc ... through the application of enzymes

Related activities:
Theory classes, laboratory practicals

Full-or-part-time: 17h
Laboratory classes: 6h
Self study : 11h

ACTIVITIES

Activity 1: Theory classes

Description:
Presentation of the contents of the subject following a model of participatory expository class.
The subject has been organized in 4 thematic areas and within these areas different aspects will be treated, as shown in the modules presented in the contents of this guide.
The evaluation of this activity will be through different evaluation questionnaires (carried out through the Atenea platform) of each of the topics explained in class. There will also be oral presentations of scientific articles related to the topics covered.

Full-or-part-time: 41h
Self study: 29h
Laboratory classes: 12h

Activity 2: Laboratory Practicals

Description:
The following laboratory practicals related to the contents of the subject will be carried out:
P1. Observation of microorganisms
P2. Activity and stability of enzymes as a function of time and temperature. Effect of the presence of lignin and other components.
P3. Effect of xylanase and laccase enzymes on pulp bleaching.
P4. Effect of cellulase on fiber properties.
P5. Effect of amylase on starch degradation.
P6. Enzymatic biomodification of lignocellulosic fibers.
For each of the practicals, the student must submit an individual report. It is a necessary condition to pass the subject the realization of the laboratory practicals and present the corresponding reports. There will also be an oral presentation of the practical contents.
The practicals will be evaluated according to the attendance and participation in the sessions, according to the reports made and according to the oral presentation made.

Full-or-part-time: 34h
Self study: 19h
Laboratory classes: 15h

GRADING SYSTEM

The global grade of the subject (NG) will be the result of the following weighted calculation:
NG = 0.30 x EV1 + 0.20 x EV2 + 0.30 x EV3 + 0.20 x EV4
where,
- EV1. Evaluation of practical work by means of deliverable reports (activity 2 of this guide)
- EV2. Attendance and participation in the practical sessions (activity 2 of this guide)
- EV3. Evaluation of individual work (activity 1 of this guide, related to the Atenea questionnaires)
- EV4. Oral presentations related to the contents of the subject (activity 1 and 2 of this guide, oral presentations)

BIBLIOGRAPHY

Basic:
- Bajpai, Pratima; Kondo, Ryuichiro; Bajpai, Pramod K. Biotechnology for environmental protection in the pulp and paper industry. Berlin [etc.]: Springer, cop. 1999. ISBN 3540656774.
- Viikari, L.; Lantto, R. Biotechnology in the pulp and paper industry. Amsterdam; New York: Elsevier, 2002. ISBN 0444510788.

Complementary:
- Bajpai, Pratima. Environmentally friendly production of pulp and paper. Hoboken, NJ: Wiley, cop. 2010. ISBN 9780470528105.
- Ek, Monica; Gellerstedt, Göran; Henriksson, Gunnar. Pulp and paper chemistry and technology. Berlin: De Gruyter, cop. 2009. ISBN 9783110213393.

RESOURCES

Other resources:
Teacher's notes deposited in ATENEA.