Course guide
205508 - 205508 - Print Technology

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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). (Compulsory subject).

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

LECTURER

Coordinating lecturer: Oriol Cusola

Others:

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:
CG3. Lead, plan and supervise multidisciplinary teams.

Transversal:
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Basic:
CB07. Student capacity to use their knowledge in new and multidisciplinary situations.

TEACHING METHODOLOGY

The teaching methodology is divided into three parts:
â□□ Lecture sessions with students participation / exercise solving.
â□□ Laboratory in-class sessions.
â□□ Self-study work (exercises and activities).
During the lecture sessions the teaching staff will introduce the theoretical aspects, methods and results, illustrating them with suitable examples, and requesting (if aplicable), exercises to facilitate their understanding.
In the laboratory sessions, the teaching staff will guide the student through the application of theoretical concepts for the resolution of experimental problems, using critical reasoning. In-class and out-of-class activities will be proposed to the students in order to apply the tools necessary to carry out an instrumentation system.
The students have to work on the material provided by the teaching staff and use the knowledge derived from the sessions to assimilate and fix the concepts. The teaching staff will provide a study plan and follow-up of activities (through ATENEA).

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student must be able to: Understand conventional and digital printing processes and related elements; know the specific requirements of papers and other substrates depending on the printing system; understand the theoretical foundations of rheology and relate the rheological properties of the different printing inks with each of the processes described in the subject; know the basic principles of colorimetry and apply them to solving exercises; understand the physicochemical principles related to printing processes, and analyze them in a practical way; critically analyze the morphological characteristics of printed materials with each of the technologies.

STUDY LOAD

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

Total learning time: 125 h

CONTENTS

Module 1: First approach to printing systems

Description:
Introduction to the graphic sector. Historical overview. Terminology. Production flow in the graphic sector. First classification of the printing systems. Conventional printing systems. NIP or digital printing systems. Characteristics.

Related activities:
Lectures and midterm exam

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

Module 2: Ink Rheology

Description:
Viscosity concept. Types of fluids according to their rheological behavior. Rheological models and their use. Viscosity measurement methods. Rheological characteristics of printing inks.

Related activities:
Lectures, laboratory work, and midterm exam

Full-or-part-time: 11h
Laboratory classes: 4h
Self study : 7h

Module 3: Colorimetry

Description:
Definition of color. Physiological aspects of color. Color attributes. Colorimetric trivariance. Additive and subtractive synthesis. RGB system. CIE XYZ1931 System. Metamerism. Illuminants. CIE L * a * b * 1976 system. Color difference dE.

Related activities:
Lectures and mid-term exam

Full-or-part-time: 16h
Laboratory classes: 5h
Self study : 11h

Module 4: Printing screens and densitometry.

Description:
Screen ruling in printing systems. Screen geometry. Resolution concept. AM and FM screens. Digital generation of screen point. Gray levels. Optical density concept. Optical density measurement.

Related activities:
Lecures, laboratory work and mid-term exam

Full-or-part-time: 7h
Laboratory classes: 3h
Self study : 4h

Module 5: Offset Printing

Description:
Basic principle of offset printing. Relationship between SdM and Ink, emulsion. Concept of surface tension and surface free energy. Ink battery elements, wetting unit elements, printing unit. Ink transfer. Phenomena in the nip. Sheet-feed and roll-to-roll Offset machinery.

Related activities:
Lectures, laboratory work and mid-term exam

Full-or-part-time: 21h
Laboratory classes: 7h
Self study : 14h

Module 6: Flexography

Description:
Operation principle. Inking units. Characteristics and manufacturing of flexographic plates, problems due to poor insolation. Manufacture, structure, geometry and operating principle of anilox cylinders. Machine pressure regulation. Band guiding and winding tensions. Flexographic machines and configurations.

Related activities:
Lectures, laboratory work and final exam

Full-or-part-time: 13h
Laboratory classes: 5h
Self study : 8h

Module 7: Rotogravure

Description:
Operation principle and structure of a typical printing unit. Special features of process speed. Rotogravure cylinders: structure, manufacture and geometry of the cells. Print characteristics and defects. Ink transfer, and transfer with electrostatic assistance. Rotogravure blades, geometry, assembly and pressure regulation.

Related activities:
Lectures, laboratory work, and final exam

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

Module 8: Inkjet Printing

Description:
Principle of operation and inkjet machines. Classification of the different inkjet printing technologies. Explanation of the two major types of technologies: Continuous inkjet and "drop on demand" inkjet. Explanation of the two main types of "drop on demand" printing: piezoelectric and thermal. Inkjet printing physics. Review of the characteristics of inkjet inks.

Related activities:
Lectures and final exam

Full-or-part-time: 7h
Laboratory classes: 3h
Self study : 4h

Module 9: Print Media and Print Identification.

Description:
Characteristics of the different printing media. Coating types. Identification of the printing system according to the observation of a print.

Related activities:
Lectures and final exam

Full-or-part-time: 16h
Laboratory classes: 6h
Self study : 10h

Module 10: Other printing systems. 3D printing.

Description:
Other conventional printing systems: screen printing. Other digital systems: electrophotography. Description of the different 3D printing systems and their operation.

Related activities:
Lectures and final exam

Full-or-part-time: 10h
Laboratory classes: 4h
Self study : 6h

ACTIVITIES

Activity 1: Lectures

Description:
Explanation of the contents of the subject following a student-engagement model. The subject has been organized into 10 chapters, as presented in this guide. As part of the theoretical lectures, exercises and problems related to the content are included. Some of the exercises will be proposed as deliverables and will be evaluated as individual student work. It will also be proposed to carry out online questionnaires related to the contents of the subject, which will also form part of the evaluation of the student's individual work.

Full-or-part-time: 95h
Self study: 64h
Laboratory classes: 31h

Activity 2: Laboratory work

Description:
There will be 5 laboratory sessions related to the contents of the subject:
- P1. Study of rheological characteristics of an offset type ink.
- P2. Determination of the surface free energies of an offset plate.
- P3. Ink-paper relationship: smoothness / roughness IGT and penetration index IGT.
- P4. Ink-to-paper ratios: IGT stripping (with IGT oils)
- P5. Ink-paper relations: IGT set-off, and IGT drying.

For each of the sessions, the student must submit an individual report according to the standardized model. Once reviewed, the student can receive feedback from the teacher.

Full-or-part-time: 24h
Self study: 16h
Laboratory classes: 8h

Activity 3: Midterm exam

Description:
Development of the midterm exam.

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

Activity 4: Final Exam

Description:
Development of the final exam.

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

GRADING SYSTEM

The final grade of the subject (NG) will be the result of the following:
NG = 0.30 x EV1P (Mid-term exam) + 0.30 x EV1F (Final exam) + 0.20 x EV2 + 0.20 x EV3
Where:
â□□ EV1. Grade obtained in written or oral tests. (Activities 3 and 4 of this guide).
â□□ EV2. Grade obtained in the evaluation of the practical work through deliverable reports. (Activity 2 of this guide).
â□□ EV3. Grade obtained in the evaluation of individual work. (Activity 1 of this guide).
The reports resulting from the practical activities will be carried out individually. It is a necessary condition to pass the subject to carry out the laboratory sessions and presenting the corresponding reports.
The unsatisfactory result of the first mid-term exam (EV1P) may be redirected by means of a written test, to be performed on the day set for the final exam EV1F (Final). This test will be only available to students non presented to the mid-term exam (EV1P), or with a grade lower than 5.0. If the grade of the recovrey exam is greater than or equal to 5.0, the final mark will be 5.0. The grade obtained in the recovery examng will replace the initial grade as long as it is higher.
For those students who meet the requirements and take a re-evaluation exam, the grade of the re-evaluation exam will substitute the marks of all the evaluation items during the course (written tests (EV1), midterm and final exams). The grades corresponding to the practical sessions will be maintained, as well as works, projects and presentations during the course. If the final grade obtained after the re-evaluation is higher than 5, the final grade for the course will be 5.0. If the final grade after the re-evaluation is less than 5, the final grade for the course will be failed. The numerical grade after the reevaluation will only replace the initial grade if it is higher.

BIBLIOGRAPHY

Basic:
- Flexography: principles & practices. 5th ed. New York: Foundation of Flexographic Technical Association, 1999-.
- Paolazzi, M. Huecograbado: conocimientos básicos y orientaciones técnicas. Barcelona: Don Bosco, DL 1974. ISBN 8423611698.
- Oittinen, Pirkko; Saarelma, Hannu. Printing. Helsinky: Fapet Oy, cop. 1998. ISBN 9525216136.
- Kipphan, Helmut. Handbook of print media: technologies and production methods. Berlin; New York: Springer, 2001. ISBN 3540673261.
- García Belchin, Roberto. Guía de reproducción digital del color. [s.l.]: Roberto García Belchín, 1999. ISBN 8478974156.
- Gravure Education Foundation. Gravure: process and technology. 2nd ed. Example Product Manufacturer, 2003. ISBN 9781880290026.

Complementary:
- Schanda, János. Colorimetry: understanding the CIE system. Hoboken, New Jersey: Wiley-Interscience, cop. 2007. ISBN 9780470049044.

RESOURCES

Other resources:
Notes from the teachers deposited in ATENEA