

## 220293 - Colorimetry, Dyes and Pigments

Coordinating unit:	205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit:	702 - CMEM - Department of Materials Science and Metallurgy
Academic year:	2019
Degree:	MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits:	5
Teaching languages:	Catalan, Spanish

### Teaching staff

Coordinator:	Diana Cayuela Marín
Others:	Marta Riba Moliner

### Degree competences to which the subject contributes

#### Specific:

1. Ability to apply multivariate analysis techniques in market knowledge about materials and textiles in order to implement a flow production system.
2. Ability to develop new fibers or yarns and woven and non-woven structures according to specifications and latest technologies for specific technical applications.
3. Ability to manage and optimize production processes of technical textiles.

### Teaching methodology

The teaching methodology is divided into three parts:

- Face-to-face sessions for the presentation of contents, participation and exercises.
- Face-to-face lab work sessions.
- Self-study work and exercises and activities.

In the exposition - participation sessions of the contents, teacher will introduce the theoretical bases of the subject, concepts, methods and results illustrating them with suitable examples and requesting, if appropriate, the exercises to facilitate their understanding.

In the laboratory work sessions, the teacher will guide the students in the application of theoretical concepts for the resolution of experimental assemblages, based at all times critical reasoning. Activities will be proposed that the student will solve in the classroom and outside the classroom, to promote the contact and use of the basic tools necessary for the realization of an instrumentation system.

The student, autonomously, has to work the material provided by the faculty and the result of the work-problems sessions to assimilate and fix the concepts. Teachers will provide a study plan and activity monitoring (ATENEA).

### Learning objectives of the subject

It enables the student to measure, analyze and reproduce color with the appropriate standardized models and acquire the fundamental knowledge of color science. The correct ordering, application of available softwares and communication of the color for use in the manufacturing processes and in the finished and related textile products, in view of their quality, as well as to carry out research, development and innovation in this field.

It trains the student for the proper selection of dyes and pigments according to their characteristics of chemical constitution, properties and relation with the color to complete the design of the textile product.

Knowledge of the particularities of presentation according to the needs of application of dyes and pigments in view of their rationalized use to achieve the quality required by the final product.

Knowledge of the environmental parameters of the coloring products and pigments used to ensure their good behavior regarding the environment.



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### Study load

Total learning time: 125h	Hours large group:	30h	24.00%
	Hours small group:	15h	12.00%
	Self study:	80h	64.00%

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### Content

<p>Module 1: Fundamentals of Color Science</p>	<p>Learning time: 6h Theory classes: 1h Self study : 5h</p>
<p>Description: 1.1. Definition of color. 1.2. Light and color 1.3. Perception of color 1.4. Visual perception of color</p>	
<p>Module 2: Components in color perception</p>	<p>Learning time: 7h Theory classes: 2h Self study : 5h</p>
<p>Description: 2.1 Light sources and illuminants. Methods for producing light. 2.2 Object: Modifications of the illumination by the objects. 2.3 Observer: Standardized observers.</p>	
<p>Module 3: Systems for color management</p>	<p>Learning time: 15h Theory classes: 3h Laboratory classes: 2h Self study : 10h</p>
<p>Description: 3.1 RGB (CMY) color model (Leyes de mezcla de color) 3.2 Munsell system 3.3 CIE color systems</p>	
<p>Module 4: Color Differences</p>	<p>Learning time: 23h Theory classes: 6h Laboratory classes: 2h Self study : 15h</p>
<p>Description: 4.1 Equations normalized by the calculation of the color coordinates in the color spaces 4.2 Assessment of color differences 4.3 Formulas by the measurement of the color differences in the color spaces 4.4 Measurement of whiteness and yellowing 4.5 Metamerism</p>	

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<p>Module 5: Applying the Kubelka-Munk theory to textiles</p>	<p>Learning time: 23h Theory classes: 6h Laboratory classes: 2h Self study : 15h</p>
<p>Description: 5.1 Kubelka-Munk law (K-M) 5.2 Application of K-M to textile materials 5.3 Matching color with K-M law</p>	
<p>Module 6: Measurement and other applications</p>	<p>Learning time: 9h Theory classes: 2h Laboratory classes: 2h Self study : 5h</p>
<p>Description: 6.1 Instruments for color measurement. 6.2 Color acceptance control (PASS - FAIL) 6.3 Objective assessment of color fastness: assessment of discharge and degradation</p>	
<p>Module 7: Color and chemical constitution</p>	<p>Learning time: 7h Theory classes: 2h Self study : 5h</p>
<p>Description: 7.1 Color theory: effects of the chemical groups of the dye molecule 7.2 Chromophore 7.3 Auxochrome 7.4 Absorption and color</p>	
<p>Module 8: Coloring materials</p>	<p>Learning time: 28h Theory classes: 6h Laboratory classes: 7h Self study : 15h</p>
<p>Description: 8.1 Historical introduction: differentiation between natural and synthetic dyes 8.2 Classification of textile dyes according to their chemical structure 8.3 Classification of textile dyes according to the dyeing class and its reactivity with the textile substrate 8.4 Classification of "Color Index" textile dyes</p>	

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Module 9: Properties of dyes and pigments	Learning time: 7h Theory classes: 2h Self study : 5h
Description: 9.1 Physical and chemical-physical properties of commercial dyes and pigments 9.2 Technical properties of colorants	

### Qualification system

- First evaluation: 35%
  - Second evaluation: 35%
  - Lab practices: 20%
  - Presentation of a work: 10%
  - The unsatisfactory results of the partial exams can be redirected by means of a written test for each of them to be carried out on the day fixed by the final examination. This test can be accessed by all students enrolled. The grade of the test will be valued between 0 and 8. The grade obtained by the application of the renewal 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:

- McDonald, Roderick. Colour physics for industry. 2nd ed. Bradford: Society of Dyers and Colourists, cop. 1997. ISBN 0901956708.
- Best, Janet (ed.). Colour design: theories and applications. Oxford [etc]: Woodhead Publishing, cop. 2012. ISBN 9781845699727.
- Shore, John (ed.). Colorants and auxiliaries: organic chemistry and application properties, vol.1, Colorants. 2nd ed. Bradford: Society of Dyers and Colourists, 2002. ISBN 9780901956781.
- Shore, John (ed.). Colorants and auxiliaries: organic chemistry and application properties, vol. 2, Auxiliaries. 2nd ed. Bradford: Society of Dyers and Colourists, 2002. ISBN 0901956783.
- Vigo, Tyrone L. Textile processing and properties: preparation, dyeing, finishing, and performance. Amsterdam [etc.]: Elsevier, 1994. ISBN 0444882243.

#### Complementary:

- Christie, Robert M. Colour chemistry. Cambridge: Royal Society of Chemistry, cop. 2001. ISBN 0854045732.