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370512 - MATERIALS - Optical Materials

Coordinating unit: 370 - FOOT - Terrassa School of Optics and Optometry
Teaching unit: 713 - EQ - Department of Chemical Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN OPTICS AND OPTOMETRY (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: PERE GARRIGA SOLÉ (http://futur.upc.edu/PereGarrigaSole)

Others: Tzanov, Tzanko (http://futur.upc.edu/TzankoTzanov)
PERE GARRIGA SOLÉ (http://futur.upc.edu/PereGarrigaSole)

Prior skills

Chemistry: Formulation and most elemental bases of inorganic and organic chemistry. Chemical equilibrium, bases of electrochemistry. Organic functions.

In mathematics: representation of functions and definite integrals solving.

Degree competences to which the subject contributes

Specific:

1. Distinguish between the characteristics of materials and designs of various types of ophthalmic lenses (including prisms and filters) and frames, and understand the basic principles of optics and not optical systems used for low vision.
2. Being able to take, treat, represent and interpret experimental data. "Use basic laboratory equipment and techniques"
3. Being able to perform literature searches.
4. Being able to relate the structure with the properties of inorganic and organic compounds and biomolecules

Generical:

5. Adaptation of all the fields of professional activity envers compatible aspects with the medium ambient (recycling, reuse of the materials,...)
6. Consistently communicate the basic knowledge of optometry acquired. (Explain orally and in writing the basic knowledge)
7. Develop empathy with people
8. Interpret and use non-verbal language
9. Judgments (ratings) reports and surveys
10. Being able to participate in multidisciplinary working groups, multicultural and multilingual
11. Be able to organize the work of a group of people to attain a previously determined aim in the due terms
12. Analyze and relate the knowledge and acquired skills.
13. Be innovative and entrepreneurial

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14. Assessing the acquisition of the course objectives.
15. Locate new information and the interpretation of it in its context.
16. Encourage methodical work, rigorous, consistent and innovative
17. Value the methods used to achieve the objectives.
18. Working with evidence, methodology and rigour.
19. Reflect and be able to make a critic of the knowledge and developed skills and the level of achievement.

Teaching methodology

Directed learning hours are, on one hand, devoted to lectures where the teacher does a brief summary of a topic to introduce the general learning objectives related to the basic concepts of the subject. Subsequently, and through practical exercises, the lecture tries to motivate and engage students in actively participating in their learning process. Students get theory notes and a collection of problems for each topic, and PowerPoint presentations with pictures, diagrams and tables that are projected in class for its follow up. Students also have worksheets for the specific contents of each item and the estimated hours to perform each activity, both in classroom and as personal work.

In addition, there is also class to small groups. There are two types of laboratory sessions, problem sessions named seminar sessions and others that are performed in the laboratory (lab work). In the seminar sessions, the students must develop problems and issues, under the supervision of teachers. They also has to deliver some exercises each session (evaluation exercices for the corresponding seminar) a week after its completion.

Finally, the lab work is done in pairs. These sessions allow the students to gain basic skills in chemical laboratory instruments and materials, and introduce students to the application of the scientific method in solving problems in the chemical and materials laboratory. In general, after each lab session, students must submit a report a week after its completion.

The schedule of the lab sessions is known at the beginning of the course.

In these lab sessions is to incorporate some generic skills such as teamwork.

There are also other hours of independent learning such as those devoted to directed readings, the resolution of the problems posed or self-evaluated questionnaires of the different course contents through the ATENEA virtual campus.

Learning objectives of the subject

At the end of the Optical Materials course, the student must be able to:
1. to know the structure of inorganic and organic materials used in the manufacture of ophthalmic lenses and contact information.
2. to know the physical and chemical properties of materials used in optics and optometry.
3. to correlate the physical and chemical properties of contact lenses and the structure of the materials used in their manufacture.
4. to know the materials used in organic and metal frames.
5. to understand the maintenance and cleaning solutions and adapt the to the ocular and lens features.
6. to establish contact with the marketing of products, storage, conservation and information.

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7. to master the practical application of the principles and methodologies of Optics and Optometry, and the acquisition of skills and competencies described in the general objectives of the degree.

Study load

Total learning time: 144h	Hours large group:	0h	0.00%
	Hours medium group:	32h	22.22%
	Hours small group:	28h	19.44%
	Guided activities:	0h	0.00%
	Self study:	84h	58.33%

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Content

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1. INORGANIC MATERIALS. INORGANIC GLASS

Learning time: 64h

Theory classes: 0h
Practical classes: 12h 30m
Laboratory classes: 14h 30m
Guided activities: 0h
Self study : 37h

Description:
First, a presentation of the subject in which the course objectives are introduced to the students, as well as the schedule of lectures, seminars and practical sessions. The system of assessment and the communication system among teachers - students will be indicated so that they can get all the necessary information on the course.

This content works
Theme 1: Vitreous State
- Definition and classification of mineral glasses.
- Composition and structure of oxide glasses.
- Vitrification.

Theme 2: Physical Properties
- Thermal properties and viscosity.
- Density.
- Optical properties. Absorption and transmission spectra.

Theme 3: Mechanical properties and chemical
- Elastic properties of glass.
- Mechanical resistance.
- Chemical resistance. Mechanisms of attack.
- Parameters that influence the chemical attack.

Theme 4: Physico-chemical and surface of the glass
- Training and state of the glass surface.
- Physical-chemical properties of the glass surface.
- Amendments to the surface. Surface treatments.

Theme 5: Production of glass
- Manufacture of flat glass
- Made of glass glasses
- Annealed Glass

Theme 6: Glasses for ophthalmic and optical applications
- Classification of optical glass.
- Glass ophthalmic.
- Optical filters, colored glass and mirrors.
- Photochromic glass photochromic.
- Recent optical applications.

Theme 7: Metal mounts
- Metals and alloys used for mounts
- Corrosion of metals and their protection
- Shape memory alloys

Related activities:

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Seminar I. Exercises on the contents of items 1 and 2.
Seminar II. Exercises on the contents of items 3 and 4.
Seminar III. Exercises on the content of item 5 and review of the above.
Seminar IV. Exercises on the contents of items 6 and 7.
Seminar V. Exercises on the contents of items 8 and 9.
Seminar VI. Exercises on the contents of item 10 and review of the above.

Practice 1. Explanation of the laboratory, the organization of practices and their contents.
Practice 2.1. Physical properties of a mineral glass.
Practice 2.2. Optical properties: UV-Vis spectrophotometry.
Practice 2.3. Mineral glass engraving.
Lab 3.1. Impact resistance and heat treatment of glass.
Lab 3.2. Resistance to abrasion.
Lab 4.1. Physical properties of monomers.
Practice 4.2. Physical properties of polymeric materials.
Practice 4.3. Optical properties: UV-Vis spectrophotometry.
Lab 5.1. Polymerization.
Lab 5.2. Colouring of a polymeric material.
Practice 6.1. Water Absorption of a polymeric material.
Practice 6.2. Measurement of contact angles.
Practice 6.3. Water content of a contact lens.
Practice 7.1. Corrosion of metal.
Practice 7.2. Electrolyticl coatings.

Partial Tests.
Laboratory test.

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2. ORGANIC MATERIALS. ORGANIC GLASS

Learning time: 80h

Theory classes: 0h
Practical classes: 17h 30m
Laboratory classes: 15h 30m
Guided activities: 0h
Self study : 47h

Description:
This content will work:

Theme 8: Definitions, classification and synthesis of polymers
- Macromolecules, polymers and plastics.
- Classification of polymers as: source, form, to obtain reaction, physical properties and nature of monomers.
- Synthesis of polymers: poliaddició and policondensació.
- Phases of the reaction of polymerization, copolymerization and kinetic properties of copolymers.

Theme 9: Properties of polymers
- Types of links in macromolecules (covalent, polar, H-bridges, van der Waals interactions).
- Relationship between chemical structure and properties: thermoplastics, thermosets and elastomers. Crystallinity and transparency.
- Correlation between the properties of a polymer and the structural unit.
- Thermal properties, mechanical and optical properties. Density and water absorption.
- Modification of the properties with additives: dyes, pigments and plasticizers.

Theme 10: Organic Eyewear
- Thermoplastic materials: cellulose acetate propionate and cellulose, polyamide and PMMA
- Materials thermosets: epoxy resins and carbon fiber
- Additives used in obtaining mounts
- Manufacture of mounts

Theme 11: Materials for ophthalmic lenses
- Lenses thermoplastic (derived from Bisphenol A PC, PMMA, polystyrene, copolymer PMMA / PS) and thermoset lenses (CR-39 and DAP and copolymers with DATP).
- Material properties for ophthalmic lenses: hard, resitència to abrasion, refractive index and Abbe number.
- Hardening treatments, and color antireflectants of ophthalmic lenses.
- Fotocromàtics compounds for organic lenses.
- Acquisition of ophthalmic lenses.

Theme 12: Materials for Contact Lenses
- Materials for hydrophobic contact lenses: PMMA, CAB. Silicone lenses. Lenses siloxanil-acrylates and fluorosiloxanilacrilats.
- Materials for hydrophilic contact lenses. Hydrogels.
- Properties of hydrogels: water content (WC), gas permeability (DK), refractive index and dependency between them. Influence of pH and the% crosslinking agent.
- Silicone hydrogels. The ideal contact lens and its relationship with physicochemical properties of the material.

Related activities:

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Seminar IV. Exercises on the contents of items 6 and 7.
Seminar V. Exercises on the contents of items 8 and 9.
Seminar VI. Exercises on the contents of item 10 and review of the above.

Practice 4. Properties of organic materials.
4.1. Physical properties of monomers.
4.2. Physical properties of polymeric materials.
4.3. Optical properties: UV-Vis spectrophotometry.
Practice 5. Polymerization and coloration.
5.1. Polymerization.
5.2. Colouring of a polymeric material.
Practice 6. Absorption, water content and contact angle.
6.1. Water Absorption of a polymeric material.
6.2. Measurement of contact angles.
6.3. Water content of a contact lens.

Partial Tests.
Laboratory test.

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Planning of activities

1. LABORATORY PRACTICE	Hours: 14h Laboratory classes: 14h

Description:

Practice 1. Explanation of the laboratory, the organization of practices and their contents.
Practice 2.1. Physical properties of a mineral glass.
Practice 2.2. Optical properties: UV-Vis spectrophotometry.
Practice 2.3. Mineral glass engraving.
Lab 3.1. Impact resistance and heat treatment of glass.
Lab 3.2. Resistance to abrasion.
Lab 4.1. Physical properties of monomers.
Practice 4.2. Physical properties of polymeric materials.
Practice 4.3. Optical properties: UV-Vis spectrophotometry.
Lab 5.1. Polymerization.
Lab 5.2. Colouring of a polymeric material.
Practice 6.1. Water Absorption of a polymeric material.
Practice 6.2. Measurement of contact angles.
Practice 6.3. Water content of a contact lens.
Practice 7.1. Corrosion of metal.
Practice 7.2. Electrolyticl coatings.
The practices must be made in the laboratory in pairs, with a duration of 2 hours.

Support materials:

All materials and reagents needed to perform the experiment in the laboratory.
Detailed lab guide and the questionnaire associated with the experiment.

Descriptions of the assignments due and their relation to the assessment:

Questionnaire with the results of the experiment, must be delivered one week after the completion of the practice. The teacher will give back the corrected report. The final lab grade is the average of the lab reports and the seminar exercices (NL).

Specific objectives:

On doing the lab work, the student must be able to:
- to know the location of the materials tol be used in practice, the instruments to be used for the experimental development, the location of the reagents and the equipment for general use.
- to understand the schedue of lab work and to know the laboratory guidelines.
- to know the safety precautions that have to be adopted in the laboratory to prevent accidents.
- to acquire data and record experimental observations.
- to present the results in tables and graphs and to prepare a report.
- to correlate the practical work with the theoretical bases developed in the lecture sessions.

2. SEMINARS	Hours: 14h Laboratory classes: 14h

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Description:
Seminar I. Exercises on the contents of items 1 and 2.
Seminar II. Exercises on the contents of items 3 and 4.
Seminar III. Exercises on the content of item 5 and review of the above.
Seminar IV. Exercises on the contents of items 6 and 7.
Seminar V. Exercises on the contents of items 8 and 9.
Seminar VI. Exercises on the contents of item 10 and review of the above.
Seminar VII. Exercises items 11 and 12.
Workout and problems that must be done individually or in small groups, 2-3 people, with a duration of 2 hours.
Students will work in the classroom exercises and problems selected by the faculty.

Support materials:
Notes theme and presentations (PowerPoint) available in ATENEA. Collection of evaluation exercises.

Descriptions of the assignments due and their relation to the assessment:
Evaluation exercises of the seminar are problems similar to those worked in the classroom, students have to submit a week after the seminar. The teacher returns the corrected exercises. It is half of the lab reports and exercises to assess the seminars (NL).

Specific objectives:
To perform the work of practice session of seminar, students must be able to:

- To relate the exercises to the more theoretical aspects explained in class.
- Learning to solve short questions and problems.

3. FOUR PARTIAL TEST (CONTENTS 1 AND 2)

Hours: 2h
Practical classes: 2h

Description:
Individual achievement in the classroom exercises, problems and cuestions of contents 1 and 2. Correction by the teacher.

Support materials:
Series of auto tests with multiple choice exercises, notes of the contents and presentations (PowerPoint) available in ATENEA for test preparation. These can not be brought the day of the test.
Exercices propose and scientific calculator allowed to perform the test. Subsequent resolution official marking criteria available on the day of exam review.

Descriptions of the assignments due and their relation to the assessment:
Resolution of the tests by the students. It represents 85% of the final grade (21,5% for each test).

4. FINAL TEST

Hours: 2h
Practical classes: 2h

Description:
Individual fina exam for those students that have not passed the course with the partial tests. Correction by the teacher.

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Support materials:
Series of self tests with multiple choice exercises notes of the contents and presentations (PowerPoint) available in ATENEA for test preparation. These can not be brought on the day of the exam.
Exercices proposed and sceintific calculator to perform the test. Subsequent resolution and official marking criteria available on the day of exam review.

Descriptions of the assignments due and their relation to the assessment:
Resolution of the exam by the students.

5. LABORATORY TEST	Hours: 2h Laboratory classes: 2h

Description:
Individual achievement in the laboratory of one of the experiments (random) that students have done previously.

Support materials:
The day of the test the student can bring the corrected reports, the practice outlines, calculator, graph paper and ruler.

Descriptions of the assignments due and their relation to the assessment:
After the experience the students have to deliver the solved questions to the professor. It represents 15% of the final grade.

Qualification system

The final mark is the partial sum of the following qualifications:
Nfinal = 0,215 Np1 + 0,215 Np2 + 0,215 Np3 + 0,215 Np4 + 0,15 NpL

Nfinal: final grade.
Np1: qualification of the test part 1.
Np2: qualification of the test part 2.
Np3: qualification of the test part 3.
Np4: qualification of the test part 4.
NpL: the average grade of laboratory test and laboratory reports
NL: qualification of evaluation exercises of seminars .

The partial tests 1 and 2 consist of questions on concepts associated with the learning objectives of the course with regard to knowledge and understanding of the 1st part of the programme (themes 1-7) and a set of application exercises.

The partial tests 3 and 4 consist of questions on concepts associated with the learning objectives of the course with regard to knowledge and understanding of the second part of the programme (themes 8-12) and a set of application exercises.

The lab test consists of conducting a particular experiment from those that the students have done in the laboratory, and the presentation of the relevant questionnaire (NPL). This grade will weight a 50% of the global mark for laboratory work and the other 50% will be the average of the written reports for each laboratory practice.

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Regulations for carrying out activities

It is necessary, in order to get an average mark, to have completed all laboratory practices and seminars and have delivered the corresponding reports.
It is a necessary condition for passing the Optica Materials course to have a minimum grade of 4 in the partial tests 1-4.

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