COURSE DATA

DATA SUBJECT

Code: 46998
Name: Advanced optical instrumentation
Cycle: Master's Degree
ECTS Credits: 4.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2280 - Master's Degree in Advanced Optometry and Vision Sciences	Facultat de Física	1	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2280 - Master's Degree in Advanced Optometry and Vision Sciences	Instrumentación óptica avanzada	COMPULSORY

COORDINATION

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SUMMARY

The subject Advanced Optical Instrumentation provides a solid understanding of the physical foundations and clinical applications of optical instruments used in optometry and ophthalmology. Throughout the course, topics are studied ranging from focusing principles to image formation processes using coherent and incoherent light sources. Students develop the skills required to interpret clinical results, assess the suitability of each diagnostic technique, and apply this instrumentation in real professional contexts.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

It is recommended to have prior knowledge of geometric optics, physical optics, and basic clinical optometry.

COMPETENCES / LEARNING OUTCOMES

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Act autonomously in learning, make informed decisions in different contexts, issue judgements based on experimentation and analysis and transfer knowledge to new situations.

Apply quantitative and qualitative research methods to collect, analyse and interpret data related to optometry and eye health.

Apply the knowledge acquired and be able to solve proplems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to the field of study.

Be able to communicate effectively, both orally and in writing, adapting to the characteristics of the situation and audience.

Collaborate effectively in work teams, taking on responsibilities and leadership roles and contributing to collective improvement and development.

Communicate scientific results, conclusions, knowledge or diagnoses, and the conceptual framework on which they are based, to both expert and non-expert audiences clearly and unambiguously.

Compare the usefulness of different exploratory techniques used to analyse the anterior, middle and posterior ocular segments.

Contribute to the design, development and implementation of solutions that respond to social demands, considering the Sustainable Development Goals as a reference.

Convey scientific knowledge in the field of optometry.

Demonstrate critical and self-critical reasoning in the field of the degree, considering aspects such as professional ethics, moral value and the social implications of the different activities carried out.

Engage in planning and management activities within public and private health services.

Evaluate and compare new visual examination methods and techniques.

Handle sources of legislation related to the optometric profession and business activity with ease.

Identify dietary and nutritional factors that may affect eye health and the progression of chronic eye diseases.

Identify the effects of drugs on visual function.

Interpret the complementary tests necessary in vision consultations.

Interpret the optical principles applied in different ocular examination techniques and analyse their results.

Know advanced ocular exploration techniques from a functional perspective.

Know and understand, within the area of the degree, inequalities based on sex and gender in society; integrate different needs and preferences based on sex and gender into the design of solutions and problem-solving.

Plan and carry out research projects that contribute to the production of knowledge in the field of optometry.

Plan the use of advanced optical instrumentation for the diagnosis and treatment of visual conditions.

Promote collaboration with other healthcare professionals.

Propose creative and innovative solutions to complex situations or problems within the field of knowledge to respond to diverse professional and social needs.

Relate the visual and ocular effects of medication use.

Select the most appropriate ocular and visual clinical assessments related to the use of medication.

Understand methods for searching and accessing scientific information in bibliographic databases related to optometry.

Understand ocular photography: retinography.

Understand the effectiveness, progression and discharge in pharmacological treatments.

Understand the fundamental properties of laser radiation and its applications, optoelectronics and optomechanics, which form the basis of new therapeutic and diagnostic technologies.

Understand the fundamentals and the difference in image formation in an optical system with and without optical aberrations.

Understand the operating principles of the latest-generation optical and optometric instruments and their applications.

Understand the physicochemical properties of ocular drugs and their effects on ocular pathologies including knowledge of possible adverse pharmacological reactions.

Understand the principles of advanced optics applied to vision and instrumentation.

Understand the protein and vitamin components of food, nutrients and nutraceuticals and their impact on eye health and patients quality of life.

Understand the techniques for examining the retinal nerve fibre layer.

Understand the therapeutic or diagnostic aim of drugs and their adverse effects.

Understand the types of anterior and middle segment analysers.

Work in multidisciplinary teams in the health sciences.

DESCRIPTION OF CONTENTS

Topic 1. Wave optics. Image formation in optical systems
Physical principles of image formation in optical systems in terms of wave optics.
Image formation in the presence of optical aberrations.
Optical quality criteria: merit functions and performance evaluation of an optical system.
Applications in vision science and in optometric and ophthalmic instrumentation.

Topic 2. Laser radiation and related technologies
Fundamental properties of laser radiation and its interaction with ocular tissues.
Applications of lasers in the diagnosis and treatment of ocular dysfunctions and pathologies.
Regulations and considerations on laser safety.

Topic 3. Advanced ocular examination techniques
Operating principles of advanced instruments for ocular diagnosis.
Classification and operation of anterior and intermediate segment analyzers.
Classification and operation of posterior segment analyzers.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Seminar	14,00
Total hours	**44,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	40,00
Preparation of lessons	0,00
Preparation for assessment activities	8,50
Resolution of case studies	0,00
Total hours	**68,50**

TEACHING METHODOLOGY

The course combines lectures and seminars aimed at promoting both knowledge acquisition and active student participation.

Lectures:
An expository method (lecture-based teaching) is used with audiovisual support (videos). The audiovisual material will be available on the Virtual Classroom before each session. Face-to-face hours are used for the analysis and discussion of the video content for each topic.
Seminars:
The activities include individual presentations based on the review of scientific publications related to the theoretical topics and/or the resolution of questionnaires based on the course content, encouraging discussion on procedures and results.

EVALUATION

The assessment system combines individual tests with the following components, minimum thresholds, and recovery conditions:

Theoretical or theoretical-practical exam (70%)

- First session: for this component to count, students must obtain at least 5/10 in the exam.
- Retake (second session): same format and criterion (70% of the final grade, minimum 5/10).

Assessment of individual assignments (30%). Includes exercise resolution, presentations, and critical analysis of articles.

- First session: it counts if the student¿s average for the assignments is at least 5/10.
- Retake (second session): students must repeat the failed assignments or, at the instructor¿s discretion, complete a specific exam. To pass, the average for the continuous assessment must be at least 5/10.

Final grade and general conditions

- The final grade is the weighted sum of both components, provided each one meets its minimum threshold (at least 5/10).
- If students pass both components in the first session, the evaluation process is complete.
- If only one component is failed, only that part is recovered in the second session, maintaining the grade of the passed component.
- If both are failed, the exam and the assignments must be recovered according to the above criteria.

REFERENCES

Basic references:

- Kaschke M., Donnerhacke K.H., Rill M.S. *Optical Devices in Ophthalmology and Optometry*. Wiley VCH; 2014. ISBN 978-3527410682
- Niemz M.H. *Laser-Tissue Interactions: Fundamentals and Applications*. Springer; 2019. ISBN 978-3-030-11916-4
- Yasuno Y. *Optical Coherence Tomography-Principles, Implementation, and Applications in Ophthalmology*. Preprint; 2022. arXiv:2212.04380v1

Complementary references:

- Hecht E. *Optics* (5ª ed.). Pearson; 2017. ISBN 978-0133977226
- Benjamin W.J. *Borish's Clinical Refraction* (2ª ed.). Butterworth-Heinemann; 2006. ISBN 978-0750675246