COURSE DATA

DATA SUBJECT

Code: 46998
Name: Advanced optical instrumentation
Cycle: Master's Degree
ECTS Credits: 4.5
Academic year: 2026-27

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 course 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, students study topics ranging from focusing principles to image formation processes using coherent and incoherent light sources. Students will 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

Previous knowledge of geometrical optics, physical optics and basic clinical optometry is recommended.

COMPETENCES / LEARNING OUTCOMES

2280 - Master's Degree in Advanced Optometry and Vision Sciences

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

This topic addresses the foundations of wave optics applied to image formation in optical systems. Students study the physical principles underlying image formation, both in ideal systems and in the presence of optical aberrations, as well as optical quality criteria, merit functions and procedures for evaluating the performance of an optical system. These contents are contextualised within vision science and within the design, analysis and use of optometric and ophthalmic instrumentation.

Topic 2. Laser radiation and related technologies

This topic analyses the fundamental properties of laser radiation and related technologies, with particular attention to their interaction with ocular tissues. Their applications in the diagnosis and treatment of ocular dysfunctions and pathologies are studied, together with the main regulations and considerations related to laser safety.

Topic 3. Advanced ocular examination techniques

This topic explores advanced ocular examination techniques and the operating principles of instruments used in ocular diagnosis. The classification and operation of anterior, intermediate and posterior segment analysers are studied in order to understand their clinical usefulness and their application in optometry and ophthalmology.

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 with the aim of promoting both knowledge acquisition and active student participation.

Lectures will use an expository approach, supported by audiovisual material and other teaching resources. The material required to follow the sessions will be available in the Virtual Classroom before each class, so that face-to-face sessions can focus on explaining the fundamental concepts, analysing the contents, discussing examples and resolving questions.

Seminars will involve activities aimed at applying and discussing the course contents. These activities may include individual presentations based on the study of scientific publications related to the theoretical topics, the resolution of questionnaires and the critical analysis of procedures, results and instruments. The aim is to promote interpretation skills, scientific communication and critical reflection on the use of advanced optical instrumentation in optometric and ophthalmological contexts.

EVALUATION

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

Theoretical or theoretical-practical exam: 70% of the final grade.

In the first examination period, this component will only count towards the final grade if students obtain at least 5 out of 10 in the exam.

In the second examination period, the exam will have the same weight and the same pass criterion: 70% of the final grade and a minimum mark of 5 out of 10.

Assessment of individual assignments: 30% of the final grade.

This component includes exercise resolution, presentations and critical analysis of articles. In the first examination period, this component will count if the average mark for the assignments is at least 5 out of 10.

In the second examination period, this component may be recovered by repeating the failed assignments or, at the instructor's discretion, by completing a specific test. To pass this component, the average mark for the assignment-based assessment must be at least 5 out of 10.

The final grade will be the weighted sum of both components, provided that the minimum threshold established for each component is met. If students pass both components in the first examination period, the assessment process will be complete. If only one component is passed, only the failed component will be recovered in the second examination period, while the mark for the passed component will be maintained. If neither component is passed, both the exam and the assignment-based assessment must be recovered according to the criteria indicated above.

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. 5th ed. Pearson; 2017. ISBN 978-0133977226.

• Benjamin W.J. Borish's Clinical Refraction. 2nd ed. Butterworth-Heinemann; 2006. ISBN 978-0750675246.