Course guide
370001 - MATES - Mathematics for Optics and Optometry

Last modified: 02/07/2025

Unit in charge: Terrassa School of Optics and Optometry
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN OPTICS AND OPTOMETRY (Syllabus 2020). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Molinero Albareda, Xavier (https://futur.upc.edu/xavier.molinero)

Others: Pfeifle, Julian Thoralf (https://futur.upc.edu/JulianThoralfPfeifle)
Puerta Coll, Francisco Javier (https://futur.upc.edu/FranciscoJavierPuertaColl)

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE03. (ENG) The ability to show basic knowledge of geometry and mathematical analysis. The ability to apply general statistical methods to optometry and vision sciences.

Generical:
CG13. Demonstrate and interpret methods for critical analysis and theory development and apply them to the field of optometry.
CG16. Participate effectively in both single-discipline and multidisciplinary work groups on projects related to optometry.

Transversal:
CT6. Independent learning. Identify and overcome gaps in one's knowledge by thinking critically and choosing the best approach to extending one's knowledge.

TEACHING METHODOLOGY

MD01 – Participatory lecture on theoretical and practical concepts.
MD02 – Active classroom methodologies (project-based learning [PBL], case studies, role-playing games, cooperative learning, etc.)
MD03 (15 h) – Practical problem-solving class requiring student participation in case studies and/or exercises on topics related to the subject matter.
MD05 – Reading of educational materials, texts and articles related to course topics.
MD06 – Working on problems, exercises and assignments, and resolving doubts via the ATENEA virtual campus.

Face-to-face sessions will be organised around theories, problems and practicals, some of which will take place in FOOT computer rooms (small group). Mid-semester and final exams will be carried out, as well.

Lectures will consist of presentations made by the teaching staff in which the basic concepts and specific learning objectives for each session will be introduced. In these same sessions, all of this will be applied to problem solving, which will actively engage students in the learning process. Students have available to them support material for all of these activities. This material and the complementary course material are available in the ATENEA virtual learning environment.

Practical sessions are structured around scripts created for each session and topis so that students can familiarise themselves with solving mathematical problems in the field of optics and optometry. In some of these sessions, students will learn how to use specific software.

Time for self-directed learning serves to reinforce theoretical and practical concepts via a review of theories and the solving of related problems. During this time, an assignment will be carried out that, along with other avaluable activities, corresponds to an assessment of the independent learning.

LEARNING OBJECTIVES OF THE SUBJECT

To use the concepts of plane geometry to model and solve problems in real contexts in the fields of optics and optometry, for example, the concept of visual acuity.

To use the concepts of univariate and multivariate real functions to model and solve problems in real contexts related to the fields of optics and optometry, for example, to interpret medical images of the anterior part of the eye.

This module contributes to the European Diploma in Optometry competencies indicated in the following link:
https://drive.google.com/drive/folders/1bwmHBsvkrGnY63DfXAnWZB_i0I2pXa-I?usp=drive_link

STUDY LOAD

Type	Hours	Percentage
Hours medium group	45,0	30.00
Self study	90,0	60.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

Subject Area 1. Plane geometry.

Description:
Topic 1. Angles, triangles and similarities. Trigonometric relations in the different quadrants: concepts of periodicity and transformation:
(translation, multiplying by a scalar magnitude, etc.). The solid angle.
Topic 2. Calculation of visual acuity.
Topic 3. Plane geometry: points, vectors, polar coordinates, scalar product, slope and straight lines (ordinary form y = mx + b). Dependent and independent variables. Approximation of a straight line from points (regression line, approximation by least squares).
Topic 4. Conics and properties.

Related activities:
Activities 1, 2 and 3 will be carried out in Subject Area 1.

Full-or-part-time: 60h
Practical classes: 45h
Laboratory classes: 15h

Subject Area 2. Univariate functions.

Description:
Topic 5. Elementary functions (trigonometric, exponential, logarithmic and rational): concepts related to transformation (translation, scalar multiplication, etc.). LogMAR.
Topic 6. Concept of derivatives. Calculation of critical points and representation of univariate functions. Linear approximation, Taylor polynomials and Fourier series.

Related activities:
Activities 4 and 5 will be carried out in Subject Area 2.

Full-or-part-time: 40h
Practical classes: 12h
Laboratory classes: 4h
Self study : 24h

Subject Area 3. Multivariate functions.

Description:
Topic 7. Representation and contour lines.
Topic 8. Partial derivatives.
Topic 9. Directional derivatives and gradients.

Related activities:
Activities 6 and 7 will be carried out in Subject Area 3.

Full-or-part-time: 50h
Practical classes: 15h
Laboratory classes: 5h
Self study : 30h

ACTIVITIES

Activity num. 6.

Description:
Practical exercises from Topic 7, such as curvature maps.
There will be gradable questions or a gradable independent learning assignment.

Related competencies :
CT6. Independent learning. Identify and overcome gaps in one's knowledge by thinking critically and choosing the best approach to extending one's knowledge.

Full-or-part-time: 5h
Self study: 3h
Laboratory classes: 2h

Activity num. 7.

Description:
Practical exercises from topics 8 and 9 with an analytical part and a part to be completed.

Full-or-part-time: 5h
Self study: 3h
Laboratory classes: 2h

Activity num. 2.

Description:
Practical exercises from topic 3 (approximation of a line based on some points, etc.).

Full-or-part-time: 5h
Self study: 3h
Laboratory classes: 2h

Activity núm. 1.

Description:
Trigonometry. Various practical exercises from topics 1 and 2 will be analysed.

Full-or-part-time: 5h
Self study: 3h
Laboratory classes: 2h

Activity num. 3.

Description:
Practical exercises from Topic 4 with an analytical part and a part to be completed.
Properties of conics will be studied with regard to various parameters, for example, semi-major and semi-minor axes and the semi-focal length.

Full-or-part-time: 5h
Self study: 3h
Laboratory classes: 2h

Activity num. 4.

Description:
Practical exercises from Topic 5 with an analytical part and a part to be completed.
Translation and displacement and the LogMAR chart will be studied.

Full-or-part-time: 5h
Self study: 3h
Laboratory classes: 2h

Activity num. 5.

Description:
Practical exercises from Topic 6. A practical example of a Fourier series will be shown.
There will be gradable questions or a gradable independent learning assignment.

Related competencies :
CT6. Independent learning. Identify and overcome gaps in one's knowledge by thinking critically and choosing the best approach to extending one's knowledge.

Full-or-part-time: 5h
Self study: 3h
Laboratory classes: 2h

GRADING SYSTEM

Continuous assessment marks are based on the following calculation.
On the one han, two exams that focus on knowledge of subject areas 1, 2 and 3, which have a grade of 40% and 40%, respectively.
On the other hand, two activities with a grade of 10% each.
Additionally, the cross-disciplinary competency CT06 (Independent learning. The ability to identify and overcome gaps in one's knowledge by thinking critically and choosing the best approach to extending one's knowledge) will be assessed with the activities and the exams.
Students who fail the subject with a mark greater than or equal to 3.5 have the option to pass it by taking a unique written resit examination. This resit examination will be conducted under the conditions established by the Academic Regulations for Bachelor's and Master's Degrees at the UPC (NAGRAMA) and the specific conditions established by the Terrassa School of Optics and Optometry.
Students who pass the resit exam are given a final mark of 5 in the course. Otherwise, they keep the highest mark they received between the previous assessment and the resit exam.

EXAMINATION RULES.

If any of the continuous assessment activities are not completed, students will be given a mark of 0 for the subject.

If copying (either partial or total) is found to have taken place on any course assessment, that which is stipulated in the Academic Regulations for Bachelor's and Master's Degrees at the UPC will apply:
''Irregular actions potentially leading to a significant variation of the marks obtained by one or more students will be considered a breach of the assessment regulations. Such behaviour will result in a descriptive mark of "Fail" and a numerical mark of 0 for the examination in question and for the subject, without prejudice to any disciplinary proceedings that may result from that behaviour.
If students disagree with this decision, they may file a complaint with the dean or director of the school. If students are not satisfied with the response, they may lodge an appeal with the rector.
The total or partial reproduction of academic and research works, or their use for any other purpose, must have the express permission of the author or authors of the works.
The director or dean of the school makes decisions regarding allegations about any aspects not covered in the regulations.''

BIBLIOGRAPHY

Basic:
- Álvarez Quetglas, María José [et al.]. Matemàtiques per a l'òptica i l'optometria [on line]. Barcelona: Edicions UPC, 2008 [Consultation: 21/01/2021]. Available on: http://hdl.handle.net/2099.3/36847. ISBN 9788483019603.
- Larson, Ron E.; Edwards, Bruce H. Cálculo. Vol. 1, De una variable [on line]. 9a ed. México: McGraw-Hill, 2010 [Consultation: 09/05/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5686. ISBN 9786071502735.
- Larson, R.; Edwards, B.H.. Cálculo. Vol. 2, De varias variables [on line]. 9a ed. México: McGraw-Hill, 2010 [Consultation: 09/05/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5686. ISBN 9789701071342.

Complementary:
- Belin MW, Khachikian SS. "An introduction to understanding elevation-based topography: how elevation data are displayed –a review". Clinical & experimental ophthalmology [on line]. 2009, núm. 37, p. 14-29 [Consultation: 09/05/2022]. Available on: https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/full/10.1111/j.1442-9071.2008.01821.x.- Caum Aregay, Jesús [et al.]. Tecnología óptica: lentes oftálmicas, diseño y adaptación [on line]. Barcelona: Edicions UPC, 2001 [Consultation: 24/07/2024]. Available on: http://hdl.handle.net/2099.3/36343. ISBN 8483014742.