

**COURSE DATA****DATA SUBJECT**

Code: 34296
Name: Mechanisms and models of vision
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1207 - Degree in Optics and Optometry	Facultat de Física	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1207 - Degree in Optics and Optometry	Visual perception II	COMPULSORY

COORDINATION

CAPILLA PEREA PASCUAL

MALO LOPEZ JESUS

SUMMARY

The course Mechanisms and Models of Vision, which is part of the Visual Perception subject area, focuses on the study of the neural mechanisms involved in visual perception, as well as the simplest models that quantitatively describe the perception of colour, form and motion. The models covered will be limited to linear models that rely on low-level mechanisms, that is, up to the striate cortex.

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 that students have previously taken Psychophysics of Vision and have elementary knowledge of the anatomy and physiology of the visual system.



COMPETENCES / LEARNING OUTCOMES

1207 - Degree in Optics and Optometry

Being able to gather and interpret relevant data to make judgments.

Being able to transmit information, ideas, problems and solutions to both a specialized and non-specialized audience.

Development of learning skills necessary to undertake further studies with a high degree of autonomy.

Knowing how to apply the knowledge acquired to professional activity, knowing how to solve problems and develop and defend arguments.

To have and to understand the fundamentals of Optometry for its correct clinical and healthcare application.

To know and to apply Fourier theory to vision models.

To know how to correlate psychophysical experiments with the physiology of the visual system.

To know the basic models of color, shape and movement vision.

To know the basic models of vision.

To know the spatial and temporal aspects of vision.

To know the spatial and temporal chromatic aspects of vision.

DESCRIPTION OF CONTENTS

1. Neural foundations of vision

Introduction to the structure and function of the visual system. The retina, visual pathways and the striate cortex.

2. Colour vision

Introduction to cone excitations and tristimulus values. Linear models based on trichromatic theory. Chromatic and achromatic mechanisms: linear models with opponent transformation.



3. Spatial vision

Introduction to the spectrum of an image. The visual system as a filter: the single-channel model. Contrast sensitivity in colour space. The visual system as a discrete set of filters: multichannel models.

4. Spatiotemporal properties of the visual system and motion perception

Uses of motion information. Contrast sensitivity in the spatiotemporal domain: the spatiotemporal contrast sensitivity function. Mechanisms and models of motion perception.

5. Practical exercises: seminars and laboratory

- (1) Computer-generated images.
- (2) Instruments for colour vision: colour calibration.
- (3) Tristimulus colorimetry and appearance in LMS and ATD.
- (4) Instruments for spatial vision: calibration of extent and spatial frequency.
- (5) Responses of LGN neurons to LMS images.
- (6) Responses of achromatic and chromatic contrast sensitivity functions to LMS images.
- (7) Responses of V1 neurons to LMS images.
- (8) Instruments for motion perception: calibration of time and temporal frequency.
- (9) Response of the spatiotemporal contrast sensitivity function.
- (10) Pattern visibility.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	15,00
Theory	30,00
Laboratory	15,00
Total hours	60,00

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	40,00
Independent study and work	45,00
Preparation of lessons	0,00
Preparation for assessment activities	5,00
Resolution of case studies	0,00
Total hours	90,00

TEACHING METHODOLOGY



The course will consist of:

- Theory classes in which the teaching staff will explain the contents of the programme using the blackboard and audiovisual resources. Supporting materials used in class, including presentations and videos needed to illustrate the different visual phenomena, will be made available to students in advance.
- Practical seminar and laboratory sessions. In the seminar sessions, the experimental and computational techniques needed to solve the proposed exercises will be presented, and the teaching staff will solve any illustrative examples required. Subsequently, in the laboratory sessions, students will complete the proposed exercises using the appropriate tools. Therefore, the seminar and laboratory sessions constitute a single practical thematic unit in this course (UT 5).

EVALUATION

The assessment will consist of two parts:

A. Theory exam, consisting of 5 theoretical-practical questions. This part will be worth 5 points out of 10.

B. Submission of the exercises proposed during the practical seminar and laboratory sessions. This part will be worth 5 points out of 10.

To pass the course, students must obtain at least 4 points out of 10 in each of the two parts. The final mark will be the weighted sum of both parts, provided that the minimum mark required in each part has been achieved.

Attendance at the practical seminar and laboratory sessions is mandatory due to their applied and experimental nature. Attendance at these sessions is considered a non-recoverable activity. The assessment of the practical exercises will be recoverable by submitting the corresponding exercises in the second examination session.

In the second examination session, the same weightings and minimum requirements as in the first examination session will apply. The mark obtained in any part that has reached the required minimum will be retained. Students will only have to complete the part not passed: the theory exam, if the minimum mark was not achieved in that part, and/or the submission of the practical exercises, if they were not submitted or did not reach the minimum mark.

REFERENCES

Basic references:



- Capilla, P. Percepción visual: psicofísica, mecanismos y modelos. Editorial Médica Panamericana, 2019. ISBN 978-84-9835-959-6.
- Capilla, P., Pujol, J., Artigas, J.M. Fundamentos de colorimetría. Servei de Publicacions de la Universitat de València, 2002. ISBN 978-84-370-5411-6.
- Hubel, D.H. Ojo, cerebro y visión. Servicio de Publicaciones de la Universidad de Murcia, 1999. ISBN 978-84-7684-898-2.

Further reading:

- Wandell, B. Foundations of Vision. Sinauer Associates, 1995. ISBN 978-0878938534.
- Spillmann, L., Werner, J.S. Visual Perception: The Neurophysiological Foundations. Academic Press, 1990. ISBN 978-0126576815.
- Rodieck, R.W. The First Steps in Seeing. Sinauer Associates, 1998. ISBN 978-0878934390.
- Gegenfurtner, K.R., Sharpe, L.T. Color Vision: From Genes to Perception. Cambridge University Press, 1999. ISBN 978-0521590736.