COURSE DATA

Data Subject	
Code	34296
Name	Mechanisms and models of vision
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1207 - Degree in Optics and Optometry	Faculty of Physics	3	First term

Subject-matter

Degree	Subject-matter	Character
1207 - Degree in Optics and Optometry	11 - Visual perception II	Obligatory

Coordination

Name	Department
CAPILLA PEREA, PASCUAL	280 - Optics and Optometry and Vision Sciences

SUMMARY

The subject of Mechanisms and Models of Vision, part of the matter “Visual Perception”, aims to study the neural mechanisms involved in visual perception and the simpler models quantitatively describing the vision of color, shape and movement. The models that will be studied are only linear models that use 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

Previous knowledge of Psychophysics of Vision is required, as well as an elementary knowledge of the anatomy and physiology of the visual system.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1207 - Degree in Optics and Optometry

- To have and to understand the fundamentals of Optometry for its correct clinical and healthcare application.
- Knowing how to apply the knowledge acquired to professional activity, knowing how to solve problems and develop and defend arguments.
- 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.
- To know the basic models of vision.
- To know the spatial and temporal aspects of vision.
- To know how to correlate psychophysical experiments with the physiology of the visual system.
- To know and to apply Fourier theory to vision models.
- To know the basic models of color, shape and movement vision.
- To know the spatial and temporal chromatic aspects of vision.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

Learning outcomes should be consistent with each and every one of the specific skills listed in the previous section.

DESCRIPTION OF CONTENTS

1. Neural foundations of vision.

Introduction: architecture and function of the visual system. The retina and the visual pathways. The striate cortex.

2. Colour vision.

Introduction: cone excitations vs triestímulus values. Models based on the trichromatic theory. Chromatic and achromatic mechanisms: models including an oponnent stage.

3. Spatial vision.

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

4. Spatio-temporal properties of the visual system and motion visión.

Introduction to motion vision. Contrast sensitivity in the espatio-temporal domain. Mechanisms and models of the motion vision.

5. Practical exercises (seminarls and laboratory)

(1) Images on the computer
(2) Instruments for color vision: color calibration
(3) Tristimulus colorimetry/appearance in LMS and ATD
(4) Spatial Vision Instruments: Spatial Spread/Frequency Calibration
(5) Response of LGN neurons to LMS images
(6) Responses of achromatic and chromatic CSFs to LMS images
(7) Response of V1 neurons to LMS images
(8) Instruments for motion vision: calibration of time and temporal frequency
(9) Response of space-time CSFs
(10) Pattern visibility

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Tutorials	15,00	100
Laboratory practices	15,00	100
Development of group work	10,00	0
Development of individual work	20,00	0
Study and independent work	25,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	10,00	0
Preparation of practical classes and problem	10,00	0

TOTAL	**150,00**

TEACHING METHODOLOGY

The course will consist of:

-Conventional classes in which the teacher will explain the theoretical content of the program topics, using the blackboard and audiovisual media. The files with the Power Point presentations that will be used in the classes, as well as the videos that are necessary to illustrate the different visual phenomena, will be provided to the student in advance.

-Practical classes in which the experimental and computational techniques necessary to solve the exercises will be shown, and the necessary illustrative examples will be solved by the teacher. This task will be done in seminar classes. Next, the students will carry out the exercises that are proposed using the appropriate tools. This task will be done in laboratory classes. Therefore, the seminar classes and the laboratory constitute a single thematic unit in this course (UT 5).

EVALUATION

The assessment will consist of two parts:

A1. - A theory exam consisting of 5 theoretical-practical questions.

A2. - A test-type theory exam made up of 20 theoretical-practical questions.

Each student can opt for one of the two exam modes (A1 or A2).

B.-Presentation of the exercises proposed in the practical sessions (seminars and laboratory).

Attendance at the practical sessions is mandatory.

Each part will have a value of 5 points. To add the two parts it will be necessary to have at least a 4 (out of 10) in each.

REFERENCES

Basic

- P. Capilla. Percepción visual: Psicofísica, mecanismos y modelos. Editorial Medica Panaméricana (2019).
.- P. Capilla, J. Pujol y J.M Artigas. Fundamentos de colorimetría. Servei de publicacions de la Universitat de València (2002).
.- D. H. Hubel. Ojo, cerebro y visión. Servicio de publicaciones de la Universidad de Murcia (1999).

.- B. Wandell. Foundations of visión. Sinauer (1995)
.- L. Spillman y J.S. Werner. Visual perception: The neurophysiological foundations. Academic Press (1990).

Additional

- R.W. Rodiek. The first steps in seeing. Sinauer associates (1998).
.- K.R. Gegenfurtner y L.T. Sharpe. Color vision: From genes to perception. Cambridge University Press (1999).