Course guides
370526 - PSICOFISIC - Psychophysics and Neurophysiology of Vision

Unit in charge: Terrassa School of Optics and Optometry
Teaching unit: 731 - OO - Department of Optics and Optometry.
Degree: BACHELOR'S DEGREE IN OPTICS AND OPTOMETRY (Syllabus 2009). (Compulsory subject).
Academic year: 2021 ECTS Credits: 7.5 Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: Torrents Gómez, Aurora (quadrimestre de tardor)
Jaume Pujol Ramo (quadrimestre de primavera)

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Anatomy, histology, physiology, biochemistry and neurophysiology of the visual system and the process of vision
2. Understanding the mechanism of imaging and information processing in the visual system.
3. Being able to take, treat, represent and interpret experimental data. "Use basic laboratory equipment and techniques"
4. Being able to perform literature searches.
8. Evaluate the process of formation of the optical image in the retina and the transmission and information processing in the brain
9. Value the nervous control of the visual system.

General:
15. Synthesize and organize information to convey it effectively orally and / or written
18. Define the general objectives and to carry out a specific group
21. Capacity to assume different roles within the team, leadership, coordination with other members
23. Assessing the acquisition of the course objectives.
26. Locate new information and the interpretation of it in its context.
28. Encourage methodical work, rigorous, consistent and innovative
29. Working with evidence, methodology and rigour.

TEACHING METHODOLOGY

Guided learning hours consist, on the one hand, of taking classes in which the teacher gives a brief presentation to introduce the general learning objectives related to the basic concepts of the subject.
On the other hand, learning hours also consist of taking problem classes that are worked on, often in groups, to solve exercises or questions. These sessions incorporate some generic skills, such as teamwork.
The last type of directed learning hours consists of carrying out laboratory work activities, which are carried out in small groups and which allow the development of basic instrumental skills in a laboratory of psychophysics and neurobiology of vision, as well as initiate students in the application of the scientific method in problem solving.
In general, after each session, tasks are proposed outside the classroom, which must be worked on either individually or in groups. Other hours of autonomous learning should also be considered, such as those devoted to guided reading, solving the proposed problems or self-learning questionnaires of the different contents through the ATENEA virtual campus.
LEARNING OBJECTIVES OF THE SUBJECT

Understand and handle basic laboratory equipment and techniques.
Understanding the basics and radiometric and photometric laws.
Understanding the factors that limit the quality of the retinal image.
Knowing the spatial and temporal aspects of vision.
Being able to perform psychophysical tests to determine levels of visual perception.
Knowing the properties and functions of the various elements of the visual system.
Understanding the mechanisms of ocular motor and sensory binocular vision.
Understand the functioning of the retina as a radiant energy receiver.
Learn the basic models of color vision, form and movement.
Being able to measure and interpret the data obtained in psychophysical assessment of visual perception.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group</td>
<td>63,0</td>
<td>35.00</td>
</tr>
<tr>
<td>Self study</td>
<td>105,0</td>
<td>58.33</td>
</tr>
<tr>
<td>Hours small group</td>
<td>12,0</td>
<td>6.67</td>
</tr>
</tbody>
</table>

Total learning time: 180 h

CONTENTS

Introduction to psychophysics and neurophysiology of vision

Description:
In this content we work:

The visual process.
The retina and the visual pathways.
The electromagnetic spectrum.
Eye light transmission
Introduction to psychophysics and neurophysiology of vision.

Full-or-part-time: 2h
Theory classes: 1h
Self study : 1h

Psychophysical methods

Description:
In this content you work:

Threshold measures.
Psychophysical methods for the detection of the threshold.
Weber's Law.
Magnitude and sensation.

Related activities:
Activity 1 is carried out.

Full-or-part-time: 12h
Theory classes: 3h
Laboratory classes: 2h
Self study : 7h
The visual stimulus

Description:
In this content we work:

- Basic concepts and units.
- Retinal illumination.
- Light sources.
- Characteristics of light sources.
- Filters.

Related activities:
Activity 2 is carried out.

Full-or-part-time: 18h
- Theory classes: 6h
- Laboratory classes: 2h
- Self study: 10h

Dual nature of the retina

Description:
In this content we work:

- Range of operation of visual system.
- Scotopic and photopic vision.
- Cones and rods
- Photopic and scotopic visual spectral sensitivity.
- Adapt to darkness.
- Adaptation to light.
- Spatial resolution and spatial summation.
- Stiles-Crawford Effect.

Related activities:
Activity 3 is carried out.

Full-or-part-time: 18h
- Theory classes: 6h
- Laboratory classes: 2h
- Self study: 10h
Color vision

Description:
In this content we work:

- Trichromatic theory.
- Theory of opponents colors.
- Perceptual attributes of color.
- Discrimination of the wavelength.
- Bezold-Brücke Effect.
- Color constancy.
- The Munsell color appearance system.
- The CIE color specification system.
- Additive and subtractive mixtures.
- Clinical applications.

Related activities:
Activity 4 is carried out.

Full-or-part-time: 17h
- Theory classes: 5h
- Laboratory classes: 2h
- Self study: 10h

Anomalies of color vision

Description:
In this content we work:

- Classification.
- Properties of the deficiencies of the vision of the color.
- Perception of color in dichromats and abnormal trichromats.
- Achromatopsias and chromatopsias.
- Tests of color vision.

Full-or-part-time: 12h
- Theory classes: 4h
- Self study: 8h
### Spatial vision

**Description:**
In this content we work:

- Modulation transfer function.
- Contrast sensitivity function (CSF).
- Factors affecting CSF.
- Clinical measure of CSF.
- Clinical applications of MTF and CSF.

**Related activities:**
Activity 5 is carried out

**Full-or-part-time:** 17h
- Theory classes: 6h
- Laboratory classes: 2h
- Self study: 9h

### Temporal vision

**Description:**
In this content we work:

- Perception of brief and intermittent stimuli.
- Temporal contrast sensitivity function (TCSF).
- Factors affecting TCSF.
- Clinical applications of TCSF.
- Perception of movement.

**Full-or-part-time:** 10h
- Theory classes: 4h
- Self study: 6h

### Basic neurophysiology

**Description:**
In this content we work:

- The neuron.
- Glial cells.
- Membrane potential and action potential.
- Neuronal excitability.
- Propagation of action potential.
- The synapse.
- Neural circuits.

**Full-or-part-time:** 10h
- Theory classes: 4h
- Self study: 6h
Visual processing in the retina

Description:
In this content we work:

- Structure of the retina.
- Main neurons.
- Receptive fields of ganglion cells.
- Photoreceptors.
- Horizontal cells.
- Bipolar cells.
- Amacrine cells.
- Ganglion cells.
- First and second synapses.

Clinical Considerations.

Full-or-part-time: 15h
- Theory classes: 5h
- Self study: 10h

Parallel processing

Description:
In this content we work:

- The central nervous system.
- Main visual pathway
- Parvocellular and magnocellular systems.
- Secondary visual pathway
- Clinical applications.

Full-or-part-time: 14h
- Theory classes: 4h
- Self study: 10h

Visual processing in the brain

Description:
In this content we work:

- Cerebral cortex and brain areas.
- Striated cortex.
- Cirumcised cortex.
- Psychophysics and neurophysiology.

Clinical Considerations.

Related activities:
- Activity 6 is carried out

Full-or-part-time: 20h
- Theory classes: 6h
- Laboratory classes: 2h
- Self study: 12h
Gross electrical potentials

Description:
In this content we work:
- Electrooculogram.
- Electroretinogram.
- Visual evoked potentials.

Full-or-part-time: 8h
- Theory classes: 2h
- Self study: 6h

ACTIVITIES

ACTIVITY 1: LABORATORIO. MEDIDA DE LA AV MEDIANTE DIFERENTES MÉTODOS PSICOFÍSICOS

Description:
Activity to be done in the laboratory, in groups, with a duration of 2 hours. In the laboratory, the experimental part will be carried out, and as directed autonomous learning, the student is expected to read the notes and answer the corresponding questionnaire to identify the objectives to be achieved after the experiment. Prior to the experimentation, the teachers make an assessment through questions to the students that allows to identify the degree of autonomous learning achieved. The practice is performed in the Laboratory of Physiological Optics, building TR8, plant -2.

Specific objectives:
- At the end of the activity the student should be able to:
  - Understand the different psychophysical methods used.
  - Perform AV measurements using different psychophysical methods used.
  - Understand the concept of psychometric function.

Material:
All material for the realization of the experiment in the laboratory and corresponding software, Detailed notes of the activity with the questionnaire and notes of the subject available in ATENEA.

Delivery:
Registration by the professor of the verification of autonomous learning of the student and of the work in the laboratory. The student submits the questionnaire with the results of the experiment at the end of the session. This is returned corrected and with the corresponding feedback from the professor.

Full-or-part-time: 2h
- Laboratory classes: 2h
ACTIVITY 2: LABORATORIO. LEY DE STEVENS

Description:
Activity to be done in the laboratory, in groups, with a duration of 2 hours. In the laboratory, the experimental part will be carried out, and as directed autonomous learning, the student is expected to read the notes and answer the corresponding questionnaire to identify the objectives to be achieved after the experiment. Prior to the experimentation, the teachers make an assessment through questions to the students that allows to identify the degree of autonomous learning achieved. The practice is performed in the Laboratory of Physiological Optics, building TR8, plant -2.

Specific objectives:
At the end of the activity the student should be able to:
- Understand the concepts of magnitude and sensation and their relationship.
- Verify Stevens’ law.

Material:
All material to perform the experiment in the laboratory and corresponding software (tutorial), detailed notes of the activity with the questionnaire and notes of the subject available in ATENEA.

Delivery:
Registration by the professor of the verification of autonomous learning of the student and of the work in the laboratory. The student submits the questionnaire with the results of the experiment at the end of the session. This is returned corrected and with the corresponding feedback from the professor.

Full-or-part-time: 2h
Laboratory classes: 2h

ACTIVITY 3: LABORATORIO. FUNCIÓN DE SENSIBILIDAD AL CONTRASTE

Description:
Activity to be done in the laboratory, in groups, with a duration of 2 hours. In the laboratory, the experimental part will be carried out, and as directed autonomous learning, the student is expected to read the notes and answer the corresponding questionnaire to identify the objectives to be achieved after the experiment. Prior to the experimentation, the teachers make an assessment through questions to the students that allows to identify the degree of autonomous learning achieved. The activity is performed in the Laboratory of Physiological Optics, building TR8, plant -2.

Specific objectives:
At the end of the activity the student should be able to:
- Understand the concept of contrast sensitivity function.
- Measure the contrast sensitivity function using different tests (sheets and specific PC program).

Material:
All material for the realization of the experiment in the laboratory and corresponding software, detailed notes of the activity with the questionnaire and notes of the subject are available in ATENEA.

Delivery:
Registration by the professor of the verification of autonomous learning of the student and of the work in the laboratory. The student submits the questionnaire with the results of the experiment at the end of the session. This is returned corrected and with the corresponding feedback from the professor.

Full-or-part-time: 2h
Laboratory classes: 2h
ACTIVITY 4: PHOTOMETRIC MAGNITUDES AND LIGHT SOURCES

Description:
Activity to be done in the laboratory, in groups, with a duration of 2 hours. In the laboratory, the experimental part will be carried out, and as directed autonomous learning, the student is expected to read the notes and answer the corresponding questionnaire to identify the objectives to be achieved after the experiment. Prior to the experimentation, the professor makes an assessment through questions to the students that allows to identify the degree of autonomous learning achieved. The practice is performed in the Laboratory of Physiological Optics, building TR8, plant -2.

Specific objectives:
At the end of the activity the student should be able to:
- Familiarize yourself with the radiometric and photometric concepts and magnitudes
- Understand the main features of light sources

Material:
All the material for the realization of the experiment in the laboratory and corresponding software, detailed notes of the activity with the questionnaire and notes of the subject are available in ATENEA.

Delivery:
Registration by the professor of the verification of autonomous learning of the student and of the work in the laboratory. The student submits the questionnaire with the results of the experiment at the end of the session. This is returned corrected and with the corresponding feedback from the professor.

Full-or-part-time: 2h
Laboratory classes: 2h

ACTIVITY 5: VISUAL PHENOMENA

Description:
Activity to be done in the laboratory, in groups, with a duration of 2 hours. In the laboratory, the experimental part will be carried out, and as directed autonomous learning, the student is expected to read the notes and answer the corresponding questionnaire to identify the objectives to be achieved after the experiment. Prior to the experimentation, the professor makes an assessment through questions to the students that allows to identify the degree of autonomous learning achieved.

Specific objectives:
At the end of the activity the student should be able to:
- Justify some visual phenomena from a neurophysiological point of view

Material:
All the material for the realization of the experiment in the laboratory and corresponding software, detailed notes of the activity with the questionnaire and notes of the subject are available in ATENEA.

Delivery:
Registration by the professor of the verification of autonomous learning of the student and of the work in the laboratory. The student submits the questionnaire with the results of the experiment at the end of the session. This is returned corrected and with the corresponding feedback from the professor.

Full-or-part-time: 2h
Laboratory classes: 2h
ACTIVITY 6: LUMINANCE THRESHOLDS

Description:
Activity to be carried out in the laboratory, in groups, with a duration of 2 hours. In the laboratory, the experimental part must be done, and as directed autonomous learning, the student is expected to read the notes and answer the corresponding questionnaire to identify the objectives to be achieved after the experiment. Prior to the experimentation, the professor will make an assessment by means of questions to the students that allows to identify the degree of autonomous learning achieved. The activity is done in the laboratory of Physiological Optics, building TR8, plant -2.

Specific objectives:
At the end of the practice the student must be able to:
Understand the concepts of absolute and differential threshold
Measure the absolute and differential threshold

Material:
All material for the accomplishment of the experiment in the laboratory and corresponding software (tutorial), detailed notes of the activity with the questionnaire and notes of the subject available in ATENEA.

Delivery:
Registration by the professor of the verification of autonomous learning of the student and of the work in the laboratory. The student submits the questionnaire with the results of the experiment at the end of the session. This is returned corrected and with the corresponding feedback from the professor.

Full-or-part-time: 2h
Laboratory classes: 2h

ACTIVITY 10: ACTIVITIES OF CONTINUOUS ASSESSMENT AND RESOLUTION OF DOUBTS IN CLASS

Description:
Activities related to the contents of the subject will be proposed, which will include problem solving in class, resolution of doubts in class, exams of continuous assessment (presential and non-presential) and participation on forums of doubts. Correction by PROFESSORS.

Material:
Theoretical notes, presentations, problems available through the ATENEA virtual campus and recommended bibliography.

Delivery:
Presentation of the exercise of each of the groups with the corresponding common evaluation for each of the groups. With corresponding feedback from professors and general reflection in the classroom on the most common mistakes and associated learning objectives that should be reinforced. It represents 10% of the final mark of the subject.

Full-or-part-time: 2h
Theory classes: 2h

ACTIVITY 7: FIRST TEST

Specific objectives:
At the end of the test the student should be able to:
Achieve the specific objectives of the contents 1-8

Material:
Theoretical notes and problems available through the ATENEA virtual campus and recommended bibliography.
Formulation of the questions and problems, calculator and set of formulas.

Delivery:
Resolution of the test. It represents 25% of the final mark of the subject.

Full-or-part-time: 2h
Theory classes: 2h
ACTIVITY 8: SECOND TEST

Specific objectives:
At the end of the test the student should be able to:
Achieve the specific objectives of the subject.

Material:
Theoretical notes and problems available through the ATENEA virtual campus and recommended bibliography.
Formulation of the questions and problems, calculator and set of formulas.

Delivery:
Resolution of the test. It represents 45% of the final mark of the subject.

Full-or-part-time: 2h
Theory classes: 2h

ACTIVITY 9: LABORATORY TEST

Description:
One-hour individual test. The test consists of solving issues seen in laboratory sessions

Specific objectives:
At the end of the test the student should be able to:
Achieve the specific objectives of the ACTIVITIES 1-6

Material:
Theoretical notes and problems available through the ATENEA virtual campus and recommended bibliography.
Formulation of the questions, calculator and set of formulas.

Delivery:
Resolution of the test. It represents 10% of the final mark of the subject.
The work in the lab during the experiments is another 10% of the final mark.

Full-or-part-time: 1h
Theory classes: 1h

GRADING SYSTEM

The final grade of the subject is obtained from the partial grades obtained in the first test, the second test, and the laboratory grade taking into account the following proportions:

Partial test mark: 25%
Final test note: 45%
Laboratory grade: 20%
Note on continuous assessment activities: 10%

The first test is an individual test that contains both theoretical questions related to the concepts studied in class and a section on problems. The concepts evaluated in this test are the specific objectives of contents 1, 2, 3, 4, 5, 6, 7, and 8.
The second test is an individual test that contains both theoretical questions related to the concepts studied in class and a section of more practical questions. The concepts evaluated in this test are the specific objectives of all the contents of the subject (1-13).
The laboratory grade is obtained from the grades obtained in the reports of each practice session and a final exam.
The mark of continuous evaluation is obtained from the resolution of activities that the teacher will propose throughout the course and from the participation in the forums of doubts.

EXAMINATION RULES

The attendance to the lab activities is mandatory.
BIBLIOGRAPHY

Basic:

Complementary: