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370526 - PSICOFISIC - Psychophysics and Neurophysiology of Vision

Coordinating unit: 370 - FOOT - Terrassa School of Optics and Optometry
Teaching unit: 731 - OO - Department of Optics and Optometry
Academic year: 2019
Degree: BACHELOR'S DEGREE IN OPTICS AND OPTOMETRY (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 7,5 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Jaume Pujol Ramo (http://futur.upc.edu/JaumePujolRamo)
Aurora Torrents Gomez (http://futur.upc.edu/AuroraTorrentsGomez)

Others: César Urtubia Vicario (http://futur.upc.edu/CesarurtubiaVicario)

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.

5. Technical english applied to optics and optometry

7. Establish protocols, analyze results and elaborate the corresponding reports

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.

13. Value the effects (perceptual changes) caused by the glasses, optical aids and protection elements in the visual system.

Generical:

14. Extract the main points of a text or any source of information (oral or written)

15. Synthesize and organize information to convey it effectively orally and / or written

16. Display information orally and in writing of reasonably and coherent.

17. Develop methods to encourage teamwork participation of its members, critical thinking, mutual respect, the ability to negotiate to achieve common goals
18. Define the general objectives and to carry out a specific group

19. Apply the principles of emotional intelligence to develop a teamwork

20. Flexibility to integrate into dynamic environments, multidisciplinary and multicultural.

21. Capacity to assume different roles within the team, leadership, coordination with other members

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22. Acquire communication techniques appropriate to ensure the success of teamwork
23. Assessing the acquisition of the course objectives.
24. Value the methods used to achieve the objectives.
25. Reflect and be able to make a critic of the knowledge and developed skills and the level of achievement.
26. Locate new information and the interpretation of it in its context.
27. Value and incorporate technological necessary improvements for the proper development of the profession
28. Encourage methodical work, rigorous, consistent and innovative
29. Working with evidence, methodology and rigour.

Teaching methodology

On the one hand the directed learning hours consist of lectures (large group / theory) in which the teachers make a brief introduction of general learning objectives related to the basic concepts of matter. Later, through practical exercises we try to motivate and engage the students to participate actively in their learning. It uses support material in the form of detailed syllabus by ATENEA: learning objectives for content, concepts, examples, programming and evaluation activities of learning and literature. On the other hand, the hours of learning also consist of classes of problems where you work, generally in groups of 3 to 4 members, by solving exercises and numerical problems, related with specific learning objectives of each course content. These sessions are intended to incorporate some problems generic skills such as teamwork competition. Therefore developed techniques for cooperative learning in the classroom.The last type of hours of learning activities is to perform laboratory work (small group / lab), which are held in small groups of people and can develop basic skills in a laboratory-type instruments of psychophysical and neurobiology of vision as well as the students started the application of scientific method in solving problems. In general, after each proposed tasks outside the classroom, to be working either individually or in groups. We must also consider other hours of independent learning such as those dedicated to the reading-oriented, solving proposed problems or self-study questionnaires through the contents of virtual campus Atenea.

Learning objectives of the subject

Understand the process of image formation and properties of optical systems.
Learn the basic models of vision.
Understand and handle basic laboratory equipment and techniques.
Understanding the basics and radiometric and photometric laws.
Knowing the parameters and eye models.
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.

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Study load

Total learning time: 180h	Hours large group:	0h	0.00%
	Hours medium group:	63h	35.00%
	Hours small group:	12h	6.67%
	Guided activities:	0h	0.00%
	Self study:	105h	58.33%

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Content

Introduction to phsychophysics and neurophysiology of vision

Learning time: 2h

Theory classes: 1h
Self study : 1h

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.

Psychophysical methods

Learning time: 12h

Theory classes: 3h
Laboratory classes: 2h
Self study : 7h

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.

The visual stimulus

Learning time: 18h

Theory classes: 6h
Laboratory classes: 2h
Self study : 10h

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.

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Dual nature of the retina

Learning time: 18h

Theory classes: 6h
Laboratory classes: 2h
Self study : 10h

Description:
In this content we work:

Range of operationof 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.

Color vision

Learning time: 17h

Theory classes: 5h
Laboratory classes: 2h
Self study : 10h

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.

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Anomalies of color vision	Learning time: 12h Theory classes: 4h Self study : 8h

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.
Acromatopsias and chromatopsias.
Tests of color vision.

Spatial vision	Learning time: 17h Theory classes: 6h Laboratory classes: 2h Self study : 9h

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

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Temporal vision	Learning time: 10h Theory classes: 4h Self study : 6h

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.

Basic neurophysiology	Learning time: 10h Theory classes: 4h Self study : 6h

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.

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Visual processing in the retina	Learning time: 15h Theory classes: 5h Self study : 10h

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.

Parallel processing	Learning time: 14h Theory classes: 4h Self study : 10h

Description:
In this content we work:

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

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Visual processing in the brain	Learning time: 20h Theory classes: 6h Laboratory classes: 2h Self study : 12h

Description:
In this content we work:

Cerebral cortex and brain areas.
Striated cortex.
Circumcised cortex.
Psychophysics and neurophysiology.
Clinical Considerations.

Related activities:
Activity 6 is carried out

Gross electrical potentials	Learning time: 8h Theory classes: 2h Self study : 6h

Description:
In this content we work:

Electrooculogram.
Electroretinogram.
Visual evoked potentials.

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Planning of activities

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

Hours: 2h
Laboratory classes: 2h

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.

Support materials:
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.

Descriptions of the assignments due and their relation to the assessment:
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.

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.

ACTIVITY 2: LABORATORIO. LEY DE STEVENS

Hours: 2h
Laboratory classes: 2h

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.

Support materials:
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.

Descriptions of the assignments due and their relation to the assessment:
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.

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.

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ACTIVITY 3: LABORATORIO. FUNCIÓN DE SENSIBILIDAD AL CONTRASTE

Hours: 2h
Laboratory classes: 2h

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.

Support materials:
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.

Descriptions of the assignments due and their relation to the assessment:
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.

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).

ACTIVITY 4: PHOTOMETRIC MAGNITUDES AND LIGHT SOURCES

Hours: 2h
Laboratory classes: 2h

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.

Support materials:
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.

Descriptions of the assignments due and their relation to the assessment:
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.

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

ACTIVITY 5: VISUAL PHENOMENA

Hours: 2h
Laboratory classes: 2h

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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.

Support materials:
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.

Descriptions of the assignments due and their relation to the assessment:
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.

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

ACTIVITY 6: LUMINANCE THRESHOLDS	Hours: 2h Laboratory classes: 2h

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.

Support materials:
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.

Descriptions of the assignments due and their relation to the assessment:
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.

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

ACTIVITY 10: ACTIVITIES OF CONTINUOUS ASSESSMENT AND RESOLUTION OF DOUBTS IN CLASS	Hours: 2h Theory classes: 2h

Description:
Activities related to the contents of the subject will be proposed, which will include critical readings of scientific articles, problem solving in class, resolution of doubts in class, etc. Correction by PROFESSORS.

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

Descriptions of the assignments due and their relation to the assessment:
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 5% of the final mark of the subject.

Specific objectives:
Presentation of the brief summary of the article, the resolution of problems, etc. With corresponding feedback from professors and general reflection in the classroom on the most common mistakes and associated learning objectives that should be reinforced.

ACTIVITY 7: FIRST TEST	Hours: 2h Theory classes: 2h

Description:
Individual test of two hours of duration. The test consists of a theoretical part where questions are formulated concerning theoretical concepts of the contents given in class and in a practical part, where several problems have to be solved.

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

Descriptions of the assignments due and their relation to the assessment:
Resolution of the test. It represents 40% of the final mark of the subject.

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

ACTIVITY 8: SECOND TEST	Hours: 2h Theory classes: 2h

Description:
Individual test of two hours of duration. The test consists of a theoretical part where questions are formulated concerning theoretical concepts of the contents given in class and in a practical part, where several problems have to be solved.

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

Descriptions of the assignments due and their relation to the assessment:
Resolution of the test. It represents 35% of the final mark of the subject.

Specific objectives:
At the end of the test the student should be able to:
· Achieve the specific objectives of the contents 9-13

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ACTIVITY 9: LABORATORY TEST	Hours: 1h Theory classes: 1h

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

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

Descriptions of the assignments due and their relation to the assessment:
Resolution of the test. It represents 10% of the final mark of the subject.

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

Qualification system

The final grade for the course comes from the partial marks obtained in the first test, the second test, and laboratory mark considering the following proportions:

Mark partial test: 40%
Mark final test: 35%
Laboratory mark: 20%
Mark continuous evaluation: 5%

The first test is an individual test of 2 hours. It contains theoretical questionnaires related to the concepts studied in class and a section of problems. The concepts evaluated in this test are the specific objectives of the contents 1,2,3,4,5,6, 7 and 8.
The second test is an individual test of 2 hours. It contains theoretical questionnaires related to the concepts studied in class and a section of problems. The concepts evaluated in this test are the specific objectives of the contents 9, 10, 11,12 and 13.

The score from the laboratory is obtained from the laboratory work (independent learning, performing experiments, the script activity questionnaire), and an exam.

The continuous evaluation score is obtained from resolution of problems in class and deliverables proposed along the course.

Regulations for carrying out activities

The attendance to the lab activities is mandatory.

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