Universidad Zaragoza

Academic Year/course: 2024/25

26804 - Visual Optics I

Syllabus Information

Academic year: 2024/25
Subject: 26804 - Visual Optics I
Faculty / School: 100 - Facultad de Ciencias
Degree: 297 - Degree in Optics and Optometry
ECTS: 12.0
Year: 1
Semester: Annual
Subject type: Basic Education
Module:

1. General information

The more general objective is to understand the functioning of the human eyeball as an optical instrument forming images, as the first important stage of visual perception, and to study the quality of the images obtained with it. The subject is part of the Basic Module of the study plan of Optics and Optometry, dedicated to the student to be able to know and apply the concepts, principles, laws, models and theories of the different basic scientific disciplines. It is interesting that the students have studied Science and Technology in the Baccalaureate, and within it, the subjects of mathematics and physics.

2. Learning results

Use the notation and units of geometric optics with rigor and skill.

Handle analytically and graphically the fundamental laws of light propagation at the interface of two media.

Calculate the basic optical properties (first order) of an optical system from its geometrical and material characteristics

Calculate the position and size of the dioptric image and the object when transformed by an optical system.

Solve both accommodated and unaccommodated theoretical eyes.

Determine the type of ametropia present in an eye, as well as how to neutralize it.

Quantitatively determine the dimensions and quality of the retinal image of the compensated and uncompensated eye.

Recognize the concept of visual acuity and contrast sensitivity.

Calculate the deflection and effect of a prism on the propagation of light.

3. Syllabus

TOPIC 0. The nature of light and its interaction with matter.

TOPIC 1. Optically smooth surfaces. Snell's law for refraction and reflection of a light ray.

TOPIC 2. Refraction of light beams. The imaging process and surface geometry of media separation.

TOPIC 3. Paraxial approximation of Snell's law. The Maxwellian paraxial image formation process: the focal and the law of Gauss.

TOPIC 4. Gauss's law in centred systems of 2 paraxial spherical diopters. The two diopter system: The optically thick lens. Analysis and ray tracing.

TOPIC 5. The approximation of optically thick lens to optically thin lens. Thin lens paraxial optical systems: Analysis and ray tracing.

TOPIC 6. The equivalent optical systems for n-element systems (diopters or thin lenses). The optical system of 4 diopters.

TOPIC 7. Refraction in elements with non-parallel flat faces. Optical prisms.

TOPIC 8. Reflection of ray beams. The image formation process and the geometry of the specular surface.

TOPIC 9. Ray limitation: aperture and field diaphragms.

TOPIC 10. - Retinal image of a misaligned eye.

TOPIC 11. Optical quality of the retinal image.

TOPIC 12. - Accommodation.
TOPIC 13. Optical compensation of spherical ametropia.
TOPIC 14. Ocular astigmatism.

4. Academic activities

Training Activity 1: Acquisition of basic knowledge on Geometrical and Physiological Optics (7 ECTS).
Methodology:

- Participative master classes in large groups.
- Tutorials (small groups and/or individualized)
- Self-learning: viewing of videos and use of programs for ray tracing in the lens-eye system.

Exam preparation and performance.

Training Activity 2: Problem solving and case study analysis (2 ECTS)
Methodology:

- Learning based on case studies analysed in small groups.
- Learning based on analysis and resolution of problems posed in Moodle.
- Group and individual work.

Preparation of reports with results of proposed problems and case studies.
Preparation and performance of midterm tests.

Training Activity 3: Acquisition of practical knowledge, skills and abilities in Ocular Optics (3 ECTS)
Methodology:

- Laboratory practices in small groups.

List of the 11 practices:
0. Optical characterization of refracting diopters.
1. Characterization of optically thick lenses.
2. Imaging by means of principal planes and thin lens approach.
3. Imaging with thin negative lens and composite systems.
4. Refraction of light by a regular astigmatic lens.
5. Eye simulation on bench and with OSLO EDU.
6. Real eye simulation with OSLO EDU.
7. Simulation of ametropia and its compensation in the reduced eye on an optical bench.
8. Simulation of ametropia with digital video camera.
9. Ametropia compensation in digital video camera.
10. Simulation of the accommodation process with digital video camera.

- Group and individual work: preparation of reports.

The teaching and evaluation activities will be carried out face-to-face unless, due to the nature of the health situation, the provisions issued by the competent authorities and by the University of Zaragoza make it compulsory to perform them telematically or semi-telematically with rotating reduced capacity.

5. Assessment system

Evaluation for face-to-face students:

1.Evaluation of laboratory practices

The evaluation will be carried out by means of the presentation of a report for each of the practices elaborated (individually or in groups) during the development of the same and/or the realization of two objective tests (multiple choice), one at the end of the first semester (practices 0 to 4) and another at the end of the second semester (practices 5 to 10).

The grade for the practices will be from 0 to 10 points and will be obtained as the average of all the grades achieved. The grade of the practices will constitute 20% of the final grade of the subject and a minimum grade of 5 points will be required to pass the subject.

2. Evaluation of the knowledge acquired in the theoretical and practical classes

Two written mid-term exams in February and May/June respectively. The written tests will consist of a part of problem solving and another part of resolution of theoretical multiple choice questions. For the calculation of the final midterm grades the same weight will be given to the theory part and to the problems.

In the event that a student achieves a grade of 4 or higher on the February test, that grade may, if desired, be saved for averaging with the grade of the evaluation test to be taken in May/June with respect to the knowledge imparted in the theoretical-practical classes of the second semester.

In the event that the student achieves a grade of less than 4 on the February test, the student will be required to retake the test in May/June or July

Likewise, the teacher will propose during the term the realization of several voluntary exercises that may increase (in the case of passing) the final grade by up to 4 points.

3. Final grade of the subject

In the event that the grade of the laboratory practices is greater than or equal to 5, the final grade of the subject will be the sum of 80% of the evaluation of the theoretical-practical classes + 20% of the evaluation of the laboratory practices.

The results of the last midterm exams with a minimum grade of PASSED (grade of 5 points or higher) will be saved for the July exam.

Evaluation for non-face-to-face students:

1. Final exam of the laboratory practices: by performing the experimental set-up and writing a report with concrete numerical and graphical results of several parts of different practices of all those performed during the term.

The exam will be graded from 0 to 10 points and it is essential to obtain at least 5 points in order to pass the exam of laboratory practices. This grade will constitute 20% of the final grade.

2. Final written test: final exam consisting of two parts, corresponding to the two midterm tests described for on-site students, with the same contents and evaluations. Students must pass both parts in order to pass the final exam. This grade will constitute 80% of the final grade.

The results of the last partial midterm tests with a minimum grade of PASSED (grade of 5 points or higher) will be saved for the July exam.

6. Sustainable Development Goals

3 - Good Health & Well-Being