VNIVERSITAT DE VALÈNCIA

# Course Guide
# 34294 Physiological optics

## COURSE DATA

| Data Subject | |
|---|---|
| **Code** | 34294 |
| **Name** | Physiological optics |
| **Cycle** | Grade |
| **ECTS Credits** | 6.0 |
| **Academic year** | 2018 - 2019 |

**Study (s)**

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1207 - Degree in Optics and Optometry | Faculty of Physics | 1 | Second term |

**Subject-matter**

| Degree | Subject-matter | Character |
|---|---|---|
| 1207 - Degree in Optics and Optometry | 9 - Physiological optics | Obligatory |

**Coordination**

| Name | Department |
|---|---|
| DIEZ AJENJO, MARIA AMPARO | 280 - Optics and Optometry and Vision Sciences |
| MICO SERRANO, VICENTE | 280 - Optics and Optometry and Vision Sciences |

## SUMMARY

The subject of Physiological Optics is responsible for explaining the fundamentals of optometry from a theoretical point of view. This subject requires basic knowledge of both ocular anatomy and treatment of optical systems, knowledge acquired by the student in the subjects of human and eye anatomy (anatomía humana y ocular) and geometric optics (óptica geométrica).

The first topic will be devoted to the adaptation and particularization of equations and concepts used in Geometric Optics for its application, in the future, to the concrete case of the human eye. With these tools, we will define and compare different models of theoretical eye, and develop the necessary calculations to get to obtain the equivalent system of the eye. Thus, the complexity of surfaces and indices of refraction that form the optical system of the eye, will be reduced to the main points and foci of a single equivalent system, so called because the image calculated through this unique system is equivalent to what would be obtained with the calculations that were made through each and every one of the dioptric surfaces that constitute the optical system of the complete eye. Also we will obtain, the positions and diameters of the pupils of entrance and exit of the eye by its utility for multiple later applications

We will begin the following topics with the definition and description of the functioning of the emmetropic eye at rest, without capacity for accommodation, to study then the accommodation and its variation with age until reaching presbyopia. Presbyopia and its optical correction and the calculation of the clear vision intervals of the eye with and without the corrective lens are the latest knowledge exposed in this section

The different spherical ametropia of the healthy eye is studied in detail in the following topics. A description and complete analysis of the myopic eye operation is made and then the same process is followed to study the hyperopic eye. With each of these eyes, as was also done with the concept of emmetropic eye, the calculation of the unfocused image is made of both a point and an extensive object. This allows us to define a sharpness or blur factor in an unfocused image.

Finally, we will devote more time to the study and management of the astigmatic eye, not only because learning this ametropia (not spherical) requires more effort, but also because this last phase of the subject serves as a summary and general review of the main concepts introduced. throughout the course.

## PREVIOUS KNOWLEDGE

### Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

### Other requirements

Geometric optics: provides the mathematical tools of the subject.
Human and ocular anatomy: it provides the anatomical knowledge with which it is going to work.

## OUTCOMES

### 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 recognize the eye as an optical system.

- To know the ocular parameters and models.
- To understand the factors that limit the quality of the retinal image.
- To know and to understand the principles of compensation through ophthalmic lenses and other techniques.
- To know the basic models of vision.

## LEARNING OUTCOMES

- Distinguish perfectly the different ametropia that a healthy eye can have

- Know how to correct them using compensating lenses

- Be able to solve any type of calculation with the eye: size of an image, entrance pupil, etc.

- To be able to determine the Visual Acuity of an eye to know if its visual capacity is normal or not.

- Know in what conditions the previous AV determinations must be made to be correct.

- Have the ability to analyze, interpret and treat the particularities of each eye that is examined

## DESCRIPTION OF CONTENTS

### 1. Geometric optics applied to the eye

An adaptation of the equations of the paraxial optics seen in the subject of geometric optics to the eye will be made. Proximities and dioptric powers, main power and equivalent dioptric power will be calculated. The formulas of step or effectiveness and the formulas of coupling of systems will also be reformulated.

### 2. Theoretical eye

all the knowledge developed in the previous topic will be applied to define the human eye as an optical system. The approximations that must be made to obtain a theoretical eye model will be introduced and some well-known and well-known theoretical eye models will be analyzed, such as the Le Grand theoretical eye model, the simplified theoretical eye of Gullstrand and the reduced eye models.

### 3. The emmetropic eye

In section 3 the concept of emmetropic eye will be explained and the concepts of remote point and retinal image of a point and a focused and unfocused extended object, the degree of sharpness or blurring, the depth of field and the concepts of cathoptic and entoptics images.

## 4. Accommodation and presbyopia

the concept of amplitude of accommodation and sharp vision intervals (IVN) will be addressed. The modifications of the eye during the accommodation will be analyzed and how these changes affect a theoretical eye model, the size of the retinal image, the pseudo-image and the blurring circle. We will also study the decrease in the amplitude of accommodation with age

## 5. Spherical ametropia

It will define, classify and formulate spherical ametropia. We will discuss the concepts of axial and refractive ametropia and how spherical ametropia affects IVN and in combination with accommodation.

## 6. Compensation of ametropias

It will address how patients with spherical ametropia will be decompensated and how compensation for the concepts of pupil entry, increased retinal image and amplitude of accommodation. It will also combine the concept of compensation of ametropia and presbyopia and the tolerance of the compensation

## 7. Astigmatism

the concept of astigmatism will be worked on. We will analyze its anatomical origin, the different definitions and classifications, and how is the vision of an astigmatic eye taking into account concepts such as the size of the retinal image, the accommodation and the necessary optical compensation for an astigmatic eye.

## 8. The quality of the image. Visual acuity.

the concept of visual acuity (AV) understood as a measure of the optical quality of the eye will be worked on. The limits of spatial vision and the resolution power of the eye will be analyzed. Different scales of AV specification will be defined as well as the different tasks that affect the VA and the optotypes to measure it. All these concepts will be related to the distribution of photoreceptors in the retina, the visual field and the aberrations of the eye.

## 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 |
| Study and independent work | 20,00 | 0 |
| Resolution of case studies | 10,00 | 0 |
| **TOTAL** | **100,00** | |

## TEACHING METHODOLOGY

Theoretical and practical classes are addressed the conceptual and formal matter. They are based mainly on lectures and use dialogued teaching tools as experimental demonstrations, animations or videos, projection of presentations, etc. Also develop application exercises theoretical practice. In some particular cases is planned use the computer lab.

Seminars: These sessions are focused on student work and active participation of an individual or group in the resolution of questions arising from the theoretical and practical classes and will also serve to reinforce concepts more difficult. They are also classes for problem solving is intended to exercise the tools presented in the theoretical and practical classes. In these types of classes will seek interactivity group through oral presentations.

Laboratory offers the student was mounted on an optical bench different eye types. It is intended to recognize each eye ametropia and analyze the possible proposed corrective lenses, also learn how to determine the intervals of clear vision with or without corrective lens.

## EVALUATION

The evaluation system of this subject will be based on:

A) Written evaluation, through exercises of theoretical questions that allow to verify the assimilation of theoretical foundations of the subject and theoretical-practical issues where the students' ability to carry out real applications of the studied techniques and models is evaluated. The critical capacity of the student will be evaluated, as well as the correctness of the argumentation and justifications proposed.

To carry out this evaluation, questions of true / false type, questions of practical application of the theory and even questions of test type can be used where the wrong answer of any of the questions will subtract part of the questions answered correctly.

The written evaluation represents 70% of the final grade and, to make it average with the other evaluation modalities, it will be necessary to obtain a minimum of 4 points out of 10.

B) Practical evaluation, through laboratory tests. In this case, both the skill and ability of the student and the ability to adapt to the different cases that may arise in real life will be evaluated.

The practical evaluation represents 20% of the final grade of the subject and it will be necessary to obtain a minimum score of 4 points out of 10 to make it average with the rest of the evaluation modalities.

C) Continuous evaluation, established from different indicators, such as interactive in the classroom. The practical part of the subjects, through the weekly monitoring card, which allows analyzing the evolution of the student's skills in the laboratory.

The continuous evaluation represents 10% of the total grade of the subject and no minimum grade will be necessary to do the average with the other evaluation modalities.

## REFERENCES

### Basic

- 10.1 Referencias Básicas

Referencia b1: Keating M.P. Geometric, Physical and Visual Optics. London, UK, Butterworths, 1988.
Referencia b2: Bennet A.G. i Rabbets R.B.. Clinical Visual Optics. Butterworth-Heineman.
Referencia b3: Artigas J.M. , Capilla P., Felipe A. y Pujol J. Óptica Fisiológica: Psicofísica de la Visión. McGrau-Hill Interamericana.
Referencia b4: Lull humà com a sistema òptic, Camps V, Coloma P, Verdú FM, Viqueira V, de Fez D. Publicacions de la Universitat dAlacant. Edició 2011. ISBN:978-84-9717-147-2

### Additional

- 10.2 Referencias Complementarias

Referencia c1: Le Grand Y. Óptica Fisiológica I. Ed. Sociedad Española de Optometría.
Referencia c2: Capilla P., Pujol J. . Problemes dÓptica Fisiológica. Ed. UPC.
Referencia c3: Romero J., García J., García A. . Curso de Introducción a la Óptica Fisiológica.. Ed. Comares.
Viqueira Pérez V. y otros. Óptica Fisiológica: Modelo paraxial y compensación óptica del ojo. Publicaciones Universidad de Alicante. (2003)