

## FUNDAMENTALS OF ENGINEERING OPTICS

### 20012 - FUNDAMENTALS OF ENGINEERING OPTICS (2024-25)

#### General

**Code:** 20012

**Lecturer responsible:**

PUERTO GARCIA, DANIEL

**Credits ECTS:**

**6,00**

Theoretical credits:

1,20

Practical credits:

1,20

Distance-base hours:

3,60

#### Departments involved

- **Dept:** PHYSICS, ENGINEERING SYSTEMS AND SIGNAL THEORY

**Area:** APPLIED PHYSICS

**Theoretical credits:** 1,2

**Practical credits:** 1,2

This Dept. is responsible for the course.

This Dept. is responsible for the final mark record.

#### Study programmes where this course is taught

- [DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING](#)  
Course type: COMPULSORY (Year: 2)
- [UNIVERSITY MASTER'S DEGREE IN TELECOMMUNICATION ENGINEERING](#)  
Course type: COMPLEMENTARY TRAINING (Year: 1)  
Course type: COMPLEMENTARY TRAINING (Year: 9)

## Competencies and objectives

### Course context for academic year 2024-25

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It is recommended that this subject be taken after passing the following subjects:

- Physical Fundamentals of Engineering I.
- Physical Fundamentals of Engineering II.
- Mathematics I.

The course aims to provide students with an understanding of the physical principles of electromagnetic waves in the specific case of the visible part of the spectrum.

The fundamentals of reflection, refraction, diffraction, interference and polarisation of electromagnetic waves are explained, as well as the laws that develop them.

On the other hand, the sources of light emission and the different lighting systems will be analysed, as well as the radiometric characteristics, and their photometric equivalent, and the principles of colorimetry, applied to different systems.

The subject consists of different face-to-face and non-face-to-face activities. The face-to-face activities are theoretical classes and practical classes of problems and laboratory. In all activities, both individual and group work will be carried out.

The activities corresponding to the theory and practical problem classes will be carried out in the classroom, while the practical laboratory classes will take place in the Optics Laboratory located on the ground floor of the EPS III.

## Course content (verified by ANECA in official undergraduate and Master's degrees) for academic year {0}

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### UA Basic Transversal Competences

- **CT11** : Capacitat d'aprendre i aplicar, de manera autònoma i interdisciplinària, nous conceptes i mètodes.
- **CT13** : Capacitat d'adoptar el mètode científic en el plantejament i realització de treballs diversos tant en l'àmbit acadèmic com en el professional.
- **CT14** : Disposar de la capacitat d'autocrítica necessària per a l'anàlisi i millora de la qualitat d'un projecte.
- **CT6** : Capacitat d'utilitzar la llengua anglesa amb fluïdesa per a accedir a la informació tècnica, respondre a les necessitats de la societat, i poder ser autosuficient en la preparació de la seua vida professional.
- **CT7** : Capacitat d'exposició oral i escrita.
- **CT8** : Capacitat de planificar tasques i comprometre's en el compliment d'objectius i terminis.
- **CT9** : Capacitat de treball en grup.

### Specific Competences:>>Basic

- **B3** : Comprensió i domini dels conceptes bàsics sobre les lleis generals de la mecànica, termodinàmica, camps i ones i electromagnetisme i la seua aplicació per a la resolució de problemes propis de l'enginyeria.

### Basic Transversal Competences

- **CT3** : Que els estudiants tinguen la capacitat de reunir i interpretar dades rellevants (normalment dins de la seua àrea d'estudi) per a emetre judicis que incloguen una reflexió sobre temes rellevants d'índole social, científica o ètica.
- **CT5** : Que els estudiants hagen desenvolupat aquelles habilitats d'aprenentatge necessàries per a emprendre estudis posteriors amb un alt grau d'autonomia.

### Specific Competences: >> Competences Common to the Telecommunications Branch

- **C15** : Coneixement de la normativa i la regulació de les telecomunicacions en els àmbits nacional, europeu i internacional.
- **C3** : Capacitat per a utilitzar eines informàtiques de recerca de recursos bibliogràfics o d'informació relacionada amb les telecomunicacions i l'electrònica.

### Specific Competences: >> Competences Specific to Sound and Image

- **E3** : Capacitat per a realitzar projectes de locals i instal·lacions destinats a la producció i enregistrament de senyals d'àudio i vídeo.
- **E5** : Capacitat per a crear, codificar, gestionar, difondre i distribuir continguts multimèdia, atenent criteris d'usabilitat i accessibilitat dels serveis audiovisuals, de difusió i interactius.

### Exclusive skill taught in this course

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No data

### Learning outcomes (Training objectives)

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No data

## Specific objectives stated by the academic staff for academic year 2024-25

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The student acquires the basic knowledge of the fundamental principles and laws of optics.

To know the mechanisms of electromagnetic wave propagation in different media.

To accustom the student to use a suitable method of reasoning to be able to apply knowledge of optics to the solution of communication problems in the field of telecommunications.

To adequately analyse the results obtained in the laboratory practices, identifying the strategies to be followed in the different measurement methods and techniques.

Correctly use bibliographic resources and different sources of information in order to keep up to date with the subjects related to the course.

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## Content for academic year 2024-25

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### **Item 1: Historical Introduction**

1. Definition of Optics.
2. Electromagnetism and optics.
3. Importance of Optics in Engineering.

### **Item 2: Geometrical Optics**

1. Introduction.
2. Basic concepts and principles. Paraxial approximation.
3. Raytracing of optical elements (lenses, mirrors and dioptrios).
4. Ray tracing in optical systems.
5. Applications.

### **Item 3: Wave Optics**

1. Introduction: Wave Motion.
2. Fermat principle.
3. Reflection and refraction.
4. Fresnel formulas.
5. Total Reflection: examples.
6. Interference.
7. Diffraction Limit of resolution, diffraction gratings.
8. Applications.

### **Item 4: Electromagnetic Optics**

1. Introduction: Electromagnetic waves.
2. Polarization of Light: Law of Malus.
3. Polarization ellipse.
4. Methods of polarization.
5. Jones matrices.
6. Propagation of light in anisotropic media.
7. Applications.

### **Item 5: Radiometry and Photometry**

1. Radiometry. Basic magnitudes.
2. Radiation sources and receivers.
3. Spectral sensitivity curve. Luminous efficiency.
4. Photometry. Basic magnitudes.

### **Item 6: Light sources**

1. Conventional light sources.
2. Unconventional light sources.
3. Spectral and spatial characterization of light sources.
4. Power Laser Light: resonant cavity modes, spatial and temporal coherence of laser types.
5. Regulations.

### **Item 7: Lighting systems**

1. Types of light.
2. Qualities of light.
3. Lighting objects.
4. Regulations.

### **Item 8: Colorimetry**

1. Appearance of color.
2. Principles of colorimetry.

3. Measure color.
4. Reproduction in color.
5. Regulations.

#### **Item 9 Applications of optical engineering**

1. Holographic storage of information.
2. Optical storage of information.
3. Applications of different types of conventional light sources and unconventional.
4. Applications of the optical fiber.
5. Applications of the anisotropic media.
6. Characteristics and applications of the LEDs.
7. Colorimetric characterization of digital cameras.
8. Characterization of graded index optical fiber.
9. Characterization and applications of laser emission sources.
10. Color discrimination in the human visual system.
11. Lighting effects in digital recordings.
12. Polarized light, characteristics and applications.
13. Models of vision and color appearance
14. Properties and photographic performance projection systems and instruments.
15. Radiometry, importance and applications.
16. Lighting systems via optical fiber (operating, state of the art and business)
17. Techniques for three dimensional viewing.
18. Physical principle of luminescence emission and applications.
19. Dispersion shifted fibers.
20. Principle and emission Helium Neon laser.
21. Principle of operation of interferometers: applications.

#### **Listings of practical activities in the sessions listed in the schedule**

Session 1 through 4:

- Refraction and reflection of light.
- Focal of a diverging lens.

Session 5-10:

- Diffraction of light.
- Interference of light waves.
- Determination of the the Brewster angle.
- Light polarization, Malus Law.
- Pointwise focuses. First law of Lambert.

#### **Related links**

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No data

### 100 problemas de óptica

**Author(s):** MEJÍAS, Pedro M. ; MARTINEZ- HERRERO, Rosario

**Issue:** Madrid : Alianza, 1996;

**ISBN:** 84-206-8632-8

**Category:** Sin especificar

### Física para ingeniería y ciencias. Vol. 2: con física moderna

**Author(s):** Bauer, Wolfgang

**Issue:** México : McGraw Hill, 2011;

**ISBN:** 978-607-15-0546-0 (v.2)

**Category:** Básico

### Fundamentos de óptica para ingeniería informática

**Author(s):** Beléndez Vázquez, Augusto

**Issue:** San Vicente del Raspeig : Universidad de Alicante, 1996;

**ISBN:** 84-7908-278-X

**Category:** Sin especificar

### Óptica

**Author(s):** Casas Peláez, Justiniano

**Issue:** Zaragoza : Librería Pons, 1994;

**ISBN:** 84-605-0062-4

**Category:** Sin especificar

## Assessment

### Assessment procedures and criteria 2024-25

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In continuous assessment: It is necessary that the final grade of Block 1 and Block 2 is greater than or equal to 4 out of 10 to pass the subject.

Grade = 45% (Block 1) + 25% (Block 2) + 10% (Block 3) + 15% (Block 4) + 5% (Block 5).

If the final mark of the continuous assessment is greater than or equal to 5, the course is passed.

If the mark obtained in the continuous assessment is lower than 5, the student must take the ordinary final exam of the totality of the contents of the course. For this exam, the marks of all the blocks will be kept.

Final mark = 50% (Final exam mark) + 50% (Continuous assessment).

Extraordinary final exam (July and December)

In the extraordinary exams the following relation will be applied:

Final mark = 50% (Final exam mark) + 50% (Continuous assessment).

Recoverable:

Grades of blocks 1, 3 and 4 (completion of 2 additional problems in the extraordinary final exam).

Qualification of the Laboratory Practical Reports (completion of a final practical exam).

Not recoverable:

Block of Transversal Competences.

Completion of the laboratory practicals, practical poster and exhibition.

Theoretical and practical work must be original. The detection of copying or plagiarism will result in a grade of "0" in the corresponding test. The management of the Department and the Polytechnic School will be informed of this incident. Repeated misconduct in this or any other subject will lead to the corresponding vice-rectorate being notified of the misconduct so that they can study the case and impose sanctions in accordance with current legislation.

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Description	Criteria	Type	Weighting system
Block 1: Evaluations of theory	<p>It consists of multiple choice exams and problem solving applied to engineering.</p> <p>It is necessary that the final note of this block is greater than or equal to 4 out of 10 to pass the subject of ongoing evaluation.</p> <p>- Week 6: Class theory: Test + questions Unit 2 and 3</p> <p>- Week 10: Class theory: Test + questions Unit 4</p> <p>- In January Exam- Test + questions Units 5, 6, 7, 8</p>	ACTIVITIES OF EVALUATION DURING THE SEMESTER	45
Block 2: Laboratory sessions	<p>Each practice is carried out for 2 sessions. The reports of practice are delivered in the format indicated in each script in the second session of each practice. Practices are individually delivered by the Virtual Campus.</p> <p>The final grade will be 60% memories practices and 40% oral presentation of a practice assigned by the teacher. For the oral presentation the maximum number of members of each group will be two.</p> <p>The oral presentation will take place in sessions 9 and 10.</p> <p><b>It is necessary that the final note of this block is greater than or equal to 4 out of 10 to pass the course.</b></p>	ACTIVITIES OF EVALUATION DURING THE SEMESTER	25
Block 3: Questions practices	<p>It consists of the delivery problems that during the problems classes.</p> <p>-Week 3: Practice problems: Delivery of problems done in class</p> <p>- Week 9: Practice problems: Delivery of problems done in class.</p> <p>- Week 14: Practice problems: Delivery of problems done in class.</p>	ACTIVITIES OF EVALUATION DURING THE SEMESTER	10

Bloque 4: Oral presentation and work in group	<p>The possible fields for the work are: Applications of the anisotropic media. Different light sources, characteristic and applications. Radiometry, importance and applications. Colorimetry.</p> <p>Week 2: Formation and coordination of working groups (2 students per group).</p> <p>Week 5: Discussion with the lecturer to orientate and clarify the work.</p> <p><b>Week 9:</b> Submission of the final work, in pdf by email.</p> <p><b>Week 11:</b> Oral presentation of a poster with free format during 5 minutes.</p> <p>The works that are web copies or publications will not be qualified.</p>	ACTIVITIES OF EVALUATION DURING THE SEMESTER	15
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Block 5: Transferable skills	<p>All activities will be evaluated:</p> <ul style="list-style-type: none"> <li>-Punctuality, attendance and class participation.</li> <li>-Ability to work in groups.</li> <li>-Compliance with deadlines.</li> <li>-Capacity of writing: spelling, legibility and order documents.</li> </ul>	ACTIVITIES OF EVALUATION DURING THE SEMESTER	5
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## Official exam dates for academic year 2024-25

Exam session	Date	Time	Group - Classroom(s) allocated	Comments
(C2) Periodo ordinario para asignaturas de primer semestre	24/01/2025			Teoría
(C4) Pruebas extraordinarias para asignaturas de grado y máster	27/06/2025			Teoría

## Academic staff



### PUERTO GARCIA, DANIEL

Lecturer responsible

LAB PRACTICALS: Groups: 1, 2, 3

PROBLEM PRACTICALS / WORKSHOP: Groups: 1



### ALVAREZ LOPEZ, MARIELA LAZARA

THEORY CLASS: Groups: 2

PROBLEM PRACTICALS / WORKSHOP: Groups: 2



**NEIPP LOPEZ, CRISTIAN**

THEORY CLASS: Groups: 1

## Groups

### THEORY CLASS

Group	Semester	Morning or afternoon session	Language	No. of enrolled students	
Gr. 1 (THEORY CLASS) : 1 (ARA)	1S	Afternoon	English	8	<ul style="list-style-type: none"><li>▪ Allowed INTERNATIONAL MOBILITY PROGRAMME</li><li>▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING</li></ul>
Gr. 2 (THEORY CLASS) : 2	1S	Morning	Spanish	32	

### LAB PRACTICALS



Group	Semester	Morning or afternoon session	Language	No. of enrolled students	
Gr. 1 (LAB PRACTICALS) : 1 (ARA)	1S	Afternoon	English	8	<ul style="list-style-type: none"><li>▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING</li><li>▪ Allowed INTERNATIONAL MOBILITY PROGRAMME</li></ul>
Gr. 2 (LAB PRACTICALS) : 2	1S	Morning	Spanish	16	
Gr. 3 (LAB PRACTICALS) : 3	1S	Morning	Spanish	16	

### PROBLEM PRACTICALS / WORKSHOP















Group	Semester	Morning or afternoon session	Language	No. of enrolled students	
Gr. 1 (PROBLEM PRACTICALS / WORKSHOP) : 1 (ARA)	1S	Morning	English	8	<ul style="list-style-type: none"><li>▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING</li><li>▪ Allowed INTERNATIONAL MOBILITY PROGRAMME</li></ul>
Gr. 2 (PROBLEM PRACTICALS / WORKSHOP) : 2	1S	Morning	Spanish	32	

## Timetables

### THEORY CLASS


Group	Start date	End date	Day	Start time	End time	Lecture room
1	09/09/2024	20/12/2024	LUN	16:00	18:00	<a href="#">0016P2008</a> 
2	09/09/2024	20/12/2024	MAR	08:30	10:30	<a href="#">A2/C02</a> 

### LAB PRACTICALS

Group	Start date	End date	Day	Start time	End time	Lecture room
1	19/09/2024	03/10/2024	JUE	15:00	16:30	<a href="#">0014PB064</a> 
1	17/10/2024	24/10/2024	JUE	15:00	16:30	<a href="#">0014PB064</a> 
1	07/11/2024	07/11/2024	JUE	15:00	16:30	<a href="#">0014PB064</a> 
1	21/11/2024	28/11/2024	JUE	15:00	16:30	<a href="#">0014PB064</a> 
1	12/12/2024	19/12/2024	JUE	15:00	16:30	<a href="#">0014PB064</a> 
2	23/09/2024	23/09/2024	LUN	08:30	10:00	<a href="#">0014PB064</a> 
2	30/09/2024	30/09/2024	LUN	08:30	10:00	<a href="#">0014PB064</a> 
2	14/10/2024	04/11/2024	LUN	08:30	10:00	<a href="#">0014PB064</a> 
2	18/11/2024	25/11/2024	LUN	08:30	10:00	<a href="#">0014PB064</a> 
2	09/12/2024	16/12/2024	LUN	08:30	10:00	<a href="#">0014PB064</a> 
3	23/09/2024	30/09/2024	LUN	13:00	14:30	<a href="#">0014PB064</a> 
3	14/10/2024	04/11/2024	LUN	13:00	14:30	<a href="#">0014PB064</a> 
3	18/11/2024	25/11/2024	LUN	13:00	14:30	<a href="#">0014PB064</a> 
3	09/12/2024	16/12/2024	LUN	13:00	14:30	<a href="#">0014PB064</a> 

## PROBLEM PRACTICALS / WORKSHOP

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Group	Start date	End date	Day	Start time	End time	Lecture room
1	09/09/2024	20/12/2024	JUE	14:00	15:00	<a href="#">0016P2008</a> 
2	09/09/2024	20/12/2024	MIE	08:30	09:30	<a href="#">A2/C02</a> 