Course guide
820082 - FA - Applied Photonics

Unit in charge: Barcelona East School of Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2023 ECTS Credits: 6.0 Languages: English

LECTURER

Coordinating lecturer: Muriel Botey
Others: Segon quadrimestre:
MURIEL BOTEY CUMELLA - T11, T12

PRIOR SKILLS

Students should have the prior knowledge of mathematics and physics acquired in the initial phase.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

TEACHING METHODOLOGY

The subject is divided into expository classes (30%) group work in the laboratory practices (20%) individual work of exercises, problems and computer simulations (25%) and final group expository presentation (25%)

LEARNING OBJECTIVES OF THE SUBJECT

The field of Photonics involves the generation and control of light (photons) for applications. The main objective of the subject is to study the technological applications of light based on the understanding of the properties of light that are the basis of photonic systems. Specifically, the different light sources will be studied and especially the different kinds of lasers, their industrial applications, the propagation, transmission and guidance of light ... An overview of the technological applications of photonics, which are virtually unlimited!
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Hours large group</td>
<td>45,0</td>
<td>30.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

-Unit 1: The nature of light and its propagation: optical tweezers and antennas.

Description:
2. Electromagnetic spectrum.
4. Electromagnetic waves in dielectric materials.
7. Propagation in non-homogeneous media

Related activities:
Laboratory sessions:
1-Propagation in a medium with non-uniform refractive index
4-Spectroscopy with a prism

Full-or-part-time: 9h
Theory classes: 3h
Laboratory classes: 6h

-Unit 2: Light sources: solar energy, bulbs, LEDs and Lasers.

Description:
1. Introduction. Sources of electromagnetic radiation
2. Black body radiation. Thermal emitters. (Sunlight)
4. Band structure of semiconductors. Non-thermal emitters. (LED, halogen lights, ..)

Full-or-part-time: 5h
Theory classes: 5h
-Unit 3: Polarization: filters and 3D vision.

Description:
2. Fresnel coefficients. Brewster angle
3. Dichroism: Dichroism. Polaroids. (Glasses, filters, ..)
4. Binocular vision. Stereoscopy. Autostereoscopy (3D cinema)
6. Photoelasticity. Interference colors. (Polarimetry)

Related activities:
Laboratory Session: 2-Polarization of light
Full-or-part-time: 9h
Theory classes: 6h
Laboratory classes: 2h
Guided activities: 1h

-Unit 4: Geometrical optics, from microns to light years: microscopes, satellite dishes, telescopes, ...

Description:
1. Representation of optical systems.
2. Dioptries within the paraxial approach.
4. Optical aberrations.
5. Mirrors: Flat mirror. Spherical mirrors. Parabolic mirror. (Satellite dishes)
7. Optical instrumentation. (Telescopes, microscopes, ...)
8. Prisms. Changing the image orientation. (Binoculares)

Related activities:
Laboratory Sessions: 3-Construction of optical systems
4-Dispersion. Spectroscopy with a diffraction grating
Full-or-part-time: 9h
Theory classes: 6h
Laboratory classes: 3h

- Unit 5: Light interferences: nanometric indirect measurement, color filters, ...

Description:
4. Multiple beam interference: Fabry-Perot interferometer. (Precision metrology)
5. Multilayer optics (Interference filters, mirrors, ...)

Related activities:
Laboratory Session
5-Interferences and diffraction
Full-or-part-time: 7h 20m
Theory classes: 4h 20m
Laboratory classes: 2h
Guided activities: 1h
-Unit 6: Difraction and holography.

Description:
1. Concept of diffraction
4. Fresnel Diffraction: Fresnel approximation. Fresnel zonal plate

Related activities:
Laboratory Practices:
5-Interferences and diffraction
4-Spectroscopy with a diffraction grating

Full-or-part-time: 9h
Theory classes: 6h
Laboratory classes: 3h

-Unit 7: Laser security

Description:
1. Effects of laser light on human tissues (eyes and skin)
2. Lasers' Classification
3. Laser safety and safety goggles.

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

-Unit 8: Optical characterization and Biophotonics

Description:
2. Diagnosis and Characterization with light: Microscopy, Fluorescence, Sensors (cytometry, nanosensors ...). Measuring devices at the Multiscale center of Barcelona

Full-or-part-time: 4h
Theory classes: 2h
Guided activities: 2h

-Unit 9: Laser material processing: cutting, welding, 3D printing, marking,...

Description:
3. Macroprocessing. Cutting and welding
4. 3D writing. Additive laser processing.

Full-or-part-time: 2h
Theory classes: 2h
-Unit 10: Optical communications. Optical fibers.

Description:
1. Waves guides. Types of waveguides.
2. Structure of optical communications.

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

GRADING SYSTEM

10% Attendance and participation
20% Selected topic presentation
20% Exercises, problems and simulations
20% Laboratory Sessions
25% Final exam

EXAMINATION RULES.

The exam can be performed using a formulary and calculator.

BIBLIOGRAPHY

Basic: