



## IDENTIFYING DATA

### Laser Technology

|                     |                                                                                                              |          |      |            |
|---------------------|--------------------------------------------------------------------------------------------------------------|----------|------|------------|
| Subject             | Laser Technology                                                                                             |          |      |            |
| Code                | V12G350V01908                                                                                                |          |      |            |
| Study programme     | (*)Grao en Enxeñaría en Química Industrial                                                                   |          |      |            |
| Descriptors         | ECTS Credits                                                                                                 | Choose   | Year | Quadmester |
|                     | 6                                                                                                            | Optional | 4th  | 2nd        |
| Teaching language   |                                                                                                              |          |      |            |
| Department          |                                                                                                              |          |      |            |
| Coordinator         | Pou Saracho, Juan María                                                                                      |          |      |            |
| Lecturers           | Pou Saracho, Juan María<br>Quintero Martínez, Félix<br>Trillo Yáñez, María Cristina                          |          |      |            |
| E-mail              | jpou@uvigo.es                                                                                                |          |      |            |
| Web                 |                                                                                                              |          |      |            |
| General description | (*)Introduction to laser technology and its applications for undergraduate students of the industrial field. |          |      |            |

## Competencies

|      |                                                                           |
|------|---------------------------------------------------------------------------|
| Code |                                                                           |
| B10  | CG10 Ability to work in a multidisciplinary and multilingual environment. |
| D10  | CT10 Self learning and work.                                              |

## Learning outcomes

| Expected results from this subject                                                                                | Training and Learning Results |     |
|-------------------------------------------------------------------------------------------------------------------|-------------------------------|-----|
|                                                                                                                   | B10                           | D10 |
| <input type="checkbox"/> - Know the physical principles in which it bases the operation of a laser and his parts. |                               |     |
| <input type="checkbox"/> - Know the main properties of a laser and relate them with the potential applications.   |                               |     |
| <input type="checkbox"/> - Know the different types of lasers differentiating his specific characteristics.       |                               |     |
| <input type="checkbox"/> - Know the main applications of the technology laser in the industry.                    |                               |     |

## Contents

|                                  |                                                                                                                                                                            |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                            |                                                                                                                                                                            |
| Chapter 1.- INTRODUCTION         | 1. Electromagnetic waves in the vacuum and in the matter.<br>2. Laser radiation.<br>3. Properties of the laser radiation.                                                  |
| Chapter 2.- BASICS               | 1. Photons and energy level diagrams.<br>2. Spontaneous emission of electromagnetic radiation.<br>3. Population inversion.<br>4. Stimulated emission.<br>5. Amplification. |
| Chapter 3. COMPONENTS OF A LASER | 1. Active medium<br>2. Excitation mechanisms.<br>3. Feedback mechanisms.<br>4. Optical cavity.<br>5. Exit device.                                                          |
| Chapter 4. TYPES OF LASER        | 1. Gas lasers<br>2. Solid-state lasers<br>3. Diode lasers.<br>4. Other lasers.                                                                                             |

|                                           |                                                                                                                                                                      |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chapter 5. OPTICAL COMPONENTS AND SYSTEMS | 1. Spherical lenses.<br>2. optical centre of a lens.<br>3. Thin lenses. Ray tracing.<br>4. Thin lenses coupling.<br>5. Mirrors.<br>6. Filters.<br>7. Optical fibers. |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                    |                                                                                                                                                                                                                           |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chapter 6. INDUSTRIAL APPLICATIONS | 1. Introduction to laser materials processing<br>2. Introduction to laser cutting and drilling.<br>3. Introduction to laser welding.<br>4. Introduction to laser marking.<br>5. Introduction to laser surface treatments. |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Planning

|                                   | Class hours | Hours outside the classroom | Total hours |
|-----------------------------------|-------------|-----------------------------|-------------|
| Laboratory practises              | 18          | 30.6                        | 48.6        |
| Master Session                    | 32.5        | 65                          | 97.5        |
| Long answer tests and development | 1.7         | 0                           | 1.7         |
| Reports / memories of practice    | 1.9         | 0                           | 1.9         |
| Short answer tests                | 0.3         | 0                           | 0.3         |

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

### Methodologies

|                      | Description                                                                                                                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Laboratory practises | Activities of application of the knowledge to specific situations and of acquisition of basic and practical skills related to the matter object of study. They will be developed in the laboratories of industrial applications of the lasers of the EEI. |
| Master Session       | Exhibition on the part of the teacher of the contents on the matter object of study. Exhibition of real cases of application of the laser technology in the industry.                                                                                     |

### Personalized attention

| Methodologies        | Description                                                                                         |
|----------------------|-----------------------------------------------------------------------------------------------------|
| Laboratory practises | They will attend individually the questions that can arise during the development of the practices. |

### Assessment

|                                   | Description                                                                                                                                                                               | Qualification | Training and Learning Results |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|
| Long answer tests and development | The examination will consist of five questions of equal value. Four of them will correspond to the contents of theory and the fifth one to the contents seen in the laboratory practices. | 70            | B10 D10                       |
| Reports / memories of practice    | The evaluation of the laboratory practices will be carried out by means of the qualification of the corresponding practice reports.                                                       | 20            | B10 D10                       |
| Short answer tests                | During the course there will be carried out a test of follow-up of the subject that will consist of two questions of equal value.                                                         | 10            | B10 D10                       |

### Other comments on the Evaluation

If some student was resigning officially the continuous assessment that is carried out by means of the test of follow-up of the subject, the final note would be calculated by the following formula:

$(0.8 \times \text{Exam qualification}) + (0.2 \times \text{Practices qualification})$ .

It is mandatory to carry out the laboratory practices in order to pass the subject.

It is mandatory to attend the 75% of the theory lessons to pass the subject.

Ethical commitment: it is expected an adequate ethical behaviour of the student. In case of detecting unethical behaviour (copying, plagiarism, unauthorized use of electronic devices, etc.) shall be deemed that the student does not meet the requirements for passing the subject. In this case, the overall rating in the current academic year will be Fail (0.0).

The use of any electronic device for the assessment tests is not allowed unless explicitly authorized. The fact of introducing unauthorized electronic device in the examination room will be considered reason for not passing the subject in the current

academic year and will hold overall rating (0.0).

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### **Sources of information**

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UNDERSTANDING LASERS: AN ENTRY-LEVEL GUIDE. Jeff Hecht. New York, EE.UU., IEEE, 2008.

UNDERSTANDING LASER TECHNOLOGY: AN INTUITIVE INTRODUCTION TO BASIC AND ADVANCED LASER CONCEPTS, Breck Hitz, Tulsa, EE.UU., PennWell.

LASER MATERIALS PROCESSING. W. Steen, J. Mazumder, Ed. Springer. 2010.

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### **Recommendations**

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### **Other comments**

Requirements: To register for this module the student must have passed or be registered for all the modules of the previous year.

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