



## Teaching Guide

| Teaching Guide           |                                                                                                                         |        |                                                                            |           |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------|--------|----------------------------------------------------------------------------|-----------|
| Identifying Data         |                                                                                                                         |        |                                                                            | 2015/16   |
| Subject (*)              | Aplicacións Industriais dos Láseres                                                                                     |        | Code                                                                       | 730460104 |
| Study programme          | Mestrado Universitario en Fotónica e Tecnoloxías do Láser                                                               |        |                                                                            |           |
| Descriptors              |                                                                                                                         |        |                                                                            |           |
| Cycle                    | Period                                                                                                                  | Year   | Type                                                                       | Credits   |
| Official Master's Degree | 2nd four-month period                                                                                                   | First  | Optativa                                                                   | 6         |
| Language                 | Spanish                                                                                                                 |        |                                                                            |           |
| Teaching method          | Face-to-face                                                                                                            |        |                                                                            |           |
| Prerequisites            |                                                                                                                         |        |                                                                            |           |
| Department               | Enxeñaría Industrial 2                                                                                                  |        |                                                                            |           |
| Coordinador              | Tobar Vidal, María José                                                                                                 | E-mail | maria.jose.tobar@udc.es                                                    |           |
| Lecturers                | Alvarez Feal, Jose Carlos Juan<br>Saavedra Otero, Emilio<br>Tobar Vidal, María José                                     | E-mail | carlos.alvarez@udc.es<br>emilio.saavedra@udc.es<br>maria.jose.tobar@udc.es |           |
| Web                      | <a href="http://master.laserphotonics.org/esp/descrpcion.html">http://master.laserphotonics.org/esp/descrpcion.html</a> |        |                                                                            |           |
| General description      |                                                                                                                         |        |                                                                            |           |

## Study programme competences

| Code | Study programme competences                                                                                                                                                                                                                                                                                                                                                                   |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A1   | CE1 Capacidade para a comprensión dos fundamentos físicos das aplicacións dos láseres en diferentes campos de especial relevancia, como a metroloxía, biomedicina, industria e medio ambiente. Identificación e recoñecemento de novas tecnoloxías, as súas aplicacións, sistemas comerciais, normativa vixente en láseres, así como o desenvolvemento de procesos e sistemas para a análise. |
| A2   | CE2 Capacidade para a análise, deseño e aplicación de métodos computacionais, sistemas non lineais, métodos numéricos, modelado numérico, simulacións, algoritmos, e software específico para o seu emprego en fotónica e tecnoloxías láser.                                                                                                                                                  |
| B1   | CB6 Posuír e comprender coñecementos que acheguen unha base ou oportunidade de ser orixinais no desenvolvemento e/ou aplicación de ideas, a miúdo nun contexto de investigación                                                                                                                                                                                                               |
| B2   | CB7 Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en contornas novas ou pouco coñecidos dentro de contextos máis amplos (ou multidisciplinares) relacionados coa súa área de estudo.                                                                                                                                              |
| B3   | CB8 Que os estudantes sexan capaces de integrar coñecementos e enfrontarse á complexidade de formular xuízos a partir dunha información que, sendo incompleta ou limitada, inclúa reflexións sobre as responsabilidades sociais e éticas vinculadas á aplicación dos seus coñecementos e xuízos.                                                                                              |
| B5   | CB10 Que os estudantes posúan as habilidades de aprendizaxe que lles permitan continuar estudando dun modo que haberá de ser en gran medida autodirigido ou autónomo.                                                                                                                                                                                                                         |
| B6   | CG1 Capacidade para recompilar información sobre un tema de interese a través de documentos científicos, así como para analízala, clasificala e sintetizala.                                                                                                                                                                                                                                  |
| B7   | CG2 Capacidade para manexar ferramentas de software que apoién a resolución de problemas relacionados coa fotónica e as tecnoloxías do láser.                                                                                                                                                                                                                                                 |
| B8   | CG3 Capacidade para a planificación de tarefas de investigación, desenvolvemento e innovación en Institucións de investigación, tecnolóxicas e empresas, en todos aqueles ámbitos relacionados coa fotónica e as tecnoloxías do láser.                                                                                                                                                        |
| B9   | CG4 Capacidade para identificar métodos experimentais e teóricos relacionados coa fotónica e as tecnoloxías do láser, así como as súas aplicacións en ciencia e tecnoloxía.                                                                                                                                                                                                                   |
| C2   | CT2 Capacidade para traballar en equipos multidisciplinares e multilingües, nun contexto internacional.                                                                                                                                                                                                                                                                                       |
| C3   | CT3 Habilidade nas relacións interpersoais.                                                                                                                                                                                                                                                                                                                                                   |
| C6   | CT6 Motivación pola calidade e a mellora continua                                                                                                                                                                                                                                                                                                                                             |
| C7   | CT7 Respetar os dereitos fundamentais de igualdade de oportunidades entre homes e mulleres, así como a accesibilidade universal das persoas con discapacidade.                                                                                                                                                                                                                                |

## Learning outcomes



| Learning outcomes                                                               | Study programme competences |                                                      |                          |
|---------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------|--------------------------|
| Knowledge of application of laser in industrial processing and manufacturing.   | AC1                         | BC1<br>BC5<br>BC6<br>BC9                             |                          |
| Knowledge of suitable laser systems and equipment for every process             | AC1                         | BC2<br>BC3<br>BC5<br>BC6                             | CC3                      |
| Knowledge of laser safety guidelines                                            | AC1                         | BC3<br>BC5<br>BC6                                    | CC3<br>CC6               |
| Determine main components in laser installations according to industrial needs. |                             | BC1<br>BC2<br>BC3<br>BC5<br>BC6<br>BC7<br>BC8<br>BC9 | CC2<br>CC3<br>CC6<br>CC7 |
| Analyze parameters and results of a laser treatment for optimization purposes.  | AC2                         | BC2<br>BC3<br>BC6<br>BC7<br>BC8<br>BC9               | CC2<br>CC3               |

| Contents                |                                                                                                                                                                                        |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                   | Sub-topic                                                                                                                                                                              |
| Introduction            | Basics of Laser processing<br>Laser systems for materials processing<br>Optic systems<br>System components for laser materials processing<br>Laser-matter interaction.<br>Laser Safety |
| Laser surface treatment | Hardening<br>Alloying<br>Cladding<br>Direct fabrication                                                                                                                                |
| Welding                 | Conduction<br>Keyhole<br>Hybrid welding<br>Remote welding<br>Brazing                                                                                                                   |
| Cutting and drilling    | Cutting<br>Drilling                                                                                                                                                                    |
| Laser ablation          | Marking<br>Micromachining                                                                                                                                                              |



|                         |                                                                                                                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Laser system components | Laser generator<br>Laser beam blocker<br>Laser beam guiding<br>Control and sensor devices<br>Safety systems<br>Auxiliary systems                                                                                  |
| Safety systems          | General considerations: Risks, hazards and control measures.<br>Ionizing and non ionizing radiation<br>Laser types : classification.<br>Laser safety protection elements and measures<br>International standards. |

| Planning                                                                                                                        |                                  |                      |                               |             |
|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests                                                                                                           | Competencies                     | Ordinary class hours | Student?s personal work hours | Total hours |
| Guest lecture / keynote speech                                                                                                  | A1 A2 B8 B9 B1 B3<br>B5 C3 C6 C7 | 45                   | 20                            | 65          |
| Laboratory practice                                                                                                             | A2 B7 B6 B9 B2 C2<br>C3          | 30                   | 50                            | 80          |
| Mixed objective/subjective test                                                                                                 | A2 A1 B7 B6 B8 B9<br>B1 B3 B2 B5 | 2                    | 0                             | 2           |
| Personalized attention                                                                                                          |                                  | 3                    | 0                             | 3           |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. |                                  |                      |                               |             |

| Methodologies                   |                                                              |
|---------------------------------|--------------------------------------------------------------|
| Methodologies                   | Description                                                  |
| Guest lecture / keynote speech  | Videoconference lectures                                     |
| Laboratory practice             | Optimizacion of a laser process: analysis of laboratory data |
| Mixed objective/subjective test | Assesment of degree of knowlegde on subject main topics      |

| Personalized attention                                |                                                     |
|-------------------------------------------------------|-----------------------------------------------------|
| Methodologies                                         | Description                                         |
| Laboratory practice<br>Guest lecture / keynote speech | Clear doubts about subject topics and practise work |

| Assessment                      |                                  |                                                                                 |               |
|---------------------------------|----------------------------------|---------------------------------------------------------------------------------|---------------|
| Methodologies                   | Competencies                     | Description                                                                     | Qualification |
| Laboratory practice             | A2 B7 B6 B9 B2 C2<br>C3          | Practise report: analysis of results and conclusions.                           | 50            |
| Mixed objective/subjective test | A2 A1 B7 B6 B8 B9<br>B1 B3 B2 B5 | Test exam with typically 10-15 questions ( lecture assistance accounts for 30%) | 50            |



|        |  |  |  |
|--------|--|--|--|
| Others |  |  |  |
|--------|--|--|--|

## Assessment comments

Assistance to lectures accounts for 30% of overall mark and test exam 20%.

## Sources of information

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic</b>         | <ul style="list-style-type: none"><li>- William Steen, Jyotirmoy Mazumder, Kenneth G. Watkins (2010). Laser Material Processing. Springer</li><li>- Gabriel Laufer (2005). Introduction to Optics and Lasers in Engineering. Cambridge University Press</li><li>- Hagop Injeyan , Gregory Goodno (2011). High Power Laser Handbook. McGraw-Hill Professional</li><li>- John F. Ready (1997). Industrial Applications of Lasers. Academic Press</li><li>- John Ion (2005). Laser Processing of Engineering Materials: Principles, Procedure and Industrial Application. Butterworth-Heinemann</li><li>- H.-G. Rubahn (1999). Laser Applications in Surface Science and Technology. Wiley</li><li>- Elijah Kannatey-Asibu Jr (2009). Principles of Laser Materials Processing . Wiley</li><li>- W.W. Duley (1998). Laser Welding . Wiley-Interscience</li><li>- C T Dawes (1992). Laser Welding: A Practical Guide. Woodhead Publishing</li><li>- S Katayama (2013). Handbook of Laser Welding Technologies . Woodhead Publishing</li><li>- John Powell (1998). CO2 Laser Cutting. Springer</li><li>- Charles L. Caristan (2003). Laser Cutting Guide for Manufacturing. Society of Manufacturing Engineers</li><li>- Ronald Schaeffer (2012). Fundamentals of Laser Micromachining. CRC Press</li><li>- Larryl Matthews, Gabe Garcia. (1994). Laser and Eye Safety in the Laboratory. I.E.E.E.Press</li><li>- Ken Barat (2006). Laser Safety Management. CRC Press</li><li>- D.C. Winburn (1989). Practical Laser Safety. CRC Press</li></ul> |
| <b>Complementary</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## Recommendations

### Subjects that it is recommended to have taken before

Traballos Tutelados I/730415113

Traballos Tutelados II/730415114

### Subjects that are recommended to be taken simultaneously

### Subjects that continue the syllabus

Laboratorio de Fundamentos do Láser/730415112

Comunicacións Ópticas/730415109

### Other comments

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.