



IDENTIFYING DATA

Laser Technology Applied to Industrial Production

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|---------------------|---|--------------------|-------------|-------------------|
| Subject | Laser Technology Applied to Industrial Production | | | |
| Code | V04M141V01339 | | | |
| Study programme | (*)Máster Universitario en Enxeñaría Industrial | | | |
| Descriptors | ECTS Credits 4.5 | Choose Optional | Year 2nd | Quadmester 1st |
| Teaching language | | | | |
| Department | | | | |
| Coordinator | Pou Saracho, Juan María | | | |
| Lecturers | Pou Saracho, Juan María Quintero Martínez, Félix Trillo Yáñez, María Cristina | | | |
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| General description | This course provides the future industrial engineer a vision of the role of laser technology in industrial production , so as to acquire basic knowledge about laser -assisted processes used in the industry. It also seeks the student to identify knows the different applications of industrial interest in the laser plays a major role and those in which the laser has a promising future in the coming years. | | | |

Competencies

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| Code | |
| A1 | Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context. |
| A3 | That students are able to integrate knowledge and handle complexity and formulate judgments based on information that was incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments. |
| A5 | Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous. |
| C3 | CET3. Conduct research, development and innovation in products, processes and methods. |
| C13 | CTI2. Knowledge and ability to design, calculate and design integrated manufacturing systems. |

Learning outcomes

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|---|-------------------------------|
| Expected results from this subject | Training and Learning Results |
| Distinguish the different types of industrial laser systems. | A1 A3 C13 |
| Knowledge about the main industrial laser applications and to apply this knowledge to particular industrial processes | A1 A3 A5 C3 C13 |

Contents

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| Topic |
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| SUBJECT 1.- LASER CUTTING | 1.1.- Introduction. 1.2.- Characteristics of laser cutting. 1.3.- Types of laser cutting. 1.4.- Mechanisms of laser cutting. 1.5.- Parameters of the process. 1.6.- Influence of different variables in the laser cutting quality. 1.7.- Examples and applications. |
| SUBJECT 2.- LASER DRILLING | 2.1.- Introduction. 2.2.- Characteristics of laser drilling. 2.4.- Mechanisms of laser drilling. 2.5.- Parameters of the process. 2.6.- Influence of different variables in the process. 2.7.- Examples and applications. |
| SUBJECT 3.- LASER MARKING | 3.1.- Introduction. 3.2.- Characteristics of laser marking. 3.4.- Mechanisms of laser marking. 3.5.- Parameters of the process. 3.6.- Influence of different variables in the process. 3.7.- Examples and applications. |
| SUBJECT 4.- LASER WELDING | 4.1.- Basic principles. 4.2.- Parameters of processing. 4.3.- Types of laser welding. 4.4.- Conduction welding. 4.5.- Penetration welding. 4.6.- Welding of dissimilar materials. 4.7.- Hybrid welding. 4.8.- Examples and applications. |
| SUBJECT 5.- LASER SURFACE TREATMENTS | 5.1.- Introduction. 5.2.- Laser surface hardening. 5.3.- Laser assisted surface coating. 5.4.- LCVD. 5.5.- PLD. 5.6.- Laser cladding. 5.7.- Laser surface alloying. 5.8.- Other laser assisted surface treatments. |
| SUBJECT 6.- LASER ASSISTED RAPID PROTOTYPING. | 6.1.- Introduction and glossary. 6.2.- Fundamentals of laser assisted prototyping. 6.3.- Rapid prototyping techniques. 6.4.- Selective laser sintering. 6.4.1.- Experimental system. 6.4.2.- Materials. 6.4.3.- Applications. 6.5.- Laminated object manufacturing. 6.6.- Direct light Fabrication-Laser engineered net shaping process- laser consolidation 6.7.- Comparison of laser assisted rapid prototyping systems |
| SUBJECT 7.- INDUSTRIAL LASER SYSTEMS | 7.1.- High power lasers. 7.2.- Industrial laser sources. 7.3.- Laser assisted processing systems. 7.4.- Industrial components for laser guiding. 7.5.- Laser working heads. 7.6.- Process sensors. 7.7.- Working stations. |
| SUBJECT 8.- SAFETY IN INDUSTRIAL LASER SYSTEMS | 8.1.- Hazards derived from the utilisation of lasers. 8.2.- Biological effects. 8.2.1.- Ocular damages. 8.2.2.- Damages to the skin. 8.3.- Hazards associated to laser system. 8.4.- Hazards associated to laser process. 8.5.- Classification of systems laser according to safety criteria. 8.6.- Hazard prevention. |

| Planning | | | |
|-----------------------------------|-------------|-----------------------------|-------------|
| | Class hours | Hours outside the classroom | Total hours |
| Laboratory practises | 20 | 40 | 60 |
| Master Session | 16 | 32 | 48 |
| Long answer tests and development | 1.7 | 0 | 1.7 |

| | | | |
|--------------------------------|-----|---|-----|
| Reports / memories of practice | 2 | 0 | 2 |
| Short answer tests | 0.8 | 0 | 0.8 |

*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 | |

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 | A1 A3 | C13 |
| 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 | A1 A3 A5 | C3 C13 |
| 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 | A1 A3 | C13 |

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.

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).

Sources of information

Basic Bibliography

Jeff Hecht, **UNDERSTANDING LASERS: AN ENTRY-LEVEL GUIDE**, IEEE, New York, EE.UU.,
Charles L. Caristan, **LASER CUTTING GUIDE FOR MANUFACTURING**, Society of Manufacturing Engineers, Dearborn, EE.UU.,

Complementary Bibliography

William M. Steen, **LASER MATERIALS PROCESSING**, Springer, Londres, Reino Unido,,
M. Dorronsoro, **LA TECNOLOGÍA LÁSER: FUNDAMENTOS APLICACIONES Y TENDENCIAS**, Ed. McGraw Hill,
John C. Ion., **LASER PROCESSING OF ENGINEERING MATERIALS: PRINCIPLES, PROCEDURE AND INDUSTRIAL APPLICATIONS**, Elsevier-Butterworth-Heinemann, Oxford, Reino Unido,

Recommendations

Other comments

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