Course guides
230803 - LS - Lasers

Last modified: 06/05/2019

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2019 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Artigas Garcia, David

Others: Ferran Canal, David Artigas

PRIOR SKILLS

Basic concepts of electromagnetic fields. It is recommendable that students take curses on Microwaves beforehand, although it is not indispensable.

TEACHING METHODOLOGY

Lessons in the blackboard and with slides. Problem solved in class.

LEARNING OBJECTIVES OF THE SUBJECT

The first objective is to explain the principles of laser operation. The concepts will be applied to various materials in order to attain an overall view of the topic. Students will be able to understand, study and design any laser system. Special emphasis will be placed on studying commercial systems. . Basic contents of the course are the following. The properties of light and its interaction with matter: Classical and quantum points of view. Conditions for amplifying lasers. Characteristics of laser cavities. Oscillation. The present state of laser systems: types and applications. Nonlinear effects applied to changes in frequency.

STUDY LOAD

Type	Hours	Percentage
Self study	98	65.33
Hours large group	52	34.67

Total learning time: 150 h

CONTENTS

1. Introduction

Description:
The laser today

Full-or-part-time: 1 h
Theory classes: 1h

2. Properties of light

Description:
2.1. Interaction of light with matter.2.2. Spatial and temporal coherence.2.3. Quantum concepts: Quantum model of the atom, Energy levels, Radiative transitions, Radiation andthermal equilibrium, Absorption, spontaneous emission and stimulated emission.

Full-or-part-time: 15 h
Theory classes: 15h

4.1. Longitudinal cavities.

Description:
3.1. Population inversion.3.2. Threshold condition and sufficient condition.3.3. Laser oscillation.

Full-or-part-time: 13 h
Theory classes: 13h

5. Laser structures and applications

Description:
4.1. Longitudinal modes in resonant cavities4.2. Transverse modes in cavities with spherical mirrors: stable and unstable cavities.4.3. Stable laser cavity.4.4. Unstable laser cavities.

Full-or-part-time: 17 h
Theory classes: 17h

5. Laser systems and applications.

Description:
5.1. Solid-state lasers.Neodymium, Ruby laser, Erbium laser, fiber laser, Tunable Laser (titanium-sapphire, alexandrite).5.2. Gas lasers.Helium-Neon, Argon, CO2, Excimer.5.3. Lasers or liquid dye.5.4. Laser diodes.

Full-or-part-time: 12 h
Theory classes: 12h

6. Frquency conversión

Description:
6.1. Nonlinear Processes for harmonic generation.6.2. Optical parametric oscillator (OPO).

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

GRADING SYSTEM

- Continuous assessment: two exams, 50% each. If approved by the average between exams, It is not needed to go to the final exam. - Final exam if not approved by continuous assessment only.

EXAMINATION RULES.

Notes and books are allowed in the exams

BIBLIOGRAPHY

Basic:
- Silfvast, W.T. Laser fundamentals. 2nd ed. Cambridge: Cambridge University Press, 2004. ISBN 0521833450.
- Verdeyen, J.T. Laser electronics. 3rd ed. Englewood Cliffs: Prentice Hall, 1995. ISBN 0131016687.
- Milonni, P.W.; Eberly, J.H. Lasers. New York [etc.]: Wiley, 1988. ISBN 0471627313.
- Cabrera, J.M.; López, F.J.; Agulló-López, F. Óptica electromagnética: vol I: fundamentos. 2a ed. Madrid: Addison-Wesley : Universidad Autónoma de Madrid, 1998. ISBN 8478290214 (V.1).

Complementary:
- Feynman, R.P.; Leighton, R.B.; Sands, M. The Feynman lectures on physics. New millennium ed. New York: Basic Books, 2010. ISBN 9780465023820.
- Boyd, R.W. Nonlinear optics. 3rd ed. San Diego (California): Academic Press, 2008. ISBN 9780123694706.