UNIVERSIDAD AUTÓNOMA DE MADRID

32532 - LASERS

Syllabus Information

Code - Course title: 32532 - LASERS

Degree: 616 - Máster en Química Teórica y Modelización Computacional (2013)
651 - Máster Erasmus Mundus en Química Teórica y Modelización Computacional

Faculty: 104 - Facultad de Ciencias

Academic year: 2019/20

1.Course details

1.2.Course nature

Optional

1.3.Course level

Máster (MECES 3)

1.4.Year of study

616 - Máster en Química Teórica y Modelización Computacional (2013): 1
651 - Máster Erasmus Mundus en Química Teórica y Modelización Computacional: 1

1.5.Semester

Annual

1.6.ECTS Credit allotment

5.0

1.7.Language of instruction

English

1.8.Prerequisites

There are no prerequisites.

1.9.Recommendations

There are no recommendations.

1.10.Minimum attendance requirement

Attendace is mandatory.

1.11.Faculty data

a. Course's Coordinator:
- Name and Surname: Fernando Martín García
- Email: Fernando.martin@uam.es
- Institution: Universidad Autónoma de Madrid
- Department: Química
- Office: 304
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b.- Professor:
- Name and Surname: Alicia Palacios
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- Phone number: 3019

c.- Master's Coordinators:
-Sergio Díaz-Tendero: sergio.diaztendero@uam.es
-Manuel Alcamí: manuel.alcami@uam.es

NOTE: The complete updated teaching team is published on the centre's website.

1.12.Competences and learning outcomes

1.12.1.Competences

These learning objectives contribute to provide the following skills for the students:

BASIC AND GENERAL SKILLS

CB6 – Students possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.

CB7 - Students know how to apply the acquired knowledge and their problem solving capacity in new or little known environments within broader (or multidisciplinary) contexts related to their area of study.

CB8 - Students are able to integrate knowledge and face the complexity of making judgments from information that, incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.

CB9 - Students know how to communicate their conclusions and the knowledge and reasons that support them to specialized and non-specialized audiences in a clear and unambiguous way.

CB10 - Students possess the learning skills that allow them to continue studying in a way that will be self-directed or autonomous.

CG01 - Students are able to foster, in academic and professional contexts, technological and scientific progress within a society based on knowledge and respect for: a) fundamental rights and equal opportunities between men and women, b) The principles of equal opportunities and universal accessibility for persons with disabilities, and c) the values of a culture of peace and democratic values.

CROSS-COMPREHENSIVE SKILLS

CT03 - Students have the ability of analyze and synthesize in such a way that they can understand, interpret and evaluate the relevant information by assuming with responsibility their own learning or, in the future, the identification of professional exits and employment fields.

CT04 - Students are able to generate new ideas based on their own decisions.

SPECIFIC SKILLS

CE01- Students demonstrate their knowledge and understanding of the facts applying concepts, principles and theories related to the Theoretical Chemistry and Computational Modeling.

CE24 - Students know the fundamentals of lasers and are familiar with the resolution of time-dependent problems and the treatment of states of the continuum.

1.12.2.Learning outcomes

Understand the fundamentals of laser light and its main applications in quantum chemistry and atomic and molecular physics. Get familiar with the resolution of time-dependent problems and dealing with states in the continuum.

1.13.Course contents

1. Introduction. What is a laser? What are lasers used for? Characteristics of laser light.
2. Laser properties. Energy levels. Formation of spectral lines: Einstein's coefficients. Spontaneous and stimulated emission. Population inversion and saturation. Widening of spectral lines. Practical examples of lasers.
3. Continuous wave lasers (cw) and pulsed lasers. Generation of cw lasers. Bandwidth reduction. Formation of laser pulses by Q-switching and modelocking.
4. Laser-matter interaction. Classical and quantum description. Multiphoton processes and tunneling. Three-step model. High-order Harmonic Generation (HOHG). Attosecond lasers pulses and pulse trains.
5. Strong field effects. Rabi frequencies. Stark shifts. Above-threshold ionization (ATI). Dressed states. Floquet and Volkov states. Strong-field approximation.
6. Theoretical approaches. Basis of states in the electronic continuum: B-splines. Direct integration of the time-dependent Schrödinger equation. Hybrid methods.
7. Time-resolved spectroscopy. Pump-probe schemes with laser pulses. Uses in femtochemistry and attophysics. Attochemistry.

1.14.Course bibliography

1. Introduction to Laser Technology. B. Hitz, J. J. Swing and J. Hecht. IEEE Press, New York, 2001.
2. Introduction to Quantum Optics. G. Grynberg, A. Aspect and C. Fabre. Cambridge University Press. Cambridge, 2010.
3. Principles of Lasers. O. Svelto. Plenum Press, New York. 1998.
4. Laser Fundamentals. W. T. Silfvast. Cambridge University Press, Cambridge, 2004.
5. Quantum Optics. M. O. Scully. Cambridge University Press. Cambridge, 1997.
6. Lasers. A. E. Siegman. University Science Books. 1986.
7. Bachau H, Cormier E, Decleva P, Hansen J E and Martín F 2001 Rep. Prog. Phys. 64 1815.
8. Martín F 1999 J. Phys. B (Topical Review) 32 R197.

2.Teaching-and-learning methodologies and student workload

2.1.Contact hours

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Contact hours (minimum 33%)	50
Independent study time	75

2.2.List of training activities

Activity	# hours
Lectures	34
Seminars	10
Practical sessions	
Clinical sessions	
Computer lab	
Laboratory	
Work placement	
Supervised study	
Tutorials	6
Assessment activities	
Other	

Lecture: The Professor will deliver face-to-face, or, online video lectures about the theoretical contents of the course during two-hour sessions. The presentations will be based on the different materials available at the Moodle platform.

Network teaching: All the tools available at the Moodle website (https://posgrado.uam.es) will be used (uploading of teaching materials, utilization of work team strategies, wiki, blogs, e-mail, etc.).

Tutoring sessions: The professor can organize either individual or group tutoring sessions about particular topics and questions raised by students.

3.Evaluation procedures and weight of components in the final grade

3.1.Regular assessment

The knowledge acquired by the student will be evaluated along the course. The educational model to follow will emphasize a continuous effort and advance in training and learning.

The final student mark will be based on exercises that must be done during the course. The next criteria will be followed for assessment of student exercises:
- 70% Exam at the end of the course.
- 30% from the student report.

3.1.1.List of evaluation activities

Evaluatory activity	%
Final exam	70
Continuous assessment	30

3.2.Resit

The student will have to face a final exam, including both theory and practical exercises. The student mark will be obtained from:
- 70% from the final exam,
- 30% from the individual work.

3.2.1.List of evaluation activities

Evaluatory activity	%
Final exam	70
Continuous assessment	30

4.Proposed workplan

The schedule of the course can be consulted in master's website.