Faculté des Sciences
Aix-Marseille Université

Master Physique fondamentale et applications
Fundamental in optics

Responsables	Descriptions	Informations
Andre NICOLET andre.nicolet@univ-amu.fr Gabriel SORIANO gabriel.soriano@univ-amu.fr Frederic ZOLLA frederic.zolla@univ-amu.fr	Code : SPFAU19 Nature : Unité d'enseignement Domaines : Sciences et Technologies	Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Fundamentals I: Introduction to electrodynamics

I. Electrostatics and distribution theory.
II. Magnetostatics (and some special relativity).
III. Fields with time variation : Maxwell's equations (Faraday's induction and Maxwell-Ampère theorem). Understanding the equations : a vector analysis synthesis.
IV. Macroscopic Maxwell's equations in media. Integral form of the Maxwell's equations. Electromagnetic energy.
V. Wave equations, EM plane waves, Snell-Descartes law and Fresnel coefficients.
VI. Fourier transforms of functions and distributions.
VII. Maxwell's equations in the frequency domain, dispersive materials and the Kramers-Kronig relations.
VIII. Helmholtz equation, Green functions, and the integral integral theorem of Helmholtz-Kirchhoff.
IX. Electromagnetic radiation.

Fundamentals II: Electromagnetic optics

1. Introduction to electromagnetic waves and optics
1.1. General introduction and preliminary remarks
1.2. From constitutive relations to dispersion equation
1.2.1. Generalities
1.2.2. A bit more about permittivity
1.2.3. Dispersion equation
1.3. Polarization of electromagnetic waves
1.3.1. General considerations
1.3.2. Some useful properties
1.3.3. Linear and circular polarization
1.3.3.1. Linear polarization
1.3.3.2. Circular polarization
1.4. Notions of spatial wave packets
1.4.1. Towards a 2D–problem
1.4.2. Packets of cylindrical waves
1.4.3. Packets of plane waves

2. Stratified media
2.1. Introduction
2.2. Decoupling in TE and TM waves of an arbitrary polarized incident plane wave
2.3. Reflection and transmission of a plane wave at a plane interface
2.3.1. TE case
2.3.2. TM case
2.4. Energetic considerations – Coefficients of reflection and transmission in energy
2.5. Reflection and transmission of a plane wave by a slab
2.5.1. Complex coefficients of reflection and transmission
2.5.2. A first approach of lenses
2.5.3. Introduction
2.5.4. Transfer function for a plano-convex lens
2.5.5. Transfer function for other thin lenses

3. From Fresnel to Fraunhofer
3.1. Introduction
3.2. Fresnel transform
3.2.1. Packets of plane waves : a second approach
3.2.2. Fresnel approximation
3.3. Properties of the Fresnel transform
3.3.1. The Fresnel transform is an operator of convolution
3.3.2. Fresnel vs Fourier
3.4. A first approach of Fraunhofer optics : Fresnel at "infinite" distance
3.5. A second approach of Fraunhofer optics : Fresnel Optics in using a convergent thin lens

COMPÉTENCES À ACQUÉRIR

- Understand the basic principles of electromagnetism and how they are interconnected.
- Know how to perform computations using vector analysis, Fourier transformation, and distribution theory to set up and solve simple electromagnetic problems.
- Understand that magnetism is a relativistic effect and that the observations do not depend on the inertial frame (velocity is relative) while the radiation is due to charge acceleration.
- Understand the difference between general laws (macroscopic Maxwell's equations) and constitutive laws specific to materials.
- Understand the concepts of electromagnetic energy, power density, and forces.
- Understand how the electromagnetic waves are radiated and propagates, and the optics is the study of electromagnetic waves propagation with some simplifying assumptions.
- Be able to perform dimensional analysis to get physical information with a minimum of work.

MODALITÉS D'ORGANISATION

The course will alternate between lectures and tutorials.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

1. Gbur, 2011, Mathematical Methods for Optical Physics and Engineering. As mentioned in the title, this textbook tackles the realm of Optics with a rather mathematical flavour. Available at the library on request.
2. Novotny and Hecht, n.d., Principles of Nano-Optics. All fashionable topics. . . Available at the library on request.
3. Hecht, 2002, Optics. Well suited for beginners. Available at the library on request.
4. Goodman, n.d., Introduction To Fourier Optics. For students interested in classical optics and especially Fresnel and Fourier optics. Outstanding monography but for complementary readings.
5. Marcuse, n.d., Light Transmission Optics. For the students interested in classical optics, waveguides, lenses, etc. . . Complementary readings (About 400 pages). Available at the library on request.
6. Sharf, n.d., From Electrostatics To Optics : A Concise Electrodynamics Course. For master students : Chapters I to IV. Available at my office on request.
7. Jackson, n.d., Classical Electrodynamics. For master students : Chapters VI, VII and IX partly (Too) comprehensive book in Optics (about 800 pages !). Available at my office on request.
8. Born and Wolf, 2002, Principle of Optics. For master students : Chapters I and II. (Too) comprehensive book in Optics (about 1000 pages !).
9. Saleh and Teich, 2007, Fundamentals of Photonics. Very comprehensive book (About 1200 pages!!) suited for master students. This monograph tackles the main topics in Photonics in a very pedagogical fashion with its abundant and well illustrated coloured figures with a minimum of mathematical background. (See amongst other Ch. I to VI) Available at library on request.
10. D. J. Griffiths: Introduction to Electrodynamics

11. G. van Dijk: Distribution theory, Convolution, Fourier transform, and Laplace transform
12. J. I. Richards, H. K. Youn: The theory of distributions - A nontechnical introduction
13. V. S. Vladimirov: Generalized Functions in Mathematical Physics

PRÉ-REQUIS OBLIGATOIRES

Solid mathematical background, basic knowledge in Physics, Electrodynamics and Optics

VOLUME HORAIRE

- Volume total: 60 heures
- Cours magistraux: 40 heures
- Travaux dirigés: 20 heures

CODES APOGÉE

- SPFAU19J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Faculté des Sciences Aix*Marseille Université

Master Physique fondamentale et applications
Physics for photonics 1

Responsable	Descriptions	Informations
Michael KUZMIN michael.KUZMIN@univ-amu.fr	Code : SPFAU20 Nature : Unité d'enseignement Domaines : Sciences et Technologies	Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Photonics is based on the interaction between light and matter. A knowledge of the atom structure and matter physics is needed to understand different types of interaction processes. The main objective of this course is to give students basic notions on atomic physics and statistical physics.

Atomic Physics

Early atomic physics. Hydrogen atom, stationary perturbation theory, fine and hyperfine structure. Atoms in external fields. Oscillating perturbation theory, interactions of atoms with radiation. Manipulation of atoms by light.

Statistical Physics

Microcanonical, canonical and grand canonical distributions. Classical approximation.
Ideal quantum gases. Bose gas, photon gas. Degenerate Fermi gas.

COMPÉTENCES À ACQUÉRIR

- The students should develop a thourough understanding of the uncertainty principle in terms of time-energy
- They should be able to write the Schrödinger equation in simple 1D and 3D cases
- They should be in a position to use the Gibbs distributions for solving basic statistical-mechanical problems

MODALITÉS D'ORGANISATION

The basic pattern is 2 Lectures (2h each) followed by a problem-solving session (2h). At the end of each lecture, the students are given assignments (problems to solve). During the problem-solving sessions, they present their solutions.

- Lectures in Atomic Physics - 16h
- Problem-solving in Atomic Physics - 8h
- Lectures in Statistical Physics - 20h
- Problem-solving in Statistical Physics - 8h

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

W. Demtröder, Atoms, Molecules and Photons, Springer, Heidelberg (2018).

C.J. Foot, Atomic Physics, Oxford (2005)

K.K. Likharev, Statistical Mechanics: Lecture Notes, IoP, Bristol (2019)

K.K. Likharev, Statistical Mechanics: Problems with solutions, IoP, Bristol (2019)

PRÉ-REQUIS OBLIGATOIRES

A solid mathematical background is indispensable

Further prerequisites: Electromagnetism and Thermodynamics

PRÉREQUIS RECOMMANDÉS

Basic knowledge of Quantum Mechanics: harmonic oscillator, spin 1/2

VOLUME HORAIRE

- Volume total: 52 heures
- Cours magistraux: 36 heures
- Travaux dirigés: 16 heures

CODES APOGÉE

- SPFAU20J [ELP]

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POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Light emission and laser sources

Responsable	Descriptions	Informations
Nicolas SANNER nicolas.sanner@univ-amu.fr	Code : SPFAU21 Nature : Unité d'enseignement Domaines : Sciences et Technologies	Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

This course is an introductory lecture about light and lasers, providing comprehensive description of the physics underlying the operation of lasers.

After introducing the main physical processes responsible for light emission, this lecture develops a comprehensive treatment for the fundamental concepts of lasers physics and the basic operation principles. Spatial, temporal and coherence properties of laser light are also explored. Detailed example and tutorials are included.

1. Light emission
   Historical context, thermal and blackbody emission, spontaneous and stimulated emission, spatial and temporal coherence.
2. Photon-atom interaction.
   Energy levels, radiative and non-radiative transitions, Einstein coefficients, levels populations, rate equations.
3. Light amplification
   Conditions for amplification, pumping and population inversion, 2-level, 3-level and 4-level systems, gain and saturation.
4. The laser oscillator
   Conditions for laser starting, resonant oscillation, steady-state regime, output intensity.
5. Laser cavities and laser beams
   Longitudinal modes, cavity stability, transverses modes and Gaussian beams.
6. Pulsed regimes
   Spiking, Q-switch, Modelock

COMPÉTENCES À ACQUÉRIR

At the end of this module, the student will possess knowledge on light emission and the principles and operation of laser sources as well as resulting characteristics of laser light. They will be able to:

- Study population inversion for various spectroscopic systems
- Determine the amplification gain and the saturation of a laser medium
- Asses the threshold for laser oscillation
- Design stable cavities
- Understand and calculate spatial and spectral characteritics of a laser beam, including coherence propertie

MODALITÉS D'ORGANISATION

Two hours sessions of mixed courses and tutorials

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

"Laser fundamentals", W. Silfvast, Cambridge University Press
"Lasers", A.E. Siegman, Science Books

PRÉ-REQUIS OBLIGATOIRES

BSc physics background

VOLUME HORAIRE

- Volume total: 40 heures
- Cours magistraux: 30 heures
- Travaux dirigés: 10 heures

CODES APOGÉE

- SPFAU21J [ELP]

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POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Imaging and systems in optics

Responsable	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The students from different backgrounds refresh and elaborate their knowledge of the principles of optical imaging. The course starts with a reminder of the Huygens-Fresnel principle and of the Fresnel and Fraunhofer theories of diffraction. Then, a more general and rigorous approach, based on the resolution of Maxwell's equations, is adopted. The principles of image formation are studied using this approach. In particular, the link between the object defined by its permittivity distribution and the data collected for a given illumination (coherent or non coherent) is studied. The role of optical lenses, mirrors and the limitations of the performances of optical imaging systems (telescopes, far-field microscopes, near-field microscopes) in terms of resolution, accuracy are discussed.

Applications in astronomy, biology, nanotechnology… and solutions implemented for increasing the performances are studied. Recent advances in optical imaging are presented throughout this course.

I – Introduction
I.1 – Image-vision
I.2 – Brief description of the main imaging systems : microscopes, telescopes

II – Interaction between electromagnetic waves and heterogeneous objects
II.1 – Maxwell's equations
II.2 – Calculation of the scattered field with volume integral method
II.3 – Total field inside the object
II.4 – Numerical calculation
II.5 – Fourier transform of the Green function
II.6 – Green function in far-field

III – Optical imaging
III.1 – Accessible data, Optical Transfer Function
III.2 – Optical microscopes: field propagation, role of lenses, measured signal, cases of spatially coherent and incoherent illumination

COMPÉTENCES À ACQUÉRIR

- determine the link between the object (described by its permittivity distribution) and the diffracted field using an electromagnetic approach
- determine the link between the object (described by its fluorophore density) and the fluorescence intensity using an electromagnetic approach
- know what are the main approximated theories of diffraction with their limitations and domains of validity
- understand the difference between near field imaging and far field imaging
- understand the difference between coherent and incoherent imaging
- know what are the characteristics of the main imaging systems in optics (telescopes, microscopes…)
- know what are the origins of the limitations of optical systems in terms of resolution and accuracy
- know the solutions implemented in order to overcome the main limitations of classical imaging systems in optics

MODALITÉS D'ORGANISATION

Two hours sessions of mixed courses and tutorials

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

For the prerequisites: E. Hecht: Optics

J. Mertz : Introduction to optical microscopy

PRÉ-REQUIS OBLIGATOIRES

geometrical optics; wave optics : interferences, diffraction, optical coherence; electromagnetism

VOLUME HORAIRE

- Volume total: 30 heures
- Cours magistraux: 20 heures
- Travaux dirigés: 10 heures

CODES APOGÉE

- SPFAU22J [ELP]

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Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Optics and photonics lab

Responsable	Descriptions	Informations
Julien DUBOISSET julien.duboisset@univ-amu.fr	Code : SPFAU23 Nature : Unité d'enseignement Domaines : Sciences et Technologies	Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The students from different backgrounds refresh and elaborate their knowledge of basic fields of optics and some other useful neighboring fields: Ray optics, interferences, diffraction, spectroscopy, metrology and electronics, data analysis by computer.

The objective to the Lab practice is to given them skills, reflex, automatism in manipulating experimental optical devices.

1. Geometrical optics
2. Monochromator
3. Fourier optics
4. Polarization I
5. Polarization II
6. Michelson interferometer I
7. Michelson interferometer II
8. Spectroscopy
9. Photodetectors
10. Holography

COMPÉTENCES À ACQUÉRIR

The students
• can align the different setups
• can carry out a measurement and evaluate its statistical uncertainties
• can write a scientific report
• can communicate precisely on complex experimental setups
• understand how interferometers work and what they can be used for
• understand how spectrometers work and what they can be used for
• understand basic optical instruments and the aberrations therein
• realized a precise alignment of the Michelson interferometer
• realized holograms and used them in applications
• know the different electronic circuits used in combination with photodiodes
• know how to caracterize the polarization of light.

MODALITÉS D'ORGANISATION

We apply a working methodology which is close to the one used in research or in industrial R&D. First all experiments are carried out and notes are taken in a lab book. Quantitative measurements are performed, supplemented by comments on the methodology as well as on the measurement errors.

Experimental work is done in teams of 2 students. There is one setup for each experiment, so everybody does a different experiment and the group rotates for the next session.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

"Laser fundamentals", W. Silfvast, Cambridge University Press

"Lasers", A.E. Siegman, Science Books

PRÉ-REQUIS OBLIGATOIRES

Basic knowledge in physics / optics / electronics / programming

VOLUME HORAIRE

- Volume total: 50 heures
- Travaux pratiques: 50 heures

CODES APOGÉE

- SPFAU23J [ELP]

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Dernière modification le 18/06/2024

Faculté des Sciences Aix*Marseille Université

Master Physique fondamentale et applications
Numerical simulation of EM problems

Responsables

Amelie LITMAN
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Descriptions

Code : SPFAU24

Nature : Unité d'enseignement

Domaines : Sciences et Technologies

Informations

Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

This course introduces students to MATLAB programming and visualization of electromagnetic fields. The students will acquire an operational knowledge and firm grasp of electromagnetic fundamentals by teaching them “hands on” electromagnetics through a series of computer exercises solving optical phenomena on rigorous grounds.

The first part, “Discovering Matlab”, serves as an introduction to programming languages, numerical schemes and the Matlab environment. In the second part, “Electromagnetic simulations”, several examples of light matter interactions will be numerically explored by the students, ranging from diffraction to the optical responses from stratified media.

Part 1 – Discovering Matlab
1. Arrays and operators in Matlab
2. Working with files and functions
3. Graphs, 2D and 3D plots
4. Minimization and optimization

Part 2 – Electromagnetic simulations
1. Diffraction and interferences (scalar theory, Huygens-Fresnel principle, Fraunhofer)
2. Reflection/Transmission of a plane wave at a planar interface
3. Reflection/Transmission of a plane wave on a multilayer system (anti-radar coating, Bragg mirror, ...)
4. Color rendering
5. Solar cells

COMPÉTENCES À ACQUÉRIR

At the end of this module, the student will be able to:

- Solve real-time complex physical problems using MATLAB-based short scripts
- Implement numerical strategies to model optical multilayered media and improve their performances
- Generate graphs to illustrate and analyse electromagnetic phenomena for articles and reports

MODALITÉS D'ORGANISATION

All sessions take place in the computer lab, with one computer per student. Students work at their own pace. For the assessment, students will be asked to reproduce results taken from scientific articles on electromagnetism and optics.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

"Classical Electrodynamics" John David Jackson
"Introduction to Fourier Optics" Joseph W. Goodman
"Computational Electromagnetics with MATLAB " Matthew N.O. Sadiku
"Fundamentals of Electromagnetics with MATLAB " Karl E. Lonngren

PRÉ-REQUIS OBLIGATOIRES

Electromagnetics, Linear Algebra, Algorithmic logic

VOLUME HORAIRE

- Volume total: 30 heures
- Travaux pratiques: 30 heures

CODES APOGÉE

- SPFAU24J [ELP]

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POUR PLUS D'INFORMATIONS

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Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Mathematics for photonics

Responsable

Patrick FERRAND
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Descriptions

Code : SPFAU25

Nature : Unité d'enseignement

Domaines : Sciences et Technologies

Informations

Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The purpose of this series of tutorials is to remind the common background knowledge that is required in all the lectures of the Master.

Topics Covered:

- Complex algebra including complex forms and Euler's formula
- Derivatives, differentiation, and integrals
- Linear algebra, vector operations, and matrix manipulations
- Vector analysis
- Fourier series and transforms
- Planar geometry, trigonometry, and solid angles.

COMPÉTENCES À ACQUÉRIR

Students will develop proficiency in various mathematical techniques essential for optics and photonics applications, such as:

- Analyzing intensity patterns resulting from interference phenomena
- Conducting basic electromagnetic analyses
- Computing states of polarization arising from polarizing elements
- Understanding mathematical underpinnings of Maxwell's equations
- Grasping the significance of Fourier analysis, particularly its impact on domain transformations
- Solving fundamental problems related to geometric optics

MODALITÉS D'ORGANISATION

Sessions will consist of supervised exercises following brief introductory lectures. A final examination will conclude the course.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

OpenStax textbooks on calculus (Volumes 1, 2, and 3) and university physics (Volumes 1, 2, and 3).

Mary L. Boas' "Mathematical Methods in the Physical Sciences," published by Wiley.

Sears and Zemansky's University Physics, Pearson

PRÉREQUIS RECOMMANDÉS

Familiarity with geometric optics, Fourier transforms, and integral calculus

VOLUME HORAIRE

- Volume total: 20 heures
- Travaux dirigés: 20 heures

CODES APOGÉE

- SPFAU25J [ELP]

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POUR PLUS D'INFORMATIONS

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Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Optical engineering

Responsable	Descriptions	Informations
Elodie CHOQUET elodie.CHOQUET@univ-amu.fr	Code : SPFAU26 Nature : Unité d'enseignement Domaines : Sciences et Technologies	Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The students with a basic knowledge of ray optics and optical systems develop a strong understanding of the optical systems. They know the key characteristics that drive their performance and specifications. The learn to recognise the main aberrations that limit their perfomance, and what the levers are to minimize or cancel them, with a mathematical and analytical method. They learn how to diagnose the performance of an existing optical system, and how to desing new systems given specifications.

I. Geometrical Optics (5h)
- I. 1 General Optics principles
- I. 2 Characteristics of optical systems

II. Chromatic aberrations (2h)
- II.1 Primary chromatic aberration
- II.2 Achromatic optical systems

III. Geometrical aberrations (9h)
- III.1 Transverse aberration
- III.2 Wavefront aberration
- III.3 Third order aberrations
- III.4 Third order aberrations of a spherical diopter
- III.5 Third order aberration of a thin lens
- III.6 Aberration variations with the pupil position

IV. Wave optics and aberrations (4h)
- IV.1 Diffraction theory
- IV.2 Diffracted image quality criteria
- IV.3 Third order aberrations tolerancing

V. Radiometry (4h)
- V.1 Definition of radiometric quantities
- V.2 Relations between radiometric quantities
- V.3 Radiometric properties of the optical system

COMPÉTENCES À ACQUÉRIR

I - The student will be able to determine the field of view and pupil size and position of a given optical system. They will know under which conditions they are considered as stigmatic.

II - They can compute the primary chromatic aberration of an optical system, and design optical elements that make a system achromatic.

III - They can recognize the 3rd order aberrations from their transverse or longitudinal properties, and how they vary with the aperture size, position, and with the position in the field of view. They know how to propagate aberrations through an optical system and to compute the corresponding transverse aberration.

IV - They can quantify the image quality of an optical system accounting for diffraction. They can specify the amplitude of the 3rd order aberration leading to a diffraction limited system.

V - They know the main metric quantifying the radiometry of a scene. They know how these quantities are propagated through an optical system.

MODALITÉS D'ORGANISATION

Two-hour long lectures with each chapter followed by a two-hour tutorial. Tabletop experiment during chapter IV.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

E. Hecht: Optics, Addison-Wesley 2nd ed. 1987

M. Born & E. Wolf: Principles of optics, Pergammon Press, 6th ed. 1980

W.T. Welford: Aberrations of optical systems, Adam Hilger, 1991

PRÉ-REQUIS OBLIGATOIRES

Solid mathematical background (Taylor expansions, polynomial developments)

Fundamentals in ray optics (ray tracing, conjugation formulae, definition of an optical system)

Basic knowledge of Fourier optics (diffraction, Fresnel approximation, Fourier transforms)

VOLUME HORAIRE

- Volume total: 24 heures
- Cours magistraux: 24 heures

CODES APOGÉE

- SPFAU26J [ELP]

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POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Dernière modification le 18/06/2024

Faculté des Sciences
Aix*Marseille Université

Master Physique fondamentale et applications
Français langue étrangère 1

Responsable	Descriptions	Informations
	Code : SPFAU27	Composante : Faculté des Sciences
	Nature : Unité d'enseignement	
	Domaines : Sciences et Technologies	

LANGUE(S) D'ENSEIGNEMENT

Partiellement Anglais

CONTENU

For students to acquire a competency in communication in the French language and an understanding of French society and culture so that they may express themselves, write directly, and express comprehension when communicating with French speakers.

1. Four areas of language competency will be covered – oral and written comprehension, oral and written communication – but emphasis will be placed on oral competency, therein integrating pragmatic, socio-cultural and strategic proficiencies according to the Common European Framework of Reference for Languages (CEFR).
2. The lesson plans for this class will be communicative and action-oriented. As the approach will be centered on students engaging in communicative tasks, there will be flexibility in the choice and duration of the class activities.

   The course program will therefore be adapted to best fit the linguistic needs of each level. The topics covered may vary depending on local, national or international news and the time of year.

   The course is not a lecture and its success depends greatly on student participation. Class attendance is strongly recommended. In the case of an absence, the student is invited to make up the work done in class and any homework given during the student's absence. Documents from class will be available on a digital workspace.

3. Resources and training materials : authentic documents, articles, photos, songs, videos, playful material from the publisher or made by the teacher and written or audio documents from manuals, methods or sites.

COMPÉTENCES À ACQUÉRIR

Varies according to the level of each group.

MODALITÉS D'ORGANISATION

The lesson plans for this class will be communicative and action-oriented. As the approach will be centered on students engaging in communicative tasks, there will be flexibility in the choice and duration of the class activities.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

La Grammaire des premiers temps (PUG)

Grammaire Progressive du Français (Clé International)

PRÉ-REQUIS OBLIGATOIRES

Adapted according to the level of each group.

VOLUME HORAIRE

- Volume total: 24 heures
- Travaux dirigés: 24 heures

CODES APOGÉE

- SPFAU27J [ELP]

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POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Guided optics

Responsable	Descriptions	Informations
Gilles RENVERSEZ gilles.renversez@univ-amu.fr	Code : SPFBU29 Nature : Unité d'enseignement Domaines : Sciences et Technologies	Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The students from different backgrounds elaborate their knowledge in guided optics. They get also a know-how in the theoretical study of waveguides that can be used for more general optical devices. They become familiar with the concept of modes and are able to manipulate them.

1 Main introduction

2 Maxwell's equations
2.1 Maxwell's equations
2.2 Continuity relations
2.2.1 General case
2.2.2 Perfect conductor case
2.3 Constitutive equations
2.3.1 General cases
2.3.2 Frequency domain
2.3.3 Our pratical case: a very
2.4 Plane waves
2.5 Poynting vector

3 Slab waveguide
3.1 Introduction
3.2 Geometry and indices
3.3 TE/TM splitting
3.4 Propagation equations
3.4.1 Transverse E waves (TE)
3.4.2 Transverse M waves (TM)
3.5 Dispersion equation
3.5.1 Conditions to obtain a guided wave
3.5.2 Form of the electric field profile in the guiding layer
3.5.3 Obtaining of the dispersion equationv for the TE case
3.5.4 field profile in the TE case
3.5.5 Comments on the dispersion equation
3.5.6 Discussion of the dispersion equation
3.6 General properties of modes
3.6.1 Mode orthogonality
3.7 The symmetric case
3.7.1 Symmetry properties (parity)
3.7.2 Even TE modes in the symmetric slab waveguide
3.7.3 Odd TE modes in the symmetric slab waveguide
3.7.4 Mode numbering
3.7.5 Dispersion curves
3.7.6 Quantization of mode localization in waveguide: confinement factor

4 Propagation of a signal
4.1 Introduction
4.2 Wave-packet and co
4.3 Signal enlargement
4.3.1 Extent of a signal
4.3.2 Distortion of a signal during the propagation

5 Optical fiber
5.1 Definition
5.2 Technological aspects
5.2.1 Attenuation in optical fibres
5.2.2 Transmission windows
5.2.3 Materials for optical fibres
5.3 Initial equations
5.4 Form of the solutions
5.4.1 Forms of the propagating modes
5.4.2 Transverse components of the fields
5.4.3 Azimuthal dependency
5.5 The circular step-index fiber
5.5.1 Recap equations for the radial dependency
5.6 Solutions in the core fibre
5.7 Solutions in the cladding
5.7.1 Orthoradial components
5.7.2 Consequences of the continuity relations
5.8 Guided modes of the circular SIF
5.8.1 Transverse modes
5.8.2 Hybrid modes HE v,µ and EH v,µ
5.9 Cut-Off frequencies
5.9.1 Cut-Off frequencies of TE 0,v and TM 0,v transverse modes
5.9.2 Cut-Off frequencies of EH v,µ and HE v,µ hybrid modes
5.10 Scalar modes
5.10.1 Introduction
5.10.2 Scalar wave equation
5.10.3 Forms of the solutions
5.10.4 Dispersion equations
5.10.5 Mode profiles
5.10.6 Power fraction in the core

COMPÉTENCES À ACQUÉRIR

The students

- can derive the dispersion equation for simple waveguides including slab waveguides and step-index optical fibers
- can analyse the dispersion properties of waveguides
- understand the generalization of the waveguide studies for more complex configurations
- manipulate the waveguides guided modes as the solutions of eigenvalue problems
- understand the link between waveguide symmetries and mode classification
- understand the link between waveguide dispersion properties and signal propagation
- know the main technological aspects of optical fibers
- have the knowledge and know-how to understand and use the standard textbooks on this field including for new photonic structures

MODALITÉS D'ORGANISATION

Several tutorials are realized during the semester including one on surface plasmon polaritons and one for graded index waveguide.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

K. Okamoto: Fundamentals of optical waveguides
A. W. Snyder & J. D. Love: Optical waveguide theory
H. Kogelnik: Integrated Optics,
D. Marcuse: Light Transmission Optics
D. Marcuse: Theory of Dielectric Optical Waveguides
C.-L. Chen: Foundations for guided-wave optics

PRÉ-REQUIS OBLIGATOIRES

Mathematical background, fundamentals in Mathematics including basic linear algebra, and vector analysis, basics of wave physics, Maxwell's equations, electromagnetic plane waves

VOLUME HORAIRE

- Volume total: 30 heures
- Cours magistraux: 20 heures
- Travaux dirigés: 10 heures

CODES APOGÉE

- SPFBU29J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Nonlinear optics

Responsables	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

1 Introduction
1.1 Explaining the name
1.2 The origin of the nonlinearity in P(E)
1.3 The polarization density and the susceptibility tensors
1.4 List and classification of NLO effects
1.5 The symmetries of higher order susceptibilities
1.6 Simplified photon picture

2 Linear but anisotropic optics
2.1 Propagation in an anisotropic medium
2.2 The “types” of phase matching;

3 The nonlinear wave equation
3.1 The exact version
3.2 The approximated version for three wave interaction
3.3 Energy conservation and Manley-Rowe rel.

4 Practical aspects of three wave interaction
4.1 SHG
4.2 Phase matched OPA with non-depleted pump
4.3 Influence of the crystal anisotropy: effective nonlinearity

5 Third order nonlinear optical response
5.1 Optical Kerr effect
5.2 Nonlinear optical parameters, ...

COMPÉTENCES À ACQUÉRIR

At the end of this module, the student will be able to:

- Understand the formalism of the classical description of nonlinear optics
- Develop an understanding of the classical NLO wave equation for superpositions of monochromatic waves
- Find directions of phase matching in a nonlinear optical crystal
- Understand how the crystal symmetries influence the Chi tensor and the effective nonlinearity
- Establish the system of differential equations describing a chi2 effect.
- Be able to derive the set of differential equations for a given situation and solve it using approximations or numerical tools
- Understand the physics of frequently encountered nonlinear optical phenomena
- Know some basic applications of NLO

MODALITÉS D'ORGANISATION

This course is a classical lecture. Excercises are given during the lecture.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

P. N. Butcher and D. Cotter "The Elements of Nonlinear Optics", Cambridge University Press (1991, or better1998)

Robert W. Boyd, “Nonlinear Optics” 3rd edition (Academic Press)

PRÉ-REQUIS OBLIGATOIRES

A solid mathematical background is needed: complex numbers, complex vector analysis, differential equations, Fourier transforms.

PRÉREQUIS RECOMMANDÉS

Scientific programming skills are helpful to evaluate the phase mismatch, solve the sets of differential equations, ...

VOLUME HORAIRE

- Volume total: 20 heures
- Cours magistraux: 20 heures

CODES APOGÉE

- SPFBU30J [ELP]

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Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Physics for photonics 2

Responsable	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Photonics is based on the interaction between light and matter. A knowledge of the microscopic structure and materials physics is needed to understand different types of interaction processes. The main objective of this course is to give students an introduction to the fundamental physics behind different materials, what gives materials their properties, and what are the models that explain these properties. The link between microscopic and macroscopic properties will be detailed for various systems in condensed matter.

1. Introduction to the properties of solids. Crystal structures and bonding in materials. Beyond the crystalline state: soft matter (polymers, liquid crystals). (4h)
2. Momentum-space analysis and diffraction probes. (4h)
3. Lattice dynamics, phonon theory and measurements, thermal properties.(4h)
4. Electronic band theory, classical and quantum; free, nearly-free, and tight-binding limits. (8h)
5. Electron dynamics and basic transport properties. (4h)
6. Optical properties of solids.(4h)

COMPÉTENCES À ACQUÉRIR

- Understanding of solids and of their characteristic properties
- Conceptualize the different kinds of matter and the relation between materials properties and the microscopic structure
- Understand the importance of different materials in various applications based on their electronic structure

MODALITÉS D'ORGANISATION

Two hours sessions of mixed courses and tutorials.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

M. P. Marder - Condensed Matter Physics

J. M. Ziman – Principles of the Theory of Solids

N. W. Ashcroft and N. D. Mermin - Solid State Physics

PRÉ-REQUIS OBLIGATOIRES

Physics for Photonics 1

Fundamentals in Optics and Photonics

PRÉREQUIS RECOMMANDÉS

electromagnetism, thermodynamics, quantum mechanics

VOLUME HORAIRE

- Volume total: 28 heures
- Cours magistraux: 18 heures
- Travaux dirigés: 10 heures

CODES APOGÉE

- SPFBU31J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Dernière modification le 18/06/2024

Master Physique fondamentale et applications

Basic molecular cell biology

Responsables	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The course will provide basic knowledge in molecular and cell biology, and describe the molecular tools that biologists use in order to study and label molecules and structures of interest, in particular using fluorescence microscopy.

I Introduction (4h)

- What is life ?
- Biomolecules (carbohydrates, lipids, proteins, nucleic acids)
- Cell organization, types and structures (organelles, sizes, functions)
- DNA, RNA and proteins, genetic code
- Cell division (mitosis and meiosis)

II – Experimental model systems and methodology(3h)

- Cell and animal model systems in biology
- Experimental approaches for studying biology
- Molecular cloning, Polymerase chain reaction (PCR, RT-PCR)

III – Fluorescent labeling (3h)

- Chemical labeling of proteins, immunofluorescence
- Green Fluorescent Protein (GFP), genetic fusions

IV – Cells in organs (3h)

- Cell types
- Cell differentiation
- Stem cells

V – Gene regulation (3h)

- The central Dogma of molecular Biology
- The basic mechanisms of genetic regulation: enhancers, promoters, transcription factors
- Gene regulatory networks

COMPÉTENCES À ACQUÉRIR

- Know the different families of biomolecules and their role
- Recognize different organelles and cytoskeletal filaments of a cell, and differentiate cell types
- Know the link and mechanisms between DNA, RNA and proteins
- Summarize stages of mitosis and know what dividing cells look like
- Being able to choose the proper model system and experimental approach for addressing a biological question
- Being able to use PCR for molecular cloning and detection of viral infection
- Being able to fluorescently label specific proteins of interest in fixed and living cells and tissues
- Understand the basics of gene regulation, its importance in the context of animal development, and know about the techniques associated

MODALITÉS D'ORGANISATION

2 sessions of 2 hours of course with J. Savatier, 3 with M. Mavrakis and 3 with L. Le Goff

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

Molecular Biology of the Cell, Bruce Alberts et al

PRÉ-REQUIS OBLIGATOIRES

None

VOLUME HORAIRE

- Volume total: 16 heures
- Cours magistraux: 16 heures

CODES APOGÉE

- SPFBU32J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Master Physique fondamentale et applications
Fabrication and characterization of optoelectronic devices

Responsables	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Optoelectronic devices are now core technologies for several key technical areas such as telecommunications, information processing, lighting, sensors, and photovoltaics. The objectives of this course are (i) to teach fundamental notions about physical phenomena in optoelectronic materials, (ii) to introduce the principle and architecture of optoelectronic devices, such as light emitters, photodetectors, imaging sensors, solar cells, (iii) to introduce the fabrication and characterization methods of optoelectronic materials and devices.

Part 1 - Basis of optoelectronic phenomena
Band structure, E-k diagrams (metal, semi-metal, semi-conductor), semiconductor doping
Photon absorption, charge photo-generation, diffusion, recombination
Junctions

Part 2: Optoelectronic devices
Electroluminescence
Light-emitting diode (LED)
Laser LED (edge, MQW, DFB, tunable, VCSEL)
Photodetectors, imaging sensors
Solar cells

Part 3: Device fabrication and characterization

COMPÉTENCES À ACQUÉRIR

- Be familiar with the electronic structure of materials
- Understand the key material properties for optoelectronic applications
- Get knowledge about the working principles and architecture of optoelectronic devices
- Select adequate materials and devices for chosen optoelectronic applications
- Get knowledge about technology for the fabrication and characterization of optoelectronic materials and devices

MODALITÉS D'ORGANISATION

Evaluation: 1 homework, 1 home-prepared oral presentation, 1 written exam

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

- Optoelectronics & Photonics: Principles & Practices, 2nd Edition, Safa O. Kasap, Univ of Saskatchewan
- A. Rogalski, Infrared Detectors, 2nd edition, CRC Press, Boca Raton, Florida (2010).
- Wei-Chic Wang, “Optical detectors” & “Radiometry”, teaching lessons, National, Tsing Hua University

PRÉ-REQUIS OBLIGATOIRES

- Basis in material science and solid state physics
- Basis in electronics
- Basis in optics and photonics

VOLUME HORAIRE

- Volume total: 30 heures
- Cours magistraux: 20 heures
- Travaux dirigés: 10 heures

CODES APOGÉE

- SPFBU33J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

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Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Photon spectroscopy

Responsable	Descriptions	Informations
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Dernière modification le 18/06/2024

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Photonics Spectroscopy is based on the interaction between light and matter. A knowledge of the molecule structure and matter physics is needed to understand different types of interaction processes.
The main objective of this course is to give students a fundamental basic understanding of the light-matter interaction processes used in spectroscopy.

- Molecular structure (2h)
- InfraRed absorption (4h)
- Raman scattering – point group symmetries (4h)
- Fluorescence (2h)
- Nonlinear optics: second harmonic and sum frequency generation, coherent Raman scattering (4h)

COMPÉTENCES À ACQUÉRIR

The students

- understand the different states of matter and what give materials their properties
- can describe the different processes, their usefulness, their advantages, drawbacks for spectroscopy or imaging purpose.
- are familiar with light matter interaction

MODALITÉS D'ORGANISATION

Two hours sessions of mixed courses and tutorials

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

- Principles of Fluorescence Spectroscopy, Lakowic
- Nonlinear optics, Boyd
- Symmetry and spectroscopy, Bertolucci

PRÉ-REQUIS OBLIGATOIRES

- Physics for Photonics 1
- Introductory Quantum Mechanics
- Solid mathematical background
- Imaging and systems in optics

VOLUME HORAIRE

- Volume total: 16 heures
- Cours magistraux: 16 heures

CODES APOGÉE

- SPFBU34J [ELP]

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POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Master Physique fondamentale et applications
Laboratory projects

Responsables	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Students have to deal with 4 projects during 2 afternoons each. Two setups that are similar but not identical allow up to 4 students to work on each project:

- (1) Diode lasers,
- (2) Nd:YAG lasers,
- (3) optical modulation (EOM, AOM),
- (4) simulations for imaging systems.

Keywords are given for each of the projects to guide the students to measurements that allow them to understand how the components work, quantify their action of the light they provide or characterize the light they produce.

COMPÉTENCES À ACQUÉRIR

Group work.

Alignment skills (for all participants).

Hands-on knowledge on modern optical instruments: diode lasers, Nd:YAG lasers, electro-optical modulators, acousto-optical modulators, ray tracing programs for optical system design, matlab/python

Search for useful information (manuals etc.); use it to decide how to best make your measurements; take reasonable measurement habits: check the range, use the most informative distribution of the mreasurement points; check for reproducibility.

Fit models to data, make publication style graphs, validate your numerical simulations using analytical solutions in simple configurations, extract essential information from image data.

MODALITÉS D'ORGANISATION

This teaching unit is an intermediate between an undergraduate lab work and a research project.

Students have to deal with 4 projects during 2 afternoons each. Two setups that are similar but not identical allow up to 4 students to work on each project.

A complete research style report on the background, acquired measurements and conclusions are expected for each project and student group.

PRÉ-REQUIS OBLIGATOIRES

Basic knowledge on lasers, scientific programming, anisotropic optics

PRÉREQUIS RECOMMANDÉS

Basic knowledge on ray-tracing programs (Oslo), laser safety

VOLUME HORAIRE

- Volume total: 30 heures
- Travaux pratiques: 30 heures

CODES APOGÉE

- SPFBU35J [ELP]

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POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Signal and image analysis

Responsables	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Part A : Signals : Presents the essential tools commonly used to describe continuous-time (analog) and discrete-time signals, images and noise, mostly from a deterministic waveform point of view. Continuous-time waveforms are represented by direct mathematical expressions or by the use of orthogonal series representations such as the Fourier series. Properties of these waveforms, such as their DC value, root-mean-square (RMS) value, energy and power, magnitude and phase spectrum (through the Fourier transform), power spectral density, and bandwidth, are recalled or established. In the frequency-domain, analog and digital signals are represented by their Fourier transform. The Discrete Fourier Transform (DFT), when properly applied, allows the computation of spectra.

Part B : Systems : Used to manipulate analog or digital waveforms, exploiting various operations like scalar product, convolution and correlation. In addition, effects of linear filtering is introduced. Actual systems used in signal storage, transmission and modulation, multiplexing, video signal coding, lossy signal compression (principle of JPEG standard) will be explained.

Lab Sessions (practicals) :

- Lab 1 : Signal representation using GNU-Octave: Introduction to Octave scripts and functions, application to the sinc signal.
- Lab 2 : Representation of analog signals by discrete-time signals: Introduction to discrete sinusoids, discrete frequency and sampling, empirical discovery of the Shannon-Nyquist theorem.
- Lab 3 : Signal Parameter Estimation – Part A: Estimation of the parameters of a sinusoidal signal (of known frequency f0) using the scalar product; dependence on S/N ratio and on the precise knowledge of f0.
- Lab 4 : Signal Parameter Estimation – Part B: Estimation of the parameters of a sinusoidal signal (of unknown frequency), an empirical introduction to the Discrete Fourier Transform (DFT).
- Lab 5 : Signal recognition through Correlation: Retrieve the occurrence of replicas of a reference signal hidden in a noisy signal using sliding scalar product and “running” (“real-time”) correlation; application to Radar/Sonar signals.
- Lab 6 : FIR Filtering: From running correlation to convolution, to implement various digital filters, used e.g. to extract a sinusoid of known frequency in a composite signal.
- Lab 7 : Discrete Fourier Transform: Empirical and extensive self-paced exploration of the DFT tool, supported by a complete and specifically-designed “active” reference (a Jupyter notebook).
- Lab 8 : Image Processing and Filtering: Generalizes the convolution to 2D signals (images), digital filtering of images.

COMPÉTENCES À ACQUÉRIR

The students will be able to :

- Exploit Matlab® (or its open-source equivalent GNU-Octave) to develop useful and realistic “expert systems” in digital signal and image processing, e.g. signal estimation and identification.
- Become accustomed to modern means of performing personal or team work on scientific calculations and novel ways of sharing data, programs and results (through the use of the CoCalc® platform).
- Practice personal exploration through trials and enquiries, and thus develop adequate research skills in digital signal and image processing.

MODALITÉS D'ORGANISATION

We start with 9 hours of lectures and then go on to 8 laboratory sessions based on GNU Octave (a MatLab® equivalent) and implement their own solutions, e.g. in signal estimation and identification, ubiquitous issues in signal processing.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

- Richard J.Tervo, Practical Signals Theory (with MatLab Applications), Wiley (2014)
- Hwei Hsu, Signals and Systems (2nd edition), Schaum's Outline Series, Mac Graw Hill (2011)
- Steven W. Smith, The Scientist and Engineer's Guide to Digital Signal Processing, www.dspguide.com.

PRÉ-REQUIS OBLIGATOIRES

Basic programming knowledge, preferably in MatLab or its open-source equivalent GNU Octave, basic mathematical background in Fourier series and transforms.

VOLUME HORAIRE

- Volume total: 30 heures
- Cours magistraux: 20 heures
- Travaux dirigés: 10 heures

CODES APOGÉE

- SPFBU36J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

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Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Initiation to research activities

Responsables	Descriptions	Informations
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Dernière modification le 18/06/2024

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

This project aims to make a first contact of the students with research work.The topics are provided by teachers/researchers from research labs associated to the master program.

Independent work on a specific topic is expected. Reading the litterature. Discussing with the supervisor to clear remaining questions. Start learning usage of an experimental setup or a computer code. Do some measurements or simulations and analyze them. Doing everything in a logical systematic way. Finally, present the topic and your work on it in an oral presentation, similar to what is done at conferences.

Examples of projects from previous years:

- Realization of a holographic diffraction grating and a transmission spectrometer
- Principles of holography and HOE
- Inverse design of thin film by IA
- Classification of medical and industrial images with a neural network optimized with a bio-inspired bi-objective algorithm
- Optical characterisation of the world largest and fastest EMCCD
- Electromagnetic modeling of radar signals
- Development of a thermal imaging system for the study of laser material interactions
- Wavelength or frequency measurement of laser light for spectroscopy, is it equivalent?

COMPÉTENCES À ACQUÉRIR

At the end of this module, the student will:

- Have knowledge how researchers work in the lab
- Be able to acquire specific knowledge on a research project
- Get some hands-on experience in the chosen field.

MODALITÉS D'ORGANISATION

Depends on the project and on the supervisor. Half day / Full day / week in a research lab during the Semester.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

Depends on the project and on the supervisor.

VOLUME HORAIRE

CODES APOGÉE

- SPFBU37J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Master Physique fondamentale et applications
Internship

Responsable	Descriptions	Informations
Frank WAGNER frank.wagner@univ-amu.fr	Code : SPFBU38 Nature : UE Stage Domaines : Sciences et Technologies	Composante : Faculté des Sciences

Dernière modification le 18/06/2024

LANGUE(S) D'ENSEIGNEMENT

Français

CONTENU

The internship is a study achievement. A minimum of working hours equivalent to 7 weeks of full-time work must be completed.

Students are in charge of finding their internship topic, which must be in line with the master program.

During this internship, the students gather insight in procedures and practical work in industry or research institutions. They acquire hands-on experience in a concise practical task related to a future job profile in the field of Optics and Photonics, be it in research or industry. They can participate in and contribute to an interdisciplinary team and are able to present their work in discussions with others. They are able to transfer their theoretical knowledge into practical solutions to real world problems.

COMPÉTENCES À ACQUÉRIR

The students

- understand work procedures and methodology in an industrial or a research institution.
- understand requirements in an industrial or research environment.
- understand the interrelation of theoretical findings, simulations, experimental studies and practical solutions in Optics and Photonics.
- are able to systematically approach a practical problem.
- gather experience in interdisciplinary team work and are able to express their knowledge in such an environment.
- are able to scientifically report and present their work.

MODALITÉS D'ORGANISATION

Full-time intership at an industry or research institution.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

Individual literature will be provided by the external internship advisor.

PRÉ-REQUIS OBLIGATOIRES

Scientific background in Optics and Photonics

VOLUME HORAIRE

CODES APOGÉE

- SPFBU38J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Master Physique fondamentale et applications
Français langue étrangère 2

Responsable	Descriptions	Informations
	Code : SPFBU39	Composante : Faculté des Sciences
	Nature : Unité d'enseignement	
	Domaines : Sciences et Technologies	

LANGUE(S) D'ENSEIGNEMENT

Partiellement Anglais

CONTENU

For students to acquire a competency in communication in the French language and an understanding of French society and culture so that they may express themselves, write directly, and express comprehension when communicating with French speakers.

1. Four areas of language competency will be covered – oral and written comprehension, oral and written communication – but emphasis will be placed on oral competency, therein integrating pragmatic, socio-cultural and strategic proficiencies according to the Common European Framework of Reference for Languages (CEFR).

2. The lesson plans for this class will be communicative and action- oriented. As the approach will be centered on students engaging in communicative tasks, there will be flexibility in the choice and duration of the class activities.

   The course program will therefore be adapted to best fit the linguistic needs of each level. The topics covered may vary depending on local, national or international news and the time of year.

   The course is not a lecture and its success depends greatly on student participation. Class attendance is strongly recommended. In the case of an absence, the student is invited to make up the work done in class and any homework given during the student’s absence. Documents from class will be available on a digital workspace.
3. Resources and training materials : authentic documents, articles, photos, songs, videos, playful material from the publisher or made by the teacher and written or audio documents from manuals, methods or sites.

COMPÉTENCES À ACQUÉRIR

Varies according to the level of each group.

MODALITÉS D'ORGANISATION

The lesson plans for this class will be communicative and action-oriented. As the approach will be centered on students engaging in communicative tasks, there will be flexibility in the choice and duration of the class activities

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

- La Grammaire des premiers temps (PUG)
- Grammaire Progressive du Français (Clé International)

PRÉ-REQUIS OBLIGATOIRES

Adapted according to the level of each group.

VOLUME HORAIRE

- Volume total: 24 heures
- Travaux dirigés: 24 heures

CODES APOGÉE

- SPFBU39J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

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Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Advanced theoretical optics

Responsables	Descriptions	Informations
Miguel angel ALONSO GONZALEZ miguel-angel.ALONSO-GONZALEZ@univ-amu.fr Frederic ZOLLA frederic.zolla@univ-amu.fr	Code : SPFCU41 Nature : Unité d'enseignement Domaines : Sciences et Technologies	Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Rays and Waves

An overview is given of the many ways to understand the connection between the ray and wave models, and the corresponding ways to construct models for propagating waves based exclusively on rays. Analogies with other areas of physics are stressed, particularly that with the connection between the classical and quantum models for particles.

1.1 Mathematical elements

- Asymptotic methods: stationary phase and saddle points
- Fourier uncertainty
- Phase-space representations: Wigner, Husimi/Q/Spectrogram, Kirkwood/Rihaczek/Dirac

1.2 Ray-wave connection in the paraxial limit

- Review of wave optics in the paraxial regime
- Review of ray optics in the paraxial regime: phase space representation
- Collins formula and LCT for connecting rays and waves
- Complex ray bundles and Gaussian beams

1.3 Ray-wave connection in the short-wave limit

- Nonparaxial scalar wave optics in terms of amplitude and phase: super- and sub-oscillations (Gouy phase)
- Use of stationary phase and Feynman integral picture.
- Flux lines and Bohmian paths
- Debye asymptotic series
- The many faces of ray optics: Eikonal equation, Fermat's principle and the Ibn Sahl-Decartes-Snell law
- Ray-based wave estimates in the position representation: connection with WKB
- Caustics
- Angular spectrum/Fourier regime
- Ray-based wave estimates in the direction/momentum representation: connection with Debye-Wolf (& Richards-Wolf)
- Direction/momentum caustics
- Connections through stationary phase
- Diffraction: Keller's diffracted rays
- Uniform asymptotics
- Gaussian summation methods

1.4 Ray-wave connection in the low coherence limit

- Basic elements of spatial coherence: the cross-spectral density and the Wolf equations
- Radiative transfer equation: the radiance or specific intensity
- Wave-based definitions of the radiance and conservation along rays
- Analogies in other areas of optics and physics.

Structured light

This course presents the basic elements of structured light beams, including properties and applications. General aspects of optical fields are also discussed such as polarization, geometric phase, energy flow, and gradient and scattering forces on particles.

2.1 Scalar solutions

- Types of self-similarity
- Plane-wave superposition
- Talbot effect
- Closed-form solutions of wave equations through separation of variables
- Propagation-invariant beams: Bessel, Mathieu, others
- "Accelerating" beams: Airy and its variants
- "Self-healing", "acceleration" and other apparently strange behavior
- Structured Gaussian beams: Hermite-Gauss, Laguerre-Gauss, Ince-Gauss, others
- Ray pictures
- Applications in imaging, machining, manipulation, and information transfer

2.2 Polarization

- Review: Jones vectors, Stokes parameters, Poincaré sphere
- Polarizers, birefringent elements, and geometric phase
- Vector beams and non-uniform polarization
- Orbital and Spin angular momentum in the paraxial regimes; interaction with particles.

2.3 Nonparaxial generalizations

- Modeling strongly focused light: angular spectrum, Debye-Wolf and Richard-Wolf integrals
- Multipolar expansions
- Scalar structured nonparaxial fields
- Montgomery effect
- Orbital and spin angular momenta in the nonparaxial regime, and spin-orbit coupling
- Nonparaxial descriptions of polarization
- Trapping forces and torques
- Principles of Mie theory: forces and torques.

VOLUME HORAIRE

- Volume total: 40 heures
- Cours magistraux: 40 heures

CODES APOGÉE

- SPFCU41J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Quantum optics and quantum information

Responsables	Descriptions	Informations
Thomas DURT thomas.DURT@univ-amu.fr Brian STOUT brian.stout@univ-amu.fr	Code : SPFCU42 Nature : Unité d'enseignement Domaines : Sciences et Technologies	Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The goal of our lessons is to familiarize the student with a quantum description of light; in particular it is aimed at introducing fundamentals in quantum optics and quantum information. Concepts such entanglement, vacuum fluctuations, second quantization and so on are indeed necessary in order to go beyond the classical Maxwell description. In our teachings, we aim at providing a survey of the progresses realized between Planck's derivation of the black body distribution in 1900, and quantum teleportation one century later, not fogetting precise predictions regarding spontaneous emission (Fermi golden rule-30's), the machinery of coherent states produced by a laser source (60's) and the so-called second quantum revolution initiated in the 90's. The tools that we introduce aim at giving to the student the ability to understand the most recent achievements in quantum information and quantum optics (entanglement, quantum cryptography, single photon sources, quantum tomography...).

Quantum information (11h)
qubits, entanglement, q communication, decoherence, quantum cryptography, biorthogonal Schmidt decomposition

Quantum optics - Part I (11h)
black body radiation, one mode quantization, coherent states, light-matter interaction, Fermi golden rule

Quantum Optics - Part II (6h)
Squeezed states, Quantum theory of beam-spliters, Quadrature opertators, Homodyne detection, Hong-Ou-Mandel effect

COMPÉTENCES À ACQUÉRIR

The students

- get familiar with a quantum description of light
- get acquainted with the most recent developments of quantum optics and quantum information
- are able to solve elementary exercises similar to those solved during the course and the tutorials sessions

MODALITÉS D'ORGANISATION

Two hours sessions of mixed courses and tutorials.

Evaluation: 1 written exam

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

Griffith: Introduction to Quantum Mechanics

PRÉ-REQUIS OBLIGATOIRES

- Solid mathematical background, basic knowledge in physics
- Fundamentals in Atomic Physics/Quantum Mechanics

VOLUME HORAIRE

- Volume total: 28 heures
- Cours magistraux: 28 heures

CODES APOGÉE

- SPFCU42J [ELP]

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POUR PLUS D'INFORMATIONS

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Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Nanophotonics

Responsables

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Descriptions

Code : SPFCU43

Nature : Unité d'enseignement

Domaines : Sciences et Technologies

Informations

Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Part 1: Periodic Nanophotonics (10h)
• Electromagnetic Prerequisites : Maxwell's equation in matter and constitutive relations, wave equations in 1D, 2D and 3D
• Modal analysis in Nanophotonics : dispersion relation
• Total/scattered field formulation of a typical Nanophotonic scattering problem
• Finite element computation of modal and direct nanophotonic problems
• Hands on 1: the dispersion relation of a photonic crystal
• Hands on 2: scattering by photonic crystal slabs and metasurfaces

Part 2: Resonant Nanophotonics & Metasurfaces (10h)
• Survey of plasmonics (Wood's anomalies, light absorbers)
• Pole and zero of the reflection coefficient
• Dispersion curves of SPP, Excitation of SPP (Kretschmann, Otto, Near field excitation), SPR biosensing
• Diffraction grating. Grating's law, Excitation of SPPs with gratings
• Basics of light scattering (Rayleigh & Mie scattering)
• Mie coefficients, polarizability of sub-wavelength sized particles
• LSPR : Plasmons on metallic nanospheres
• Near, intermediate and far fields scattered by electric dipoles
• Electric & magnetic Mie resonances on high refractive index particles
• Structural colors
• All-dielectric nanophotonics & Mie resonant nanophotonics
• Metasurfaces

Part 3: Nanophotonics (8h) : Green's functions, Density of States, Optical Antenna Theory
- Introduction to Green function theory
- Local Density of States and photonic Lamb shift (from Green functions)
- Spontaneous and stimulated emission of quantum emitters
- Optical antenna theory
- Decay rate enhancement, Photonic Lamb Shift

COMPÉTENCES À ACQUÉRIR

- Learn the physics and some computational aspects of today's Nanophotonics and some applications.
- Learn how to formulate and calculate Green functions and use them in optical antenna theory
- Lean how to calculate the poles of reflection coefficients and scattering coefficients, plot the dispersion relations

MODALITÉS D'ORGANISATION

This course is a classical lecture with some computer work and practical work.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

Lukas Novotny, Principles of Nano-Optics, 2012, Cambridge
Jian-Ming Jin, Theory and Computation of Electromagnetic Fields, 2010, John Wiley & Sons
S.Enoch, N. Bonod, (Eds.). (2012). Plasmonics: from basics to advanced topics (Vol. 167). Springer.
Maier, S. A. (2007). Plasmonics: fundamaentals and applications (Vol. 1, p. 245). New York: springer.

PRÉ-REQUIS OBLIGATOIRES

Basic knowledge on electrodynamics and numerical analysis

VOLUME HORAIRE

- Volume total: 28 heures
- Cours magistraux: 28 heures

CODES APOGÉE

- SPFCU43J [ELP]

M3C

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POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Modern lasers and laser-matter interaction

Responsables

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Descriptions

Code : SPFCU44

Nature : Unité d'enseignement

Domaines : Sciences et Technologies

Informations

Composante : Faculté des Sciences

Dernière modification le 18/06/2024

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Part 1: Modern laser sources
- Nanosecond lasers and thermal problems in lasers (rate equations; spiking; q-switching; MOPA architecture; q-switch devices; injection seeding; beam quality of Gauss. Beams; peak fluence measurement; thermal lenses in lasers: rod laser, slab laser, thin disc laser, fiber laser)
- Ultrashort lasers (Definitions and timescales, Building a femtosecond oscillator, Amplifying a femtosecond pulse, Measuring a femtosecond pulse)

Part 2: Ultrafast laser-matter interaction
Interests of ultrashort pulses (intense and short), Mechanisms of interaction (from energy absorption to ablation), Ultrafast measurements (pump-probe), Optical breakdown, low-density plasma and microexplosion applications - Lab work

Part 3: Laser-matter interaction from ns to ms regime
A long pulse laser as heat source; thermal diffusion; heat affected zone;

Part 4: Some applications of laser-matter interaction
laser cutting; reactive cutting, drilling, welding; Laser damage measurements and models; "fatigue" effect; fusion class lasers.

COMPÉTENCES À ACQUÉRIR

Learn the physics and practical aspects of today’s lasers and their application in material science.

MODALITÉS D'ORGANISATION

This course is a classical lecture with some excercises.

PRÉ-REQUIS OBLIGATOIRES

Basic knowledge on lasers and solid state physics

VOLUME HORAIRE

- Volume total: 32 heures
- Cours magistraux: 32 heures

CODES APOGÉE

- SPFCU44J [ELP]

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POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Faculté des Sciences
Aix-Marseille Université

Master Physique fondamentale et applications
Advanced computational EM methods

Responsables	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Direct methods in computational EM with the finite element method (18 hours)

This lecture will contain a theoretical part and also numerical demonstrations realized by the teacher and training classes for the students using dedicated softwares : Gmsh/GetDP for the Finite Element Method

- Finite Element Method and introduction to Gmsh/GetDP softwares
- Basic principles with a one dimensional example
- Few words on the Galerkin method and the boundary conditions
- Domain discretization and interpolating functions
- Numerical dispersion
- Vector problem and edge elements
- Eigenvalue problems in the harmonic regime (modal analysis): 1D and 2D scalar examples
- From classical Maxwell equations to their weak formulation
- Use of the mesh generator Gmsh and use of the solver GetDP : 3 simples examples
- Survey of more advanced topics (if possible) : perfect matching layers, outgoing wave condition, periodicity, vector field and 3D case, operator point of view, symmetry properties in electrodynamics and their use in numerical modelling

Inverse methods for characterization and imaging (14 hours)

COMPÉTENCES À ACQUÉRIR

- Understanding the theoretical basics of computational EM with the finite element method
- Knowing of the basic methodology in the correct use of numerical modelling softwares
- Know-how to use the open-source FEM softwares Gmsh and Getdp to solce simple EM problems

MODALITÉS D'ORGANISATION

This course is a classical lecture with some excercises on computers for the finite element part.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

J.-M. Jin , The finite element method in electromagnetics, 3rd edition, Wiley, 2014
M. G. Larson, and rengzon , The Finite Element Method: Theory, Implementation, and Practice", Springer, 2010
J.-M. Jin , Theory and computation of electromagnetic fields, Wiley, 2010

D. Colton and R. Kress, Inverse Acoustic and Electromagnetic Scattering Theory, Springer, 2019
X. Chen, Computational Methods for Electromagnetic Inverse Scattering, Wiley, 2018
P.M. van den Berg, Forward and Inverse Scattering Algorithms Based on Contrast Source Integral Equations, Wiley, 2021

PRÉ-REQUIS OBLIGATOIRES

Basic knowledge in electrodynamics, guided optics, differential equations and integration in maths

PRÉREQUIS RECOMMANDÉS

Functional space analysis, Linear algebra

VOLUME HORAIRE

- Volume total: 32 heures
- Cours magistraux: 22 heures
- Travaux dirigés: 10 heures

CODES APOGÉE

- SPFCU45J [ELP]

M3C

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POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Optical components

Responsables	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The students from different backgrounds elaborate their knowledge on the physical principles of optoelectronic devices. Applications in sensing, lightning, nanotechnology, energy harvesting.

The teaching unit is composed of 3 completely independent parts: Optoelectronics, crystal based components, thin film optical coatings.

Part 1: Crystal based optical components
Anisotropic optics in biaxial crystal, finding the linearly polarized waves that can propagate in a given arbitrary direction (index and polarization direction) Applications is polarizers, waveplates, pockels cells and other optical components

Part 2: Semiconductor based optical components
- Electronic band theory of semi-conductors : mono-dimensional toy model, electronic band structure, effective mass : origin of holes, extension in 3D and application to common semi-conductors, transitions in direct and indirect bandgap semi-conductors
- Light Emitting Diodes : From the Electronic band structure to the space band diagram, Classical homojunction, heterojunction
- Devices : Structure of a LED, fabrication, extraction and light management, efficiencies, emission spectrum, applications

Part 3: Thin film optical coatings
– Thin film theory (propagation and interferences inside a multilayer structure; Calculation techniques for the reflectance and transmittance factors of a coating;
– Thin film design (classical multilayer stuctures used for dielectric mirrors, antireflection coatings, edge filters, bandpass filters);
– Manufacturing and characterization of thin film filters (theoretical elements and experimental demonstration).

COMPÉTENCES À ACQUÉRIR

The students know

- how what represents an bandstructure and how it can be obtained
- what is a direct / indirect bandgap materials
- understand the applications of each
- what an LED and a CMOS sensor are and how they are build
- what the efficiency of a LED and a sensor is
- how to determine the refractive index and the polarization of the linearly polarized eigenmodes propagating in a crystal
- the different types of polarizers
- how waveplates, electro-optic modulators (pockels cells), liquid-crystal light modulators, acousto-optic modulators work.
- what happens inside a multilayer structure.
- how to design a thin film stack to obtain a given reflectance or transmittance spectral profile.
- how thin film filters are manufactured.

MODALITÉS D'ORGANISATION

Final written examination consisting of several problems and knowledge/comprehension questions on the course content

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

Pierret, Advanced semiconductor fundamentals, 1987
Parker, Physics of optoelectronics, CRC Press, 2005
Chuang, Physics of optoelectronic devices, 1995

PRÉ-REQUIS OBLIGATOIRES

Basic knowledge on electrodynamics and solid state physics

VOLUME HORAIRE

- Volume total: 32 heures
- Cours magistraux: 32 heures

CODES APOGÉE

- SPFCU46J [ELP]

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POUR PLUS D'INFORMATIONS

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Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Photonics for biomedical applications

Responsables	Descriptions	Informations
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LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Cell imaging (14h)
Optical contrasts in biological samples: absorption, scattering, fluorescence, molecular vibrational contrasts
The optical Microscope (typical optical system, diffraction and spatial resolution, confocal, TIRF, dark field)
Superresolution techniques: Above the diffraction limit (4pi-microscopy, STED, SIM, PALM, STORM)
Advanced optical microscopy techniques (Fluorescence correlation spectroscopy, fluorescence life time imaging)
Deep tissue Imaging I: clearing, light sheet, non-linear microscopy, adaptive optics, optical wavefront shaping
Deep tissue Imaging II: photoacoustic imaging

Tissue imaging and biomedical applications (10h) :
Introduction to biological tissue optics
Main contrasts: Absorption, fluorescence
Optical scattering, phase function, Rayleigh & Mie scattering
Model of light propagation through biological tissues, Radiative Transfer Equation, Diffusion Equation
Introduction to inverse problems resolution
Instrumentation and imaging/diagnostic setups examples

COMPÉTENCES À ACQUÉRIR

The students :
• become aware of the importance of the research community working on optical imaging in biology, and of the most active research activities that are animating the fields of bioimaging and biophotonics
• possess a solid knowledge on all the techniques capable of imaging living matter, from the scale of single cells in culture, to the scale of animals and patients.
• learn/consolidate fundamental knowledge in physics related to main physical contrasts, to light propagation in biological tissues, to molecular fluorescence, Raman spectroscopy.
• know basics in biology, such as in cell biology and fluorescence labelling techniques.
• perform quick calculations of relevant numbers in the lab, and learn how to make reasonable physical assumptions to simplify these calculations

MODALITÉS D'ORGANISATION

Type of Examination: written exam

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

G. Cox, Optical Imaging Techniques in Cell Biology
B. Valeur, Molecular Fluorescence Principles and Applications
M. Born and E. Wolf, Principles of Optics, Cambridge University Press Ed.
Tuan Vo-Dinh, Biomedical Photonics Handbook, CRC Press, 2003
V. Tuchin, Tissue optics, Light scattering methods and instruments for medical diagnosis, SPIE Press, 2000
Miller et al., Deep tissue imaging with multiphoton fluorescence microscopy, Current opinion in biomedical engineering (2017)
Lecoq et al., Wide. fast. deep: recent advances in multiphoton microscopy of in vivo neuronal activity, Journal of Neuroscience (2019)
Ji, Adaptive optical fluorescence microscopy, Nature methods (2017)
https://aomicroscopy.org/
Rotter and Gigan, Light fields in complex media: Mesoscopic scattering meets wave control, Reviews of Modern Physics (2017)
Mosk et al., Controlling waves in space and time for imaging and focusing in complex media, Nature photonics (2012)
Wheelock et al., High-density diffuse optical tomography for imaging human brain function, Review of Scientific Instruments (2019)
Vasilis Ntziachristos, Going deeper than microscopy: the optical imaging frontier in biology, Nature Methods (2010)
Paul Beard, “Biomedical photoacoustic imaging” Interface Focus (2011)
Manohar and Razansky, Photoacoustics: a historical review, Advances in Optics and Photonics (2016)

VOLUME HORAIRE

- Volume total: 24 heures
- Cours magistraux: 24 heures

CODES APOGÉE

- SPFCU47J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Instrumentation for astronomy

Responsable	Descriptions	Informations
Philippe AMRAM philippe.amram@univ-amu.fr	Code : SPFCU48 Nature : Unité d'enseignement Domaines : Sciences et Technologies	Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Chapter 1. Observing the universe. Links with instrumentations

1.1 Observing the universe at different wavelengths
1.2 Parasitic sources of light emission
1.3 Other sources of light emission
1.4 Neutrinos
1.5 Gravitational waves
1.6 Observatories of the 21st century

Chapter 2. Telescopes

2.1 Basics on telescopes
2.2 UVOIR (UV-Optical-IR) telescopes
2.3 High angular resolution
2.4 Radio telescopes
2.5 Observing from space
2.6 X and γ-rays astronomy

Chapter 3. Light dispersers

3.1 Prisms
3.2 Gratings and Grisms
3.3 Fabry-Perot interferometers, tunable filters
3.4 Michelson interferometers, FFT

Chapter 4. Detectors

4.1 The observer's problem
4.2 Flux Measurements and noises
4.3 Charge Coupled Devices (CCD)
4.4 Alternative detectors

Chapter 5. Introduction to spectroscopes

5.1 Introduction to astrophysical instrumentation
5.2 Spectroscopy: basic Layouts
5.3 Introduction to spectroscopes and data cubes
5.4 Quick spectroscope history
5.5 Spectrographs and spectrometers

Chapter 6. Spectrographs

6.1 Introduction
6.2 Elementary ray optics
6.3 Energy flow
6.4 Study of a spectrograph
6.5 Dispersers
6.6 Study of a spectrograph, the case of gratings
6.7 Application: Example of grating spectrograph
6.8 Instrumental design constraints

Chapter 7. Spectro-Imagers

7.1 Etendue Conservation
7.2 Multi-object spectrographs (MOS)
7.3 Spectro-imagers (IFU, IFS)
7.4 Spectro-imagers: spectrograph imagers
7.5 Spectro-imagers: spectrometer imagers

MODALITÉS D'ORGANISATION

Two hours sessions of mixed courses and tutorials. Possibility to perform observations at Observatoire de Haute-Provence.

PRÉ-REQUIS OBLIGATOIRES

Solid background in optics

VOLUME HORAIRE

- Volume total: 26 heures

CODES APOGÉE

- SPFCU48J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Innovation and patenting

Responsable	Descriptions	Informations
	Code : SPFCU50	Composante : Faculté des Sciences
	Nature : Unité d'enseignement	
	Domaines : Sciences et Technologies	

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The student has an understanding how innovative concepts for optical and photonics products are transferred into a successful business development. The student knows about and makes first hands on experiences on business development aspects in a technology start up environment. The students are provided an introduction into the field of patent rights.

This course is instructed and presented by an external innovation specialist of the R&D, business and management department of Multiwave.

COMPÉTENCES À ACQUÉRIR

The students

- understand the implications of intellectual property
- are able to perform data base research
- get an understanding of how to design a project

PRÉ-REQUIS OBLIGATOIRES

Good knowledge in optics & photonics.

VOLUME HORAIRE

- Volume total: 16 heures
- Cours magistraux: 16 heures

CODES APOGÉE

- SPFCU50J [ELP]

M3C

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POUR PLUS D'INFORMATIONS

[Aller sur le site de l'offre de formation...]

Dernière modification le 18/06/2024

Master Physique fondamentale et applications
Français langue étrangère 3

Responsable	Descriptions	Informations
	Code : SPFCU51	Composante : Faculté des Sciences
	Nature : Unité d'enseignement	
	Domaines : Sciences et Technologies	

LANGUE(S) D'ENSEIGNEMENT

Partiellement Anglais

CONTENU

For students to acquire a competency in communication in the French language and an understanding of French society and culture so that they may express themselves, write directly, and express comprehension when communicating with French speakers.

1. Four areas of language competency will be covered – oral and written comprehension, oral and written communication – but emphasis will be placed on oral competency, therein integrating pragmatic, socio-cultural and strategic proficiencies according to the Common European Framework of Reference for Languages (CEFR).
2. The lesson plans for this class will be communicative and action-oriented. As the approach will be centered on students engaging in communicative tasks, there will be flexibility in the choice and duration of the class activities.

   The course program will therefore be adapted to best fit the linguistic needs of each level. The topics covered may vary depending on local, national or international news and the time of year.

   The course is not a lecture and its success depends greatly on student participation. Class attendance is strongly recommended. In the case of an absence, the student is invited to make up the work done in class and any homework given during the student's absence. Documents from class will be available on a digital workspace.

3. Resources and training materials : authentic documents, articles, photos, songs, videos, playful material from the publisher or made by the teacher and written or audio documents from manuals, methods or sites.

COMPÉTENCES À ACQUÉRIR

Varies according to the level of each group.

MODALITÉS D'ORGANISATION

The lesson plans for this class will be communicative and action-oriented. As the approach will be centered on students engaging in communicative tasks, there will be flexibility in the choice and duration of the class activities.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

La Grammaire des premiers temps (PUG)

Grammaire Progressive du Français (Clé International)

PRÉ-REQUIS OBLIGATOIRES

Adapted according to the level of each group.

VOLUME HORAIRE

- Volume total: 24 heures
- Travaux dirigés: 24 heures

CODES APOGÉE

- SPFCU51J [ELP]

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POUR PLUS D'INFORMATIONS

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Dernière modification le 18/06/2024