

Physique fondamentale et applications

Master 1

Fiche descriptive UE

Intitulé UE	Fundamentals of Photonics: Quantum Electronics
Crédits ECTS	5
Responsable de l'UE/Equipe pédagogique	AMANTI Maria BRAIVE Rémy
Volume horaire	Cours: 24h (12 séances) TD: 24h (12 séances) TP: 12h (3 séances)
Semestre	S2
Pré-requis	<u>Enseignements pré-requis:</u> M1 Matière Condensée, Cours d'optique en L3 <u>Notions pré-requises:</u> Equations de Maxwell, Interference, Polarisation, Structure de bande, cristallographie, statistique Bose-Einstein, Statistique Fermi-Dirac, règle d'or de Fermi

Programme

1 - Photon emission and guiding

Analogy photon - electron

Emitting materials

Quantum wells / quantum dots :
electronic density of states; photon
emission; Stark effect fabrication
techniques

Optical waveguides

Guided waves in dielectric slabs
and fiber

Wave propagation in periodic
media (DFB, Photonic crystals)

Coupled waveguides

Interactions

Weak & Strong coupling

2 - Laser

Light matter interaction

Summary of black body radiation
theory

Spontaneous emission (Einstein
coefficient via thermodynamics
approach)

Absorption and stimulated
emission

Natural linewidth, Schawlow-
Townes linewidth,

Saturation

Rate equations

3 and 4 levels laser, CW laser,
Transient laser, Relaxation
oscillation

Coherence

Spatial / temporal coherence,
correlation function

3 - Nonlinear optics

Classical electron model

	<p>Polarizability and dielectric constant Non linear Polarization Second order nonlinearity: SHG and DFG Third order nonlinearity: four wave mixing Nonlinear optical effects in fibers</p> <p>4 - Introduction to photon statistics Single photon sources: Purcell effect / Parametric down conversion Correlation function (1rst and 2nd order)</p>
<p>Ouvrages de référence</p>	<ul style="list-style-type: none"> ● A Yariv and P Yeh: Photonics. Optical Electronics in Modern Communications ● O.Svelto: Principles of Lasers ● Hecht, Optics (Addison Wesley Longman) ● Loudon, The Quantum Theory of Light (Oxford Publishing)
<p>Modalité d'évaluation</p>	<p>Contrôle final : Partiel + Examen : 65 % TP : 35 %</p>