Quantum Electronics 2 ECTS credits

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Quantum electronics is a fast growing field of research and a major enabling technology playing an increasingly central role in our high-tech society. It offers a broad variety of applications in the area of information technology, life science, optical sensing, lightning, energy, and manufacturing.

This course will provide selected concepts of quantum electronics in the semi-classical approximation, and will focus on integrated components for optical communications.

2 ECTS credits can only be given to the participants who will pass the final exam.

Content:

1: Course formalia, introduction to Quantum Electronics, résumé of EM theory;

History of light and atom quantization, Maxwell equations, plane waves, light polarization, propagation in uniaxial crystals, phase and group velocities.

2: Waveguide optics & Devices

Transverse resonant condition, Fabry-Perot resonator, modes in slab waveguides, mode interference, Effective Index Method, Coupled Mode Theory, example of waveguide devices.

3: Ligth propagation in periodic media, Photonic crystals

Bragg diffraction, photonic bandgap, periodic layered media, waveguide gratings, Bloch waves in photonic crystals (PhCs), unusual dispersion properties of PhCs, defect waveguides, example devices, photonic crystals in nature.

4: Introduction to nonlinear (NL) optics

Physical origin of nonlinear polarization, conservation laws for elastic NL interactions, phase matching problem, second harmonic generation, birefringence and Quasi-Phase Matching, Self-phase modulation, Stimulated Raman Scattering

5: Electro-optic (EO) modulation of light

Introduction to light modulation, linear EO effect, phase retardation, Electro-optic modulation of amplitude or phase, traveling wave modulators

6: Laser systems

Absorption and emission of light, principle of operation for a laser, mode-locking, Q-switching, techniques for compensation of GVD (Group Velocity Dispersion), types of lasers.

Examination

The written exam will consist of questions based on the lecture material. **50%** right answers are required to pass.

Recommended literature

"Fundamentals of Photonics, Saleh & Teich", **2nd** Ed.

"Photonic Crystals: Molding the Flow of Light", Joannopoulos, Johnson, Winn, and Meade,

2nd Ed. – online: http://ab-initio.mit.edu/book/

Helpful links on particular subjects: http://www.ict.kth.se/courses/IO2655/index.htm?links.html