IO2652 Optics, Continuation Course 6.0 credits

Optik, fortsättningskurs

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for IO2652 valid from Autumn 2008

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Physics

Specific prerequisites

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

During the course, the students will examine topics that are at the frontiers of contemporary optics, photonics and nanoscience. In the first part of the course, the students will thoroughly analyse near field light and its applications in microscopy and nanophotonics. In the second part, which is more a character of general education, the students will familiarise themselves with a variety of "hot" topics in nanophotonics, such as semiconductor quantum dots, plasmonics, photonic crystals, carbon nanotubes and nanocomposites. Research-inclined students should find the course helpful in choosing their future carriers.

After the completed course, the students should be able to:

- **Define distinctions and common features between far and near field light, nano- and conventional photonics.**

- **Discriminate between different scanning microscopy techniques and be able to choose the most appropriate one for characterisation of specific material properties, such as surface morphology, optical response and electrical characteristics.**

- **Characterise near field optical microscopy conditions needed to evaluate such optical properties as luminescence, transmission and refraction. This includes identifying advantages and drawbacks of the technique and making optimal tradeoffs for specific tasks.**

- **Distinguish between different types of photonic crystals; define photonic band gaps and role of defects in photonic crystal devices.**

- **Describe basics and identify important issues in technology and applications of semiconductor nanostructures, plasmonic structures, carbon nanotubes and nanocomposites.Besides, the students will improve their literature search, seminar preparation and presentation skills.**

Course contents

The course is foreseen for the 4th year undergraduate and postgraduate students. The course is freely selectable in MSc programme in Photonics. It is also a part of the Erasmus Mundus Masters programme in Photonics. The course is given in English. The course code for undergraduates is IO2652, for PhD students - 2B5318. Successfully completed course gives 6 credits.

The topics of the course include:

- **Properties of the near field radiation, including generation, detection and analysis.**

- **Principles of operation and construction of a scanning near field optical microscope (SNOM).**

- **Plasmonics, apertureless SNOM.**

- **Non-optical scanning microscopy techniques.**

- **Principles of nanolithography and nanophotonic components.**
- **Technology and properties of semiconductor quantum dots.**
- **Photonic crystals.**
- **Carbon nanotubes, fullerenes, nanocomposites.**

Course literature

Nanophotonics, Paras N. PrasadUpplaga: 1 Förlag: John Wiley and Sons Inc. År: 2004ISBN: 0-471-64988-0

Supplementary literature

Kapitel från M. Ohtsu and K. Kobayashi, Optical Near Fields (Springer, Berlin, 2004), Introduction to Nanoscale Science and Technology, Edited by M. Di Ventra, S. Evoy and J. R. Heflin, Jr. (Kluwer, Boston, 2004) samt en del vetenskapliga skrifter. Extralitteratur delas ut vid början av kursen.

Examination

- INL1 - Assignments, 6.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

The undergraduate students are graded on the scale F to A, where F means fail and E to A corresponds to pass on an increasing scale. For the E, the students should deliver all the homework on time with 75 % of correct answers, prepare a seminar and be active in peer evaluation of seminars given by the fellow students. For higher grades, the students should complete the final home assignment (5 problems of varying difficulty) that is distributed towards the end of the course. Distinction between grades D and A is made according on the quality of the home assignment solutions, the seminar and the overall activity during the course.For the PhD students the simple grading scale with the grades pass (G) and fail (U) is maintained. To pass, the final home assignment is obligatory with a 60% of the total amount of points.The homework problems address the properties of the near field light, its applications to nanophotonics as well as optical properties metamaterials and nanostructures. To solve the problems, the students should be able to analyse the course material and apply basic principles of near field optics. Assessment of the seminar is based on

several criteria: ability to distinguish the basics of a topic, ability to pose and answer questions. The quality of presentation is not critical although a good presentation is treated as a bonus for higher grades.The final home assignment requires a more sophisticated analysis and synthesis of the course material. Its successful completion indicates that a student is able to link different course topics, can evaluate them critically and make tradeoffs in real life experimental situations.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.