Linnæus University

Course syllabus

Faculty Board of Science and Engineering
School of Computer Science, Physics and Mathematics

1FY100 Optik för Optikerutbildningen, 15 högskolepoäng
Optics for Optometrists, 15 credits

Main field of study
Physics

Subject Group
Physics

Level of classification
First Level

Progression
G1N

Date of Ratification
Approved by the Board of the School of Computer Science, Physics and Mathematics 2010-08-23

The course syllabus is valid from autumn semester 2010

Prerequisites
General entry requirements and Biology B, Chemistry B, Mathematics D, Physics B or Biology 2, Chemistry 2, Mathematics 4, Physics 2.

Expected learning outcomes

At completion of the course students should be able to:

- solve paraxial problems of imaging by spherical surface refraction, reflection, and with thin lenses
- treat thick lenses and systems of lenses, especially using principle planes
- determine the magnification and field of view for an optical system
- explain simple vision defects and calculate corrections
- use simple eye models
- explain the principle of common optical instruments, such as e.g. the microscope
- calculate simple illumination problems
- explain the basic properties of light, absorption and emission
- explain the occurrence of colors and the systematization of them, especially the RGB system
- solve simple dispersion problems
- make simple calculations related to the polarization of light
- explain the laser principle, common lasers and their context of use
- solve simple interference problems, especially in the cases of diffraction and thin films
- make calculations of antireflection coatings

- determine the significance of diffraction in an optical system
- handle optical equipment in a satisfactory manner
- assemble simple lab setups
- demonstrate optical imaging in different situations
- use interferometric measuring technique.

Content

The course covers the areas of geometric ray optics, physical optics, and photometry. The content is initially treated theoretically. Some of the material is also treated practically during laboratory work. The course is divided into three parts, two theoretical parts and laboratory work.

SUBCOURSE 1: *Geometric Ray Optics 6 credits*
The geometric optics part treats the following topics: reflection and refraction, paraxial imaging by flat surfaces, total internal reflection, prisms, imaging by spherical surface refraction and spherical mirroring, thin and thick lenses, systems of thin lenses. Furthermore, the following optics concepts are treated: wavefront, the ray concept, vergences, real and virtual images, focal point, principle plan and nodal point. Also the influence of apertures are treated, field stops, vignetting, pupils, f-numbers and numerical aperture. Common optical systems are treated, such as the camera, human eye, simple magnifier, microscope, telescope, eyepieces and condenser system. The basic optical principles are also mentioned of some common optometric instruments such as the vertometer, keratometer and retinoscope.

SUBCOURSE 2: *Physical Optics and Photometry 5 credits*
The physical optics part treats the wave nature of light, interference, diffraction and resolution, interference in thin films, antireflection coatings, color vision, dispersion and polarization of light. Interferometric measurement methods are also addressed as well as the laser and coherent light. Photometry treats concepts such as luminous flux, illumination, luminous intensity of a source, luminance, and the eye's spectral sensitivity. In addition, this subcourse also mentions the emission mechanisms of light, different light sources and laser mechanism, the basic properties of light, absorption and scattering.

SUBCOURSE 3: *Laboratory Work 4 credits*
During the laboratory work part the following topics are realized: optical imaging with thin spherical lenses, systems of lenses, and optical instruments such as the telescope and microscope. Furthermore, interferometric techniques as well as laser technologies are used. Dispersive properties of various types of glass materials are investigated using minimum angle of deviation in prisms. Polarization of light through absorption, reflection and scattering is observed. During the laboratory work students should compile a log book. During the experiments students use this log book to accurately record how the experiment is carried out and all results from the measurements. The student may then use this self-prepared log book as (only) tool during the written lab test.

Type of Instruction

Instruction consists of lectures, exercises and lab work. In addition, math workshops are scheduled. During the lectures all essential theoretical material within the course is covered. The presentation of certain sections can also reach somewhat beyond the course literature reading. During exercises standard problems and solution methodology is presented in order to consolidate understanding. It is recommended that students use exercise hours to ask questions. Math workshops are not teacher-led instructions, but rather to give students the opportunity to enhance their understanding by working with problem solving on their own and in groups. A teacher is available to answer questions. The laboratory works will give students the possibility to gain training with practical handling of optical equipment, and understanding of the relationship between the theoretical description and the corresponding physical situation. Participation in laboratory work is mandatory.

Examination

The course is assessed with the grades Fail (U), Pass (G) or Pass with Distinction (VG).
Subcourse 1 and 2 each ends with a written exam. Approved aid in these exams is the course book, formula compilation, your own notes and calculator. During the course 4 short written tests are given. These are not mandatory, but any qualified written test gives bonus for the main exam. For the main exams one of the grades fail, pass, or pass with distinction are used.

Subcourse 3, Labratory Work, ends with a special written test. As (only) aid during this test the student should use her/his own self-prepared log book. To qualify for this subcourse 3 the student must, firstly, carry out all lab work in a satisfactory way, and, secondly, perform successfully on the written test. The students will be given the grade pass or fail for subcourse 3.

To pass the complete course the student has to pass all subcourses. The final grade for the complete course is determined as a weighted average of the two exams in subcourses 1 and 2. Re-examination is offered within 4 weeks during semesters. The maximum number of exam occasions allowed are 6.

Course Evaluation

A course evaluation will be carried out at the end of the course in accordance with the guidelines of the University. The result of the course evaluation will be filed at the department.

Required Reading and Additional Study Material

Required reading

Freeman, M.H. 2003. Optics, Butterworth-Heinemann.(11th ed.), ISBN 0 7506 4248 3.

Reference Literature

Rabbets, R.B. 1998. Clinical Visual Optics. Butterworh-Heinemann. (3rd ed.), ISBN 0 7506 1817 5.

Supplementary reading

In addition, the institution provides (by the course teacher) additional material in the form of study manuals, practice compendium, dictionary, Lab instruktions, formula compilation, etc..