Detection of Light

Course concept: two Parts

We decided to split the course in two parts:

A. (Feb-Apr, 3 EC): A basic introduction in 8 lectures, completed by a written exam.

B. (Apr – Jun, 3 EC): A follow-up in the form of 7 guest lectures on specific topics/technologies, completed by a written report.

For students of Astronomy (Research) following DTL, part A is mandatory, part B is optional; for Instrumentation students, both parts are mandatory.

Lectures – Part A

#	Date	Title	Topics	Homework
1	2-Feb-18	Organization & Refresher of Solid State Physics	General: grading, exercises, book, nature of light, EM spectrum, technology, photographic plate, overview of detectors principles and types; solid state physics: atomic energy levels, crystal: bands, conductors and semi-condd., k-vector, Fermi energy	Homework
2	9-Feb-18	Intrinsic Photoconductors & Noise	general principle, box diagram, conductivity, mobility, tau, gain, quantum efficiency and responsivity; intro noise: poisson & Gaussian & 1/f noise; detector noise: Johnson, kTC, 1/f, BLIP	Homework
3	16-Feb-18	Extrinsic Photoconductors	energy bands, doping, wavelength ranges, limitations, drawbacks and comparisons; BIB detectors, photodiodes, avalanche diodes	Homework
4	23-Feb-18	IR Arrays & CCDs	IR arrays: principle, construction, readout electronics; CCDs: principle, back/front illuminated, thinned, readout, CTE, CT architectures, variants	Homework
	2-Mar-18		*Voorjaarsvakantie 2018*	
5	9-Mar-18	IR Arrays & CCDs		Homework
6	16-Mar-18	Operations and Artifacts	Readout schemes: SUR, Fowler, linearity & dynamic range, data rates; cryogenics	Homework
7	23-Mar-18	Bolometers	Basic operation, time constants, superconducting, edged; comparison: responsivity, noise, NEP	Homework
	30-Mar-18		*Good Friday*	
8	6-Apr-18	Heterodyne Detectors	general principle, IF, mixing, sidebands, bandwidth, components (HEB, SIS); performance: throughput, S/N, noise and antenna temperature, comparison coherent-incoherent detectors	Homework
	13-Apr-18	**13:30 - 16:30hr**	**EXAM in room HL414**	

Exam – Part A

- Part A (**3EC**) concludes with a written exam on 13 April 2018, 13:30 - 16:30 hr.
- It is a written, "closed book" exam. Pocket calculators are required at the exam.
- Grade = 80% written exam + 20% mandatory homeworks

The exam consists of three parts:

*I. Calculations [**35pt**] – (60 min)*

*II. Qualitative explanations [**25pt**] – (40 min)*

*III. Multiple choice questions [**20pt**] – (20 min)*

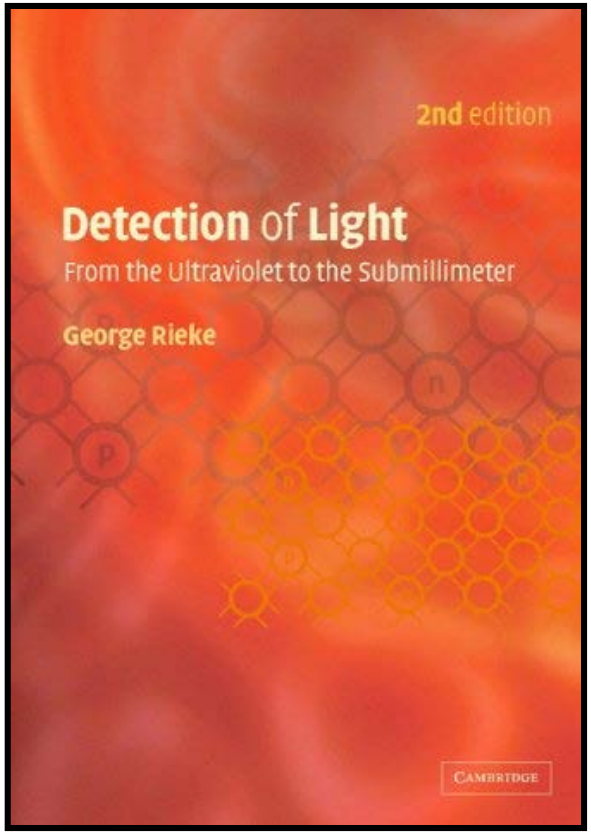
The maximum number of points is 80.

Literature

Main resource:

Detection of Light - from the Ultraviolet to the Submillimeter,

by George Rieke, 2nd Edition, 2003, Cambridge University Press, ISBN 0-521-01710-6.



Further reading:

- Introduction to Solid State Physics (8th Edition) by Charles Kittel;
- Electronic Imaging in Astronomy: Detectors and Instrumentation (2nd Edition) by Ian S. McLean;
- Observational Astrophysics by P. Lena, Francoise Lebrun & Francois Mignard;

Guest Lectures – Part B

Part B consists of talks on specific topics, given by renowned guest lecturers. Last year's program:

Date	Speaker	Affiliation	Topic
20-04-17	Akira Endo	TU Delft	
04-05-17	Michel Antolovic	TU Delft	
11-05-17	Marco Beijersbergen	cosine, U Leiden	
18-05-17	Alessandra Menicucci	TU Delft	
01-06-17	Derek Ives - **cancelled**	ESO	
08-06-17	Jochem Baselmans	SRON/TU Delft	
15-06-17	Jian-Rong Gao	SRON	

“Exam” – Part B

- For students following also Part B there are two requirements for the additional **3 EC**:
  - Attendance of (most of) the lectures
  - A report based on a literature study on a specific topic related to one of the guest lectures
- Report within 6 weeks on a topic related to a specific lecture:
- Grading: O/V/G

Last year’s topics →

Lecturer	Project title
Akira Endo	Astronomical Instruments and the Uncertainty Principle
Akira Endo	Are Photons invisible?
Michel Antolovic	Photon counting Imaging Systems for Space Applications
Michel Antolovic	Electron multiplication in CCDs
Marco Beijersbergen	Detecting X-ray Photons with a DEPFET
Marco Beijersbergen	Detecting Gamma-ray Photons
Alessandra Menicucci	SPENVIS radiation environment and its effect on detectors: L2 Orbit
Alessandra Menicucci	SPENVIS radiation environment and its effect on detectors: Highly Elliptical Orbit
Jochem Baselmans	MKIDs and LEKIDs
Jochem Baselmans	Designing an on-chip spectrometer
J.R. Gao	Should LiteBird use TES or KID detectors?
J.R. Gao	Can you use KIDs for X-ray astronomy?

Also important Points …

- You need to register in uSis
- Lecture room: Huygens #414 from 13:30 - 15:15 hr
- Lecturer: Prof. Dr. Bernhard Brandl, office: HL 1106
- TA: Patrick Dorval, office: #453
- Course website:

  http://home.strw.leidenuniv.nl/~brandl/DOL/Detection_of_Light.html

Course TA: Patrick Dorval

Office: Oort 453
Email: dorval@strw.leidenuniv.nl
Office Hours: Monday 14:00 to 15:00
Thursday 14:30 to 15:30

DTLa Weekly Exercises (8 sets)

- 20% of final grade
- Distribution: Fridays after each lecture (course website)
- Submission: On paper in following lecture
- Written feedback provided

Administrative or exercise-related questions:
drop by during office hours or send me an email