The Hong Kong University of Science and Technology

UG Course Syllabus

Photonics and Optical Communications

ELEC 4620

3 credits

Pre-requisite: ELEC 3600

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Course Description

To introduce the principles of photonics and optoelectronics for applications in optical communications. Core topics include light propagation in optical waveguides, transmission characteristics of optical fibers, fundamentals of light-matter interactions, principles of lasers, semiconductor physics for photonic devices including light-emitting diodes, laser diodes and photodetectors. Laboratory sessions will give six hands-on experiences in building experimental setups to characterize optical fibers, light-emitting diodes, laser diodes, photodetectors, and wavelength-division-multiplexed optical links.

List of Topics

Lecture Outline (tentative)

Lecture/Week 1:	Overview of photonics and optical communications
Lecture/Week 2:	Ray- and wave-optics in optical waveguides
Lecture/Week 3:	Maxwell's equations and electromagnetic wave propagation
Lecture/Week 4:	Electromagnetic theory for optical waveguides
Lecture/Week 5:	Transmission characteristics of optical fibers – fiber modes & attenuation
Lecture/Week 6:	Transmission characteristics of optical fibers - dispersion
Lecture/Week 7:	Fundamentals of light-matter interactions
Lecture/Week 8:	Principles of lasers
Lecture/Week 9:	Optical transitions in semiconductors
Lecture/Week 10:	Light-emitting diodes
Lecture/Week 11:	Semiconductor laser diodes
Lecture/Week 12:	Photodiode detectors
Lecture/Week 13:	Wavelength-division multiplexed optical communications (*optional*)

Laboratory Sessions

1. Measurement of fiber numerical aperture (NA)
2. Multimode fiber attenuation – cutback method

3. Singlemode fibers
4. Semiconductor light sources
5. Photodiode detectors
6. Wavelength-division-multiplexing components and links

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Homework	30% (5% × 6)	TBC
Lab	24% (4% × 6)	TBC
Project report	10%	TBC
Project presentation	6%	TBC
Final Examination	30%	TBC

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include [specific details, e.g., strengths, areas for improvement]. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Required Texts and Materials

Gerd Keiser, *Optical Fiber Communications*, latest edition

John Senior, *Optical Fiber Communications*, latest edition

Joseph C. Palais, *Fiber Optic Communications*, latest edition

Saleh and Teich, *Fundamentals of Photonics*, latest edition

Govind P. Agrawal, *Lightwave Technology – Components and Devices, latest edition*

Govind P. Agrawal, *Lightwave Technology – Telecommunication Systems, latest edition*

Yariv and Yeh, *Photonics – Optical electronics in modern communications*, 6th, or latest edition

Jia-Ming Liu, *Photonic Devices, latest edition*

Christopher C. Davis, *Lasers and Electro-Optics Fundamentals and Engineering, latest edition*

Pallab Bhattacharya, *Semiconductor Optoelectronic Devices, latest edition*

(Professional magazines – optional reading)

Optica Optics & Photonics News

IEEE Spectrum

Review-type articles from journals (e.g., IEEE/OSA/SPIE/APS)

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.