

Introduction to Microwave Photonics

Tentative Syllabus

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General:

This one semester course introduces the students to the basics of Microwave Photonics, which is a fusion of the microwave and optics technologies. This is an enabling technology for several interesting applications, which would be difficult to implement using any other approach.

The presented course is based on the assumption that the attending students are familiar with the basics of microwaves and optics.

The proposed course includes the following topics:

- An introductory overview:
What is microwave photonics? Advantages, a basic microwave photonics system
- The basic components (optical/microwave interaction – gain, distortion, noise):
 - optical sources-lasers – wideband direct modulation
 - optical modulators- EO, EA - wideband
 - optical detectors – wideband, high power, distributed
- Characterization of microwave photonics components
“S parameter like” approach to characterize mixed optical/electrical components
- Microwave Fiber optic Link
Analysis and design of fiber optic link for wideband (microwave rate) data transmission
- Optical switching of microwave circuits
Advantages and applications of optical switching of microwave components
- Optical control of microwave oscillators:
Switching, modulation, tuning, injection locking
- THz generation:
 - Electronic methods (frequency multiplication, Vacuum Tubes)
 - THz lasers, Cascade lasers
 - Optical downconversion
 - Photo mixing in a fast photo detector
- Optoelectronic oscillators:
Principle of operation, advantages, phase noise, frequency stability
- Optically based very high dynamic range microwave receivers:
A novel approach to implement an ultra linear, high dynamic range microwave receiver by use of optical techniques
- Monolithic integration of microwaves and optics
Implementation of true microwave photonics systems by building both optical and microwave functions on a single semiconductor substrate – mass production, low cost, miniature

References

- 1) Stavros Iezekiel, “Microwave Photonics – Devices and Applications”, Wiley 2009.
- 2) Rainee Simons, “Optical Control of Microwave Devices”, Artech House 1990.
- 3) Various papers from the technical literature.