



UNIVERSITÀ DI PISA
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE
Dottorato di Ricerca in Ingegneria dell'Informazione

Doctoral Course

“Modelling and Design of Integrated Optoelectronic Devices”

Prof. Paolo Pintus

University of Cagliari, Italy

University of California Santa Barbara, USA

Central European Institute of Technology - Brno University of Technology, Czech Republic

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Short Abstract: A vast set of integrated optoelectronic devices are based on two simple building blocks: ring resonators and Mach-Zehnder interferometers. Those building blocks are fundamental for several applications such as filters, switches and modulators, isolators and nonlinear optical elements. This class is focused on modelling and design of integrated optoelectronic devices based on ring resonators and Mach-Zehnder interferometers. The students will learn the main features of those optical components, both in a static and in a dynamic case, and how to optimize them to perform different operations.

Course Contents in brief:

- **Lecture 1: Microring resonator**
Overview on microring resonator with a focus on the main features and the input/output transfer function in the static case.
- **Lecture 2: Mach-Zehnder interferometer**
Overview on Mach-Zehnder interferometer with a focus on the main features and the input/output transfer function in the static case.
- **Lecture 3: How to tune a microring and a Mach-Zehnder interferometer?**
The main physical mechanism to control the optical refractive index will be presented, such as thermos-optic effect, electro-optic effects and magneto-optic effects.
- **Lecture 4: Dynamics of microring resonator and Mach-Zehnder interferometer**
The time-variant behavior of those building block is presented
- **Lecture 5: Applications**
The last class is focused on some applications.

Total # of hours of lecture: 16 hours

References:

1. A. Melloni, and F. Morichetti, “Photonic Devices”, Course Note 2020
 2. L. Chrostowski, M. Hochberg, “Silicon Photonics Design: From Devices to Systems”, Cambridge University Press.
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CV of the Teacher

Paolo Pintus is an Associate Professor at the University of Cagliari, Italy, a Project Scientist at the University of California, Santa Barbara (UCSB), USA, and an Academic Researcher at the Central European Institute of Technology (CEITEC), Brno University of Technology, Czech Republic.

He received his Master's degree in Electronic Engineering from the University of Cagliari in 2007 and a Ph.D. in Information Engineering from the Scuola Superiore Sant'Anna in Pisa, Italy, in 2012. After completing his Ph.D., he worked as a Research Fellow at Scuola Superiore Sant'Anna from 2012 to 2016, and as an Associate Project Scientist at the University of California, Santa Barbara, from 2016 to 2022.

Dr. Pintus has co-authored more than 100 peer-reviewed journal and conference papers and holds 7 patents. He serves as an Associate Editor for Optics Express and has been a member of the technical program committees for several international conferences, including the OPTICA Integrated Photonics Research Meeting (2023-2025), Photonics in Switching and Computing (2023), the IEEE Silicon Photonics Conference (2023-2026), and the IEEE Photonics Society Summer Topicals (2023, 2025), and Conference on Lasers and Electro-Optics (2026).

He has received several recognitions, including the Ing. Giuseppe Pedriali Award (2013), the European Anile-ECMI Prize for Mathematics in Industry (2014), and the Million Dollar International Quantum U Tech Accelerator Award (2020). Dr. Pintus is a Senior Member of the IEEE and the IEEE Photonics Society, as well as a member of the Italian Society for Industrial and Applied Mathematics (SIMAI). His research interests focus on integrated optics, silicon photonics, and computational electromagnetics.

Final Exam: Oral dissertation on theoretical and simulative aspects discussed during the course.

Room and Schedule

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione, Via G. Caruso 16, Pisa – Ground Floor*

Schedule:

19/01

20/01

21/01

22/01

h 08:30-12:30

The course is in the framework of the educational activities of IEEE Student Branch at the University of Pisa



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