HIGH SPEED OPTICAL TRANSMITTERS FOR OPTICAL INTERCONNECTS

OCTOBER 15- 20, 2018, IIT ROORKEE

OVERVIEW:

As data centers contain ever more servers (1 million servers or more per datacenter) and occupy ever larger physical spaces (several tens of thousands of square meters), with distances between buildings reaching a few km and data rates increasing to 400 Gb/s or even 1 Tb/s in the near future, optical interconnects are growing fast in importance for the networking inside and between these data centers.

Even more important in terms of market size, are the passive optical networks or PONs. Link distances are very similar to those of inter datacenter interconnects and requirements on transmitters and receivers are very similar.

The market for optical transmitters that can be used in short to medium distance optical fiber links is therefore becoming ever more important and so is the market for the required receivers and transmitters.

This course will give participants an overview of the fundamentals of optical interconnects from a systems point of view as well as provide a thorough tutorial to the design of optical transmitters for such interconnects. Attention will also be paid to some microwave aspects, driver electronics, and characterization. A brief overview of the fabrication will be provided as well.

The main objectives of this course are the following:

- To introduce the participants to the different applications of optical interconnects and the system requirements for such interconnects.
- To provide detailed information on how both directly and externally modulated transmitters can be designed, fabricated and characterized.
- To learn the basic physics about semiconductors, necessary to understand the operation and the optimization of transmitters.
- To provide a brief overview of silicon photonics and its advantages.

The course has a total of FOURTEEN interaction hours spread over FIVE working days from 15th October till 20th October 2018. The ELEVEN lectures are complimented by THREE tutorials. It will be delivered by two faculties: Professor Geert Morthier from Ghent University-IMEC and Prof. Rajesh Kumar from IIT Roorkee.

The course schedule with dates and the content to be covered is provided on the next page:

COURSE CONTENT and SCHEDULE

Day 1 : October 15

Lecture 1: 1hr: GM
Fundamentals of semiconductor physics
Lecture 2: 1hr: GM
Fundamentals of semiconductor lasers
Tutorial 1: 1hr: RK
Problem solving session on basics semiconductor physics and semiconductor lasers

Day 2: October 16

Lecture 3: 1hr: GM
Single frequency laser diodes
Lecture 4: 1hr: RK
Optical communication and interconnect basics
Lecture 5: 1hr: GM
Requirements, specifications of optical transmitters for optical communication

Day 3: October 17

Lecture 6: 1hr: GM
Coding schemes, FEC, equalisation
Lecture 7: 1hr: RK
Direct laser modulation and external modulation
Tutorial 2: 1hr: GM
Problem solving session based on the content covered till lecture 5 and discussion on solutions

Day 4: October 18

Lecture 8: 1hr: GM
Silicon photonics and silicon modulators
Lecture 9: 1hr: GM
Membrane laser diodes and overview of fabrication
Lecture 10: 1hr: GM
Overview of measurement techniques, microwave aspects, parasitic elements

Day 5: October 20

Lecture 11: 1hr: GM
High speed directly modulated InP on Si lasers and Summary
Tutorial 3: 1hr: RK
Problem solving session based on the content covered till lecture 11 and discussion on solutions

You Should Attend If you are a …	• Student at Undergraduate (B.Sc./ B.Tech.) or Post-Graduate (M.Sc., M.Tech.) level or a Research Scholar or • Research and Development Engineer working in Photonics/Electronics/Communication companies or • Scientist working in public and private laboratories or • Teacher in a Science and Technology institution/university or • Silicon Photonics Enthusiast
Registration Fees	• **Participants from abroad**: US $200, for full course; US $50 per lecture • **Participants from Industry/ Research Organizations:** Rs. 6000/- for Full Course; Rs. 1500/- per lecture • **Participants Academic Institutions:** Rs. 4000/- for Full Course; Rs. 1000/- per lecture for Faculty /Staff; Rs. 2000/- for Full Course for Students and Research Scholars This fee includes all instructional materials, examination material, computer facility based on requirement. The participants can be provided accommodation on payment basis subject to availability in the institute guest house.
Total No. of Seats	30

ABOUT FACULTIES:

Prof. Geert Morthier is a professor at Ghent University – imec, Belgium. He received the degree in electrical engineering and the Ph.D. degree from the University of Gent in 1987, 1991, respectively. Since 1991 he is a member of the permanent staff of IMEC. His main interests are in the modelling and characterisation of optoelectronic components. He has authored or co-authored over 250 papers in the field and holds several patents. He is also one of the two authors of the Handbook of Distributed Feedback Laser (Artech House, 1997, 2nd edition, 2013). From 1998 to end of 1999, he has been the project manager of the ACTS project ACTUAL dealing with the control of

widely tunable laser diodes, from 2001 to 2005 he was project manager of the IST project NEWTON on new widely tunable lasers and from 2008 to 2011 he was project manager of the FP7 project HISTORIC on microdisk lasesrs. In 2001 he was appointed parttime professor at Ghent University, where he teaches courses on optical fiber communication and lasers.
He has been or is in the Technical Program Committee of various conferences such as the European Conference on Optical Communication (ECOC), the International Semiconductor Laser Conference ISLC), Topical Meeting on Microwave Photonics (MWP),…. He also has given many invited talks at conferences such as ECOC, CLEO (Conference on Lasers and Electro-Optics), SPIE Photonics West,…
Recently, he has been very active in the realization of very high speed (40 to 56 Gb/s) optical transmitters based on Indium Phosphide DFB lasers, heterogeneously integrated on Silicon-on-Insulator waveguides.

Prof. Rajesh Kumar received M.Sc. degree in Physics and M.Tech. degree in optoelectronics and optical communication from the Indian Institute of Technology (IIT) Delhi, New Delhi, India, in 2006 and 2008 respectively. He obtained Ph.D. degree in photonics engineering from Ghent University-IMEC, Ghent, Belgium, in 2012. He investigated InP-on-SOI microdisks for various optical signal processing applications while working with IMEC-Ghent University. After completing the Ph.D. degree, he worked with the Optoelectronics Research Center, University of Southampton, Southampton, U.K., from 2012 to 2013, and with the University of Colorado, Boulder, CO, USA, from 2013 to 2015. In the year 2015, he was a visiting faculty in Indian Institute of Information Technology (IIIT) Allahabad, India.
Currently Prof. Kumar is an Assistant Professor in Indian Institute of Technology (IIT) Roorkee, India. He has authored or coauthored more than 50 peer-reviewed papers in different journals and conference proceedings. His research interests include silicon photonics based active devices, optical interconnects, optical logic and experimental optical signal processing. He is a member of OSA and serves as a Reviewer for various optics and photonics journals.

Course Coordinators

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For Registration: http://www.gian.iitkgp.ac.in/GREGN/index