E7 211 Jan 3:0

Photonic Integrated Circuits

Instructor

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Department: ECE Dept

Course Time: 11am-12.30am on Tue, Thu

Lecture venue: ECE 1.06

Detailed Course Page: www.ece.iisc.ac.in/~tsrinu

Announcements

Brief description of the course

This course is suitable for students from electronics, instrumentation, electrical and telecommunication engineering backgrounds. This covers in detail various types of integrated optic waveguides which are the fundamental components of any photonic device. The course also deals in brief with the technology aspects of the photonic integrated devices along with a a numerical technique used for the analysis. The topics include various components like resonators, couplers, periodic structures, and some recent advances in the field. A few simulations will also be demonstrated that helps in understanding these components. This course can come in handy for all those who want to pursue research in the field of Integrated Optics.

Prerequisites

basic optics, differential equations

Syllabus

Part 1:

Principles: Introduction to Photonics, optical waveguide theory- Slab and channel

waveguides, Symmetric and Asymmetric, Analysis techniques: Effective index method,

Marcatilliâ€™s method, Numerical methods.

Photonic waveguide components â€“ Directional couplers, Coupled mode theory, tapers, bends, gratings, electro-optic, acousto-optic, magneto-optic devices, modulators, switches, polarizers, filters.

Part 2:

Technology: Materials â€“ glass, lithium niobate, silicon, compound semiconductors, polymers, fabrication â€“ lithography, ion-exchange, deposition, diffusion, process and device characterization.

Part 3:

Optical resonators (Fabry Perot cavity, ring resonators, applications etc.), Wave propagation in periodic media (Bragg reflectors, photonic crystals and sub-wavelength structures).

Micro-opto- electro-mechanical systems, Quantum Cryptography.

Course outcomes

After the completion of the course, the student will,

Be able to design and analyze an integrated optic waveguide

Understand the working of various photonic components

Be able to choose the technology suitable for the intended device.

Also he/she will be ready to understand current developments.

Grading policy

Two Class tests (15%+15%, first test open book)

four assignments (10% total)

Term paper (10% total)

Final Exam (50%)

Assignments

4 assignment of problem solving, software demo, visit to fabrication facility, invited guest lectture.

Resources

C. R. Pollock and M. Lip Son, Integrated Photonics, Kluwer Pub., 2003.

T. Tamir, (ed), Guided-wave optoelectronics, (2nd edition), Springer-Verlag, 1990

H. Nishihara, M. Haruna, and T. Suhara, Optical Integrated Circuits, McGraw-Hill, 1988

E. J. Murphy, (Editor), Integrated Optical Circuits and Components: Design and Applications, Marcel and Dekker, 1999.

Current literature: Special issues of journals and review articles