Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NECD507	Silicon Photonics	3	0	0	3

Course Objective

The course objective is to provide knowledge on the fundamentals and design principles of emerging silicon photonic integrated circuits and systems. Silicon photonics (SiP) uses silicon on insulator (SOI) wafers as substrate material and CMOS manufacturing processes.

Learning Outcomes

At the end of the course, the student must be able to

- Understand the operation of building blocks of an optical circuit at a preliminary level, including waveguides and key photonic devices.
- Understand the motivations for silicon photonics including the technology drivers, and examples of implementation of Silicon photonic devices and circuits.
- Undertake advanced study in the field of Silicon Photonics.

Module No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction: Requirement - technological metrics, SiPh as the next fabless semiconductor industry. Integration of photonic devices: Major Issues, photonic-electronic integration,	6	Learn overview of silicon photonic devices and circuits.
2	Symmetric dielectric waveguides, Asymmetric dielectric waveguides, Rectangular waveguides. Computational methods for integrated photonics. Marcatilli's and effective index methods.	9	Acquire an understanding of guided mode and propagation in various waveguides.
3	Silicon Optical I/O: The challenge of optical coupling to silicon photonic chip, Grating coupler, Edge coupler,	03	Obtain the knowledge of various types of Silicon Optical I/O.
4	SiPh-based advanced waveguides and devices – SoI waveguide, Silicon plasmonic waveguide, MZI, MMI coupler- Applications, Silicon subwavelength grating, Ultrafast Modulators, Thermo-optic and Electro-optic switches, optical filters, OPA, microresonators and heterogeneous integration of laser and detectors.	9	Obtain the knowledge of various types of advanced waveguides and devices and their working principle and application.
5	Modeling and Design approaches: Mode solvers, Physical Layout: different physical layout tools, Introduction and application of KLayout (open-source) for GDS design, introduction to PDK. Introduction to Design workflow.	6	Understand Modeling and Design approaches of SiP devices and circuits.
6	Fabrication, Testing and packaging of Silicon photonic devices: Silicon Photonics Research and Manufacturing using SOI wafer, chip and wafer based testing	6	Obtain the knowledge of fabrications and characterization of SiP devices and circuits.
7	Recent applications in SiP.	03	Acquire an understanding of recent development in current research in Silicon Photonics
	Total	**42L**	

Text book:

1. Lorenzo Pavesi, David J. Lockwood, Silicon Photonics, Topics in Applied Physics (TAP, volume 94), 1/e, 2004, Springer Berlin, Heidelberg.
2. Handbook of Silicon Photonics, Laurent Vivien and Lorenzo Pavesi editors, CRC Press (Tay-lor and Francis group, April 2013) 849 pp. ISBN:978-1-4398-3610-1
3. Lukas Chrostowski and Michael Hochberg, Silicon Photonics Design: from Devices to Systems, 1/e, 2016, Cambridge University Press, University Printing House, Cambridge CB2 8BS, UK

Reference books: 1. C R Pollock and M Lipson: Integrated photonics, Kluwer Academic Pub, 2003
2. Silicon Photonics: Fueling the Next Information Revolution by Daryl Inniss, Roy Rubenstein