Nanophotonics - Web course

COURSE OUTLINE

This course outlines physically the intuitive concepts of nanophotonics using the concept of optical near-fields. Optical near-field is an electromagnetic field that mediates the interaction between nanometric materials used for the realization of novel photonic devices, fabrication techniques, and systems.

- In Unit-I, the background, history, and the present status of research and development in nanophotonics and related technologies, is dealt with.
- Unit-II presents a novel theoretical model and a new approach that describes the interaction between nanometric material systems via optical near-fields in a physically intuitive manner. The designing aspects of nanophotonic devices and systems and their performances are analyzed using this model.
- Unit-III and Unit-IV deal with nanophotonic devices and fabrication techniques.
- Unit-V presents a novel nanophotonic system realized by assembling nanophotonic devices.
- In Unit-VI, the fundamentals of nano-biophotonics are dealt with.

COURSE DETAIL

Sl. No.	Topic	Lectures
1	**MODULE-I: Introduction to Nanophotonics** Modern optical science and technology and the diffraction limit – Breaking through the diffraction limit – Nanophotonics and its true nature.	2
2	**MODULE -II: Basis of Nanophotonics** Optical near fields and effective interactions as a base for nanophotonics – Principles of operations of nanophotonic devices using optical near fields – Principles of nanofabrication using optical near fields.	10
3	**MODULE -III: Fundamentals of Nanophotonic Devices** Excitation energy transfer – Device operation: nanophotonic AND gate & nanophotonic OR gate –	3

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Nanotechnology

Pre-requisites:

- Basic knowledge of Quantum Physics and Photonics.

Additional Reading:

1. Hiroshi Masuhara, Satoshi Kawata and Fumio Tokunaga, Nano Biophotonics. Oxford, UK: Elsevier, 2007.
2. Herve Rigneault, Jean-Michel Lourtioz, ClaudeDelalande and Ariel Levenson, Nanophotonics. London, UK: ISTE Ltd., 2006.
3. Paras. N. Prasad, Nanophotonics. New Jersey, USA:John Wiley & Sons Inc.,2004.

Hyperlinks:

- davidkirkpatrick.wordpress.com/tag/nanophotonics/
- www.nanophotonics.de/
- www.ece.rice.edu/~halas/
- nanohub.org/courses/nanophotonics

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	Interconnection with photonic devices – Room temperature operation.	
4	**MODULE -IV: Fundamentals of Nanophotonic Fabrication** Adiabatic nanofabrication – Nonadiabatic nanofabrications: near field optical CVD and near field photolithography – Self assembling method via optical near field interactions – Regulating the size and position of nanoparticles using size dependent resonance – Size controlled, position controlled and separation controlled alignment of nanoparticles.	8
5	**MODULE -V: Fundamentals of Nanophotonic Systems** Introduction – Optical excitation transfer and system fundamentals – Parallel architecture using optical excitation transfer – Interconnections for nanophotonics – Signal transfer and environment – tamper resistance – Hierarchy in nanophotonics and its system fundamentals.	7
6	**MODULE -VI: Fundamentals of Nano-Biophotonics** Introduction – The cell: scale and constituents – Origin and optical contrast mechanisms – Classical contrast mechanisms: bright field, dark field, phase contrast and interferometric contrast – Fluorescence contrast mechanism – Nonlinear microscopy based on second harmonic generation and coherent anti-Stokes Raman scattering – Reduction of the observation volume – Far field methods: 4Pi microscopy, microscopy on a mirror and stimulated emission depletion – Near field methods.	10
	Total	40

References:

Text:

- Motoichi Ohtsu, Kiyoshi Kobayashi, Tadashi Kawazoe, Takashi Yatsui and Makoto Naruse, *Principles of Nanophotonics.* New York, USA: CRC Press-Taylor & Francis Group, 2008.