

Biophotonics - Web course

COURSE OUTLINE

The objective of this course is to learn about the emerging field of biophotonics which deals with the application of optics based technologies for life science applications such as biosensing, imaging, cell manipulation and so on.

COURSE DETAIL

Sl. No.	Topic	No.of Hours
1	Introductory Optics. <ul style="list-style-type: none"> • Geometric, Wave, EM and Quantum Picture of Light. • Concept of phase, polarization and coherence. • Diffraction and Interference. 	5
2	Light-matter interactions. <ul style="list-style-type: none"> • Energy level picture of materials. • Photons, Photoelectric effect, Interaction of photons with materials. • Phosphorescence and fluorescence. • Stimulated emission of photons. • Principle of laser action. • Laser types and applications (CW, Pulsed, Ultra-fast, Solid state, Gas, Dye ...). • Spectroscopy: Types and applications (UV-Vis, Infrared, Raman, FTIR ...). 	12
3	Optical Imaging I. <ul style="list-style-type: none"> • Basic imaging theory, concept of diffraction limit. • Optical microscope. • Methods for contrast-generation (Dark-field, Phase contrast, DIC, Polarization). • Fluorescence microscopy. • Fluorescence techniques (FRET, FLIM, FRAP, FCS ...). • Nanoparticle fluorescence. • 3D sectioning: Confocal and multi-photon imaging. • Advanced Topics. <ul style="list-style-type: none"> ◦ Nanoparticle fluorescence. 	14



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Electronics & Communication Engineering

Pre-requisites:

1. Basic UG level Physics and Maths, +2 level knowledge of biology.

Coordinators:

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	<ul style="list-style-type: none"> ◦ Super-resolution techniques (STED, STEM, STORM, PALM ...). ◦ Super-resolution image reconstruction methods. 	
4	<p>Optical Imaging II.</p> <ul style="list-style-type: none"> • Biomedical (Physiological Imaging). • Light Scattering phenomena. • Tomographic techniques: OCT. • Image reconstruction techniques. 	4
5	<p>Other applications.</p> <ul style="list-style-type: none"> • Optical biosensors. • Optical manipulation of biological materials. <ul style="list-style-type: none"> ◦ Optical tweezers. ◦ Laser dissection and surgery. ◦ Neural excitation. 	5
	Total	40

References:

1. Bahaa Saleh and Malvin Teich, *Fundamentals of Photonics*, Wiley & Sons (1991).
2. Paras N. Prasad, *Introduction to Biophotonics*, Wiley & Sons (2003).