

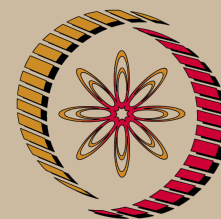
# NonLinear Optics - Web course

## COURSE OUTLINE

This introductory course on nonlinear optics is proposed to bridge the gap between the usual course in optics at B.Sc. level and the modern applications of optics in spectroscopy and photonics. The only prerequisites are elementary courses on electromagnetic theory and quantum mechanics. The lectures in this course are intended to provide theoretical background to understand and predict a host of optical phenomena that become possible when nonlinearity in the optical response of a material is included in the description. The course includes a detailed description of several of these phenomena, their experimental observation and photonic devices based on them. It is envisaged that this course could be a useful addition to the M Sc syllabus in universities. It could also be adopted as a M.Tech or pre Ph.D. course for research students in photonics and optical sciences, especially since it is designed in a modular manner.

## COURSE DETAIL

Lecture No.	Contents
<b>Module I: Introduction and Background Material</b>	
1	Introduction
2	Linear Optics In Homogeneous, Isotropic Media
3	Wave Propagation In Linear, Homogenous Isotropic Media
4	Optical Wave In Anisotropic Media
5	Introduction to Lasers
6	Properties of Lasers
<b>Module II: Nonlinear Frequency Mixing</b>	
7	Optical Response of an Harmonic Oscillator
8	Nonlinear Susceptibility Tensors



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## Physics

### Pre-requisites:

A course in Electromagnetism at the level of Griffith's book. A course in elementary quantum mechanics.

### Coordinators:

**Prof. B.P. Singh**  
Department of  
Physics IIT Bombay

**Prof. K.C. Rustagi**  
Department of  
Physics IIT Bombay

9	Nonlinear Wave Propagation
10	Second Harmonic Generation
11	Three Wave Mixing
12	Three Wave Mixing-2
13	Phase Matching
14	Frequency Conversion Devices
	<b>Module III: Nonlinear Susceptibilities of Materials.</b>
15	Optical Response Of An Atomic System
16	Nonlinear Optical Susceptibilities
17	Nonlinear Optical Materials
18	Organic Nonlinear Optical Materials
	<b>ModuleIV:Third order nonlinear optical processes</b>
19	General Theory Of Four-Wave-Mixing
20	Nonlinear Refraction And Absorption
21	Self Focusing
22	Saturation Of Absorption
23	Two-Photon Absorption And Doppler Free Spectroscopy
24	Kerr Lens Modelocking: An Application Of Self Focusing
25	Optical Phase Conjugation And Degenerate Four-Wave-Mixing
26	Third-Order Nonlinearity Measurement Techniques: Z-Scan

27	Third-Order Nonlinearity Measurement Techniques: ARINS
28	Inelastic Scattering Processes
29	Stimulated Raman Scattering(SRS)
30	Stokes Anti-Stokes Coupling
31	Coherent Anti-Stokes Raman Scattering
32	Stimulated Brillouin Scattering
33	Consequences Of The Stimulated Scattering In Optical Communication
<b>Module V: Pulse propagation through third order nonlinear optical medium</b>	
34	Propagation In Fibers
35	Pulse Propagation In A Linear Dispersive Medium
36	Optical Pulse Propagation In Nonlinear Medium
37	Solitons In Optical Fibers
38	Long Distance Soliton Transmission System

#### References:

1. R.W.Boyd, Nonlinear Optics, third edition, Academic, (2008)
2. N.Bloembergen, Nonlinear Optics, 4th edition, World Scientific(1996)
3. G.P.Agarwal, Nonlinear Fiber Optics, 4th edition, Academic(2007)
4. R.L.Sutherland, Handbook of Nonlinear Optics, 2nd edition, Marcel Dekker(2003)
5. Y.R.Shen, Principles of Nonlinear Optics, Wiley(1984)
6. P.E.Powers, Fundamentals of Nonlinear Optics, CRC Press(2011)
7. M. Schubert and B. Wilhelmi, Nonlinear Optics and Quantum Electronics