



OPTICAL ENGINEERING

PROF. SHANTI BHATTACHARYA

Department of Electrical Engineering
IIT Madras

PRE-REQUISITES : Electromagnetics

INTENDED AUDIENCE : Third or Final year BE/BTech, First year ME/MTech/MS/PhD

INDUSTRIES APPLICABLE TO : Holmarc, NeST Photonics, Appasamy Associates, LV Prasad Eye Institute , ISRO, DRDO

COURSE OUTLINE :

Optics is used in many applications today. In fact, the field of optics has quietly gone from the research table to being used in numerous applications ranging from devices to metrology. Opto-electronics and metrology are already well-developed fields merging the areas of optics and a variety of other engineering areas (such as electronics, mechanical engineering, etc) in many advanced and commonly used devices. For an engineering student to be able to understand and design optics for such applications, it is important to understand some basic optics. This course will introduce these concepts at a level relevant for an engineer. The course will also study specific engineering examples with a detailed look at the optics of these. A lab will be run along with the course. In the first part, an optical design software called Optics Software for Layout and Optimization (OSLO) will be used. The ideas and concepts of geometric optics will be developed through a series of exercises involving OSLO. Concepts on wave optics will be demonstrated through exercises involving either Python or Matlab.

ABOUT INSTRUCTOR :

Prof. Shanti Bhattacharya obtained her Ph.D. in Physics from the Indian Institute of Technology, Madras in 1997. Her doctoral work was in the area of Optical Array Illuminators. After completing her Ph.D., she worked at the Technical University of Darmstadt, Germany, first as an Alexander von Humboldt fellow and then as a Guest Scientist. Her research work there included development of an optical pick-up for CD/DVD systems and the design of diffractive optical elements for beam shaping of high power laser beams. She subsequently joined the MEMS division of Analog Devices, Cambridge, USA, where she worked on the design of an optical MEMS switch. She is currently a Professor and has been with the Department of Electrical Engineering, IIT Madras since 2005. Her current research interests are diffractive optics, optical MEMS and the development of measurement and imaging techniques using interferometry. She has co-authored over 100 conference and journal publications, as well as one book titled, "Design and Fabrication of Diffractive Optical Elements with MATLAB." She has successfully executed or is currently investigating a number of research projects with funding worth over Rs 955 lakhs (USD 1.33M). In addition to her work, she is an enthusiastic hiker and enjoys many outdoor activities.

COURSE PLAN :

- Week 1:** Introduction to Optical Engineering Postulates of Geometric Optics, Geometric Optics and Imaging, Refraction at a single surface
- Week 2:** Thin lens, Lens imaging conditions, Aperture stop, pupils, important rays
- Week 3:** Ray tracing using matrix method, Thick lenses, principal planes
- Week 4:** Monochromatic Aberrations, means of quantifying aberrations
- Week 5:** Chromatic Aberrations, correcting aberrations
- Week 6:** Gaussian beams, transmittance of an optical element
- Week 7:** Gaussian beam transformation through a lens
- Week 8:** Basics of Interference
- Week 9:** Applications of Interference, holography
- Week 10:** Basics of diffraction
- Week 11:** Applications - Barcode readers, Finger print sensors, Pick-up heads used in DVD/CD players, Biomedical instrumentation, Interferometers for metrology (Optical coherence tomography), Sensors
- Week 12:** Applications, cont'd