

# EECS 119

## Introduction to Optical Engineering Spring 2007

### Syllabus

Instructor	<a href="#">T. K. Gustafson</a> tkg@eecs 495 Cory Hall
Office Hours	Tue, Thurs 10-11:30 AM
TA	Chris Anderson cnanderson@berkeley.edu
Office Hours	TBA
About Class	Unit Value: 3units Class hours: 3 hours of lecture and 1 hour of discussion per week Class time and location: MWF 10-11A, 285 Cory Hall  Discussion Session: Th1-2pm 105 Dwinelle Prerequisites: Physics 7C
Class Homepage:	<a href="http://ospace.berkeley.edu">http://ospace.berkeley.edu</a>
Texts	<ol style="list-style-type: none"><li>1) Optics, 4th edition, by Eugene Hecht, (Addison Wesley Longman, 2002) or comparable optics text ( If you intend to use a different reference please see the instructor or G.S.I.)</li><li>2) A text covering contemporary optics and opto-electronic applications and principles. There are several ranging from introductory to advanced. A good introductory one is:<ol style="list-style-type: none"><li>a) Optics, An introduction for technicians and technologists, by J. Warren Blaker and Peter Schafer, Prentice Hall ISBN 0-13-227794-8 (freshman or early sophomore level)</li><li>An advanced selection (senior level):<ol style="list-style-type: none"><li>b)Optical Electronics in Modern Communications, Amnon Yariv, Oxford Press, ISBN 0-19-510626-1 This has far more than we could cover in one semester.</li></ol></li></ol></li></ol>
Other references to	

be used .	
Grading	Lab and Class Participation 15%
	Homework 15%
	Midterm 20%
	Final 50%
Homework	Roughly one homework every week and a half. Collaboration is encouraged!
Class Objectives	<p><b>1.</b> Introduction to the propagation of light. Snell's law and Huygen's principle. Refraction and reflection. Plane waves, spherical waves and image formation. Total internal reflection. Polarization, polarizers, and wave-plates. (2a :Ch 1-3 1: Ch 1-4)</p>
	<p><b>2.</b> Lenses and aberrations. Formation of images. Resolution and primary aberrations. Prism devices Various optical material types and their application to optical components. (2a:Ch 4-6 1:Ch 5)</p>
	<p><b>3.</b> Some simple optical instruments. Cameras, telescopes, microscopes, and projection systems. The eye. (2a:Ch 5 1 Ch 5)</p>
	<p><b>4.</b> Basic Diffraction, Fresnel and Fraunhofer. Spatial and Temporal coherence. (2a: Ch 8 1 Ch 10 )</p>
	<p><b>5.</b> Gaussian beam propagation, the ABCD matrices and paraxial concepts ( Will do this from the point of view of diffraction. Reference is Yariv Chapter 2 )</p>
	<p><b>6.</b> Coherent sources. Optical gain. Quantum mechanics sufficient to discuss spontaneous and stimulated emission. Light emitting diodes. Population inversion. Optical feedback and resonant cavities. Laser modes. Spectral bandwidth and coherence length. Parametric sources. ( 2a: Ch 9 1 Ch 13 and 14 and Yariv Ch 5)</p>
	<p><b>7.</b> Detectors. Semiconductor detectors, including pn junction diodes, PIN diodes and avalanche diodes. Photomultipliers. CCD Microchannel plate image intensifiers. ( 2a Ch 10 1 Yariv Ch 11 )</p>
	<p><b>8.</b> Polarization and light modulators. Liquid crystal light valves</p>

	<p>and flat panel displays. Deformable mirror array devices. Basis of electro-optic modulation. ( 2a Ch 8 Yariv Ch9 for electro-optic modulation )</p> <p><b>9</b> .Fiber optics. Waveguides and modes. Fiber coupling. Single and multi-mode fiber. Fiber communication systems including couplers and switches, time division and wavelength division multiplexing. Fiber dispersion. Fiber amplifiers and array detectors.. (2a: Ch 11 , Also an introductory and overview treatment is “Introduction to DWDM Technology- Data in a Rainbow, by Stamatios V. Kartalopoulos IEEE Press ISBN 0-7803-5399-4 Yariv Ch 13)</p> <p><b>10</b>. Partial coherence .Illuminators and condensers. Brightness theorem. Field uniformity and light collection efficiency. Incoherent or partially coherent light sources including Solar, arc lamp , tungsten filament lamp and mercury discharge lamp. Solar energy collectors including photovoltaics and thermal concentrators. ( 1 Ch 12 )</p> <p><b>11</b>.Interference. Young`s 2 slit experiment and fringe visibility. Michelson Interferometer. Multiple beam interference and thin film coatings. ( 1 Ch 9 2a Ch 7 )</p> <p><b>12</b>.Holography. In-line holography and off-axis holography. Various holographic schemes including reflection holograms, rainbow holograms. Holographic data storage. ( 1 14.3 2a Ch 12 )</p> <p><b>13</b>. Optics and nanostructures-recent approaches to confined optical interactions and guiding. Surface wave couplers and devices, near field effects, and sub-wavelength optical components (notes and literature references)</p> <p>.</p>
<p><b>Expected Outcomes</b></p>	<p><b>1</b> Basic knowledge of the laws governing optical propagation and the influence of boundaries and finite transverse extent on optical beams.</p> <p><b>2</b>. To have acquires basic knowledge of optical components and instruments.</p> <p><b>3</b>. Have knowledge and understand the measurement of first order spatial and temporal coherence.</p>

**4.** To have a conception of sources of coherent and incoherent optical beams.

**5** To have acquired the basic concepts of spontaneous and stimulated emission and their role in optical gain and noise.

**6** Understand the principles of optical feedback, resonant cavities.

**7.** To have acquired a comprehension of detection principles and the various types of detectors.

**8.** To have an understanding of the modulation of light beams and to be able to discuss various techniques for accomplishing this.

**9** A basic comprehension of fiber optical systems, the important parameters and various standards and economic issues.

**12.** To have acquired some knowledge of optical signal processing techniques including holography, Fourier transforms and phase contrast.

**13.** To have some knowledge of recent developments in linear, nonlinear and surface wave optics.

**14.** To have exposure to experimental technique either through demonstration experiments, mini-labs, or a class project.