

Date	Topics	PSets	Class Demos
TR 05 Sep	<b>Course Overview</b> – Description of content, expectations and requirements, grading policy, exams, etc. <b>1. Geometric optics</b> – Lenses and mirrors. Ray tracing. Linear image magnification. Real and virtual images.		
TU 10 Sep	Ray-matrix (ABCD) methods. Single-lens and multiple-lens imaging systems. Angular magnification. Applications to telescopes and microscopes and zoom systems. Lens waveguide.	<b>1 Geom out</b>	
	<b>Lab 0</b> – Lab orientation (38-633); Lab safety training, etc. Lab 1A - Single-lens imaging system with positive and negative lenses		
TR 12 Sep	<b>2. Review of properties of E&amp;M waves</b> ; amplitude, intensity, phase, polarization and coherence, E and H fields, Maxwell's equations, dielectric and conducting media, wave equation, plane and spherical wave solutions. Dipole model of interaction of light with matter.		
TU 17 Sep	Linear, circular, and elliptical polarization. Quarter & half-wave plates. Propagation in anisotropic materials. Jones vectors and matrices.	<b>1 Geom In 2 EMW out</b>	Polarizers, magic sheet. Calcite xtal, plexiglass
	<b>Lab 1B</b> – Design, build and evaluate your own zoom lens system for: (a) classroom projector, or (b) terrestrial projector, or (c) binoculars		
TR 19 Sep	Reflection, refraction, Snell's law, critical angle, Brewster's angle, reflection and transmission coeffs.		
TU 24 Sep	<b>3. Coherence and Interferometry</b> - Temporal and spatial coherence, conditions for interference, two-beam interferometers (Michelson and Mach-Zehnder).	<b>2 EMW in 3 Intf out</b>	
	<b>Lab 2</b> – Experiments with LPs, QWPs and HWPs. Dielectric reflection.		
TR 26 Sep	Multiple-beam interference, finesse. Fabry-Perot and Lummer-Gehrcke interferometers. Antireflection coatings, dielectric mirrors, interference filters.		Soap films, dielectric filters/mirrors
TU 01 Oct	<b>4. Diffraction</b> - Spatial frequency concept, wavefront analysis, scalar diffraction theory	<b>3 Intf in 4 Diffr out</b>	Laser pointer-phone screen
	<b>Lab 3</b> – Haidinger Interference fringes (thin glass sides), two-beam and multiple-beam interferometers.		
TR 03 Oct	Free-space propagation, Fresnel diffraction formula. Fourier Optics interpretation. Fraunhofer approximation.		
TU 08 Oct	Review of the properties of Fourier transforms. Fourier transforming properties of lenses.		
	Lab 4 - Fresnel and Fraunhofer diffraction from various apertures and objects. Example, diffraction-based light modulation (MEMS mirror phase modulator).		
TR 10 Oct	Concept of Fresnel zones and design of diffractive optical elements	<b>4 Diffr in</b>	
TU 15 Oct	No Class		
<b>TR 17 Oct</b>	<b>Quiz 1 on fundamentals</b>		

	<b>Open House Lab Session</b>		
TU 22 Oct	<b>5. Holographic Imaging</b> - Top level view of basic principles. Transmission and reflection holography. Readout with reference and phase-conjugate waves. CW central dogma of holography.	<b>5 Hol out</b>	
	<b>Lab 5A</b> – View, analyze and fabricate transmission & reflection holograms. Design and begin setup for your own holograms		
TR 24 Oct	Thick holograms. Bragg readout condition. Choice of recording media, image separation conditions, effects of recording medium resolution. Computer-generated holography. Volumetric imaging. Optical storage.		View white light, and CG holograms
TU 29 Oct	<b>6. Light modulators and displays</b> - Electro-optic light modulation, index ellipsoid, Pockels and Kerr effect, electro-optic tensor. Longitudinal and transverse modulators.	<b>5 Hol in 6 Mod out</b>	
	<b>Lab 5B</b> - Make your own static holograms.		
TU 29 Oct	<b>Proposal for final project due (Begin Projects)</b>		
TR 31 Oct	Principles of liquid-crystal, acousto-optic and photorefractive light modulation. Spatial Light Modulators		
TU 05 Nov	<b>7. Principles of Lasers</b> - Spontaneous and stimulated emission, gain, rate eqns., resonators, oscillation frequencies, longitudinal modes	<b>6 Mod in 7. Las out</b>	
	<b>Lab 6(a)</b> – Electro-optic, acoustic and Liquid crystal light modulators. Use phone with red interference filter as an electrically addressed SLM with spatial filtering to remove pixel grid <b>Lab 6(b)</b> Real-time holography in a photorefractive crystal.		
TR 07 Nov	Scanning Fabry-Perot spectrometer. Specific laser systems (e.g., He-Ne, GaAs, CO <sub>2</sub> , YAG:Nd). Frequency doubling (Second Harmonic generation)		In class Scanning F-P spectrometer
TU 12 Nov	<b>8. Introduction to coherent optical signal processing.</b> Two-lens coherent image processors.	<b>Las in</b>	
TR 14 Nov	Vander Lugt & matched filters, polychromatic image processors.		In Lab demo of 2-lens processor
TU 19 Nov	<b>9. Optics of the eye - 3D-Perception:</b> Binocular disparity (stereopsis), accommodation, vergence, disparity difference, motion parallax, horopter circle.		
TR 21 Nov	<b>Near-eye imaging systems:</b> Stereoscopic systems. Digital light field. Virtual reality systems. Augmented reality. Survey of commercial systems (e.g., Oculus, HoloLens, Magic Leap System, Google glass, etc.)		
TU 26 Nov	<b>Quiz 2 on fundamentals</b>		
TR 28 Nov	Thanksgiving Holiday		
TU 03 Dec	<b>10. Photodetectors</b> - Thermal and quantum detectors. Responsivity, NEP, D*. Detector noise. Visible and infrared photodetector arrays.		Bolometer Photodiode, CCD, PMT.
TR 05 Dec	Specific detector devices and systems in the visible and infrared. Infrared imaging techniques and systems (e.g., thermal imagers)		
TU 10 Dec	In-class Final project Presentations		