6.2370-6.6370 COURSE CALENDAR **SPRING 2023** **(Revised 06 Feb 2023)**

Date	Topics	PSets	Class Demos
Tu 07 Feb	**Course Overview –** Description of content, expectations and requirements, grading policy, exams, etc. **1. Geometric optics** – Lenses and mirrors. Ray tracing. Linear image magnification. Real and virtual images.		
TR 09 Feb	Ray-matrix (ABCD) methods. Single-lens and multiple-lens imaging systems. Angular magnification. Applications to telescopes and microscopes and zoom systems. Lens waveguide.	**1 Geom out**	
	Lab 0 – Lab orientation (38-633); Lab safety training, etc. Lab 1A - Single-lens imaging system with positive and negative lenses		
TU 14 Feb	**2. Review of properties of E&M waves**; amplitude, intensity, phase, polarization and coherence, E and H fields, Maxwell's equations, dielectric and conducting media, wave equation, plane and spherical wave solutions.		
TR 16 Feb	Linear, circular and elliptical polarization. Quarter & half-wave plates. Propagation in anisotropic materials. Jones vectors and matrices. Dipole model of interaction of light with matter.	**1 Geom In** **2 EMW out**	Polarizers, magic sheet. Calcite xtal, plexiglass
TU 21 Feb	**No Class**		
	Lab 1B – Design, build and evaluate your own zoom lens system for: (a) classroom projector, or (b) terrestrial projector, or (c) binoculars		
TR 23 Feb	Reflection, refraction, Snell's law, critical angle, Brewster's angle, reflection and transmission coeffs.		
TU 28 Feb	**3. Coherence and Interferometry** - Temporal and spatial coherence, conditions for interference, two-beam interferometers (Michelson and Mach-Zehnder).	**2 EMW in** **3 Intf out**	
	Lab 2 – Experiments with LPs, QWPs and HWPs. Dielectric reflection.		
TR 02 Mar	Multiple-beam interference, finesse. Fabry-Perot and Lummer-Gehrcke interferometers. Antireflection coatings, dielectric mirrors, interference filters.		Soap films, dielectric filters/mirrors
TU 07 Mar	**4. Diffraction** - Spatial frequency concept, wavefront analysis, scalar diffraction theory	**3 Intf in** **4 Diffr out**	Laser pointer-phone screen
	Lab 3 – Haidinger Interference fringes (thin glass sides), two-beam and multiple-beam interferometers.		
TR 09 Mar	Free-space propagation, Fresnel diffraction formula. Fourier Optics interpretation. Fraunhofer approximation.		
TU 14 Mar	Review of the properties of Fourier transforms.		
	Lab 4 - Fresnel and Fraunhofer diffraction from various apertures and objects. Example, diffraction-based light modulation (MEMS mirror phase modulator)		
TR 16 Mar	Fresnel zones and diffractive optical elements	**4 Diffr in**	
TU 21 Mar	**5. Holographic Imaging** - Top level view of basic principles of holography. Transmission and reflection holography. Readout with	**5 Hol out**	

	reference and phase-conjugate waves. CW central dogma of holography.		
	Lab 5A – View, analyze and fabricate transmission & reflection holograms		
TR 23 Mar	**QUIZ 1**		
	Spring Break		
TU 04 Apr	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
	Lab 5B - Design and make your own static Hologram.		
TR 06 Apr	**6. Optics of the eye - 3D-Perception:** Binocular disparity (stereopsis), accommodation, vergence, disparity difference, motion parallax, horopter circle.	**5 Hol in 6 3D Vis out**	
TU 11 Apr	**Proposal for final project due (Begin Projects)**		
TU 11 Apr	**Near-eye imaging systems:** Stereoscopic systems. Digital light field. Virtual reality systems. Augmented reality. Survey of commercial systems (e.g., Occulus, Hololens, Magic Leap System, Google glass, etc.)		
	Lab 6 – Design and build a near-eye 3-D stereoscopic system – possibly 3D-print the package (maybe expand to possible project) Another idea: Record FT of a rotating 3-D object in photorefractive media as possible demonstration of volumetric imaging		
TR 13 Apr	**7. Light modulators and displays -** Electro-optic light modulation, index ellipsoid, Pockels and Kerr effect, electro-optic tensor. Longitudinal and transverse modulators.	**6 3D Vis in 7 Mod out**	
TU 18 Apr	Principles of photorefractive light modulation, liquid-crystal light modulation, and acousto-optic light modulation		
	Lab 7 – Electro-optic, acoustic and photorefractive light modulation. Real-time holography in a photorefractive crystal.		
TR 20 Apr	**8. Introduction to optical signal processing.** Fourier Optics – 2-D Transforming properties of lenses.	**7 Mod in 8 Fou out**	
TU 25 Apr	**Quiz 2**		
TR 27 Apr	Two-lens coherent image processors. Vander Lugt & matched filters, polychromatic image processors.		View Fourier transforms
TU 02 May	**9. Principles of Lasers** - Spontaneous and stimulated emission, gain, rate eqns., resonators, oscillation frequencies, longitudinal modes	**8 Fou in**	
TR 04 May	Scanning Fabry-Perot spectrometer. Specific laser systems (e.g., He-Ne, GaAs, CO_2, YAG:Nd). Frequency doubling (Second Harmonic generation)		Scanning Fabry-Perot spectrometer
TU 09 May	**Image detection** - Thermal and quantum detectors. Responsivity, NEP, D*. Detector noise. Visible and infrared photodetector arrays.		Bolometer Photodiode, CCD, PMT.
TR 11 May	Specific detector devices and systems in the visible and infrared. Infrared imaging techniques and systems (e.g., thermal imagers)		
TU 16 May	**Final Project Presentations (2 hours - class begins at 12:30 pm)**		