OSE6115 Interference, Diffraction, and Coherence

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The grade in this class will be divided as follows:
Homeworks: 30%; Midterm1: 20%; Midterm2: 20%; Final: 30%

Class Day & Time: Mondays, Wednesdays 4:30 AM to 5:45 AM, Room: 102

Syllabus:
1- Review of the Fourier transform
2- Review of electromagnetic wave propagation, and the plane-wave angular spectrum
3- Two-beam interference: Mach-Zehnder interferometer, Michelson interferometer, Sagnac interferometer
4- Double slit-interference
5- Multiple-beam interference
6- Rayleigh-Sommerfield diffraction
7- Fresnel and Fraunhofer diffraction
8- Introduction to Fourier optics
9- Diffraction limited optical imaging
10- Diffraction Gratings
11- Introduction to coherence theory
12- Second-order spatial and temporal coherence
13- Effect of coherence on optical imaging

Textbooks:
B. E. A. Saleh and M. C. Teich, “Fundamentals of Photonics”
J. W. Goodman, “Introduction to Fourier Optics”
A. Papoulis, “Systems and Transforms with Applications in Optics”
J. W. Goodman, “Statistical Optics”
J. D. Gaskill, “Linear Systems, Fourier Transforms, and Optics”
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**Week 1:** Review of 1D and 2D Fourier transforms; plane-wave spectrum

**Week 2:** Review of 1D and 2D Fourier transforms; plane-wave spectrum

**Week 3:** Temporal interference, Mach-Zehnder interferometer, optical pulses

**Week 4:** Michelson interferometer, optical coherence tomography with pulsed light, effect of dispersion, Fabry-Perot interferometer, Sagnac interferometer

**Week 5:** Interference of two plane waves, interference of an infinite number of waves (x-ray diffraction), double-slit interference

**Week 6:** Scalar diffraction theory

**Week 7:** Fresnel and Fraunhofer diffraction, effect of a lens

**Week 8:** Fourier optics, spatial filtering

**Week 9:** Diffraction-limited imaging, introduction to optical microscopy I

**Week 10:** Diffraction-limited imaging, introduction to optical microscopy II

**Week 11:** Review of random variables and stochastic processes, introduction to coherence theory

**Week 12:** Temporal coherence theory, Weiner-Khintchine theorem, temporal coherence of an optical pulse

**Week 13:** Spatial coherence, the double slit revisited, Schmidt (modal) decomposition

**Week 14:** Propagation of coherence functions, can Cittert-Zernike theorem, higher-order coherence functions, Hanbury-Brown and Twiss interferometry