

OSE6211 - Imaging and Optical Systems

Credit Hours:

3 hours (3,0)

Prerequisite:

Graduate standing or consent of instructor

List of topics

1. Introduction to Signals and Linear Systems

Vector spaces, inner products, mapping, operators, projections.

2. Discrete Systems

Matrix description. Unitary and Hermitian Systems. Modes.

3. Continuous 1D Systems (temporal systems)

Description of linear systems using integral transforms.

Linear shift invariant systems. Impulse response. Convolution.

1D Fourier transforms and its properties.

Description of linear systems in frequency domain. Transfer functions.

Example: propagation of optical pulse in a dispersive fiber

4. Continuous 2D Systems (spatial systems)

Point spread function. Transfer function. Spatial filters.

Example: spatial filtering of images.

Projection slice theorem. Radon transforms.

Example: CT tomography.

5. Coherent Optical Systems

Angular spectrum representation of an arbitrary wave.

Transfer function of free-space propagation. Fresnel diffraction. Talbot imaging.

Optical Fourier transform. Optical spatial filtering.

Analogy between diffraction and dispersion.

Example: Gaussian beam.

Image formation as a linear system. Point spread and transfer function. Resolution.

Example: laser scanning imaging. Depth of focus.

6. Incoherent Optical Systems

Image formation. PSF, OTF and MTF for diffraction-limited systems.

Effect of defocus and aberration on PSF, OTF, MTF.

Confocal microscopy.

Laser scanning fluorescence microscopy.

Computations microscopies

7. Scattering Systems

Grading:

25% Exam 1

25% Exam 2

10% Homework

40% Final