IMAGING AND OPTICAL SYSTEMS

1. **Introduction to Signals and Linear Systems**

2. **Discrete Systems** (2 weeks)
   a. Matrix description of systems. Unitary and Hermitian systems. Modes
   b. Example. Polarization devices
   c. Example. Modes of an optical resonator
   d. Example. Coupled modes of a waveguide

3. **Continuous 1D Systems (Temporal Systems)** (2 weeks)
   a. Integral transforms. Shift-invariant systems
   b. 1D Fourier transform and its properties
   c. Linear shift-invariant systems. Impulse response function. Convolution. Transfer function
   d. Example: Propagation of an optical pulse in a dispersive medium

4. **Continuous 2D Systems (Spatial Systems)** (2 weeks)
   a. 2D Fourier transforms and its properties
   b. Projection-slice theorem. Application to CT tomography
   c. 2D linear systems. Point spread function. Transfer functions. Spatial filters

5. **Coherent Optical Systems** (3-4 weeks)
   a. Expansion of arbitrary waves in terms of plane waves. Angular spectrum
   b. Transfer function of free-space propagation. Fresnel diffraction. Analogy between diffraction and dispersion
   c. Hermite-Gauass beams as resonator modes.
   d. Non-diffracting beams. Talbot imaging
   e. Image formation as a linear system. Point spread function and transfer function. Resolutions
   f. Optical Fourier transform. Optical spatial Filtering
   g. Imaging phase objects. Phase contrast microscopy
   h. Laser scanning imaging system. Point spread function and depth of focus.

6. **Incoherent Imaging Systems** (2-3 weeks)
   a. Image formation with incoherent light. PSF, OTF, and MTF of diffraction-limited system
   b. Effect of defocus and aberration on PSF, OTF, and MTF
   c. Confocal microscopy
   d. Laser scanning fluorescence microscopy

*7. **Scattering Systems** (1 week)
   a. Rayleigh scattering. Born approximation
   b. Optical diffraction tomography