OPTI 604- Mathematical Methods for Optics

Course Description:


Textbooks:


Recommended


Outline

Linear Algebra

1. Linear vector spaces - general theory.
2. Linear operators and imaging.
3. Eigenanalysis of Hermitian operators.
4. Singular-value decomposition; null functions.
5. Solutions of linear equations; pseudoinverses.

Dirac Delta Function

7. Motivation and elementary properties. Limiting representations.
8. Functionals and distributions.
10. Linear shift-invariant (LSIV) systems. Convolutions and eigenfunctions.

Fourier Theory

11. Fourier series; convergence issues.
12. Introduction to Fourier transforms; the inverse
13. ID Fourier transforms - properties and examples.
14. Application to LSIV systems; transfer function and impulse response.
15. 2D Fourier transforms. Cartesian and polar coordinates.
16. 2D linear systems.
17. Sampling theory.
18. Discrete Fourier transforms.

Series Expansions and Integral Transforms

19. Orthogonal polynomials; generalized Fourier analysis.
21. Fresnel integrals and chirps; application to diffraction.

Mixed Representations

22. Local Fourier transforms.
23. Wigner distribution functions.
24. Wavelets: general theory.
25. Wavelets: applications.

Group Theory

26. Definition of a group.
27. Classes and representation.
28. Irreducible representations.
29. Continuous groups.
30. Groups of operators on a Hilbert space.
32. Functions and transforms on groups.

Take-home final exam.