

Department and Course Number	<b>CEG 428</b>	Course Coordinator	Forouzan Golshani
Course Title	<b>Linear Optical Systems for Computer Engineers</b>	Total Credits	4

BS CE: Elective; BS CS: Elective.

This document was prepared by: Prabhaker Mateti

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### **Catalog Data**

Introduction to linear optical systems, transformation properties of optical systems, correlation, convolution, diffraction, applications related to optical computers, such as beam steering for optical interconnection, digital multiplication by analog convolution, and parallel optical algorithm for pattern search, neural network. Prerequisites : EE 321, 322.

### **Text Books and Other Source Materials**

1. J. D. Gaskill, Linear Systems, Fourier Transforms and Optics, John Wiley & Sons, Inc. New York, 1978, ISBN 0-471-29288-5.
2. J. W. Goodman, Introduction to Fourier Optics, McGraw-Hill, 1996, ISBN 0-07-024254-2.
3. Selected papers published in refereed journals such as Applied Optics, Optical Engineering.

### **Learning Objectives**

The student should have learned the following:

1. Complex representation of optical signals.
2. Optical linear systems theory and point spread function
3. correlation and convolution
4. 1-D and 2-D Fourier transform and its properties
5. Linear Optical filtering: amplitude filter, phase filter and complex filter
6. Simulation of optical filtering using matlab.
7. Propagation of optical information
8. Fourier transform using lenses
9. Optical pattern recognition.
10. Optical holography: recording and generation

### **Prerequisites by Topic**

1. Complex algebra.
2. Impulse response.
3. Linear system theory and convolution
4. Discrete Fourier transform using matlab.

5. Fourier transform.
6. Matlab tools.

### Course Content

Wk	Topics	Read
1	Optical functions and representation	Gaskill – Chap. 2-5
2	Optical linear system theory: Correlation and convolution	Gaskill – Chap. 6
3	Fourier transform and properties	Gaskill – Chap 7
4	Linear filtering applications: complex, amplitude and phase filter	Gaskill – Chap 8
5	2-D Fourier transforms, simulation using digital computers (2D FFT)	Gaskill – Chap 9; Goodman – Chap 2
6	Propagation of lasers: short distance (Fresnel) and long distance (Fraunhoffer)	Goodman – Chap 4
7-8	Optical information processing I: Fourier transform using lenses, pattern recognition algorithm	Goodman – Chap 5,8
9-10	Optical information processing II: optical holography, computer generated holograms	Goodman – Chap 9

### Class/Laboratory Schedule

Each week has two lectures of 75-minutes each. There is no scheduled lab. Students are expected to work in open labs for no less than 2 hours a week.

### Contribution to Professional Component

CEG 428 contributes 4 hours to the Criterion 4(b), and also contains engineering design.

### Course Contribution to Program Educational Objectives

CEG 4283 contributes to Objectives 1 and 2.

### Course Contribution to Program Outcomes and Assessment

a	b	c	d	e	f	g	h	i	j	k
PXX	PX	PXX	PXX	PXX	0	0	PX	PX	PX	PXX