Electrical Engineering 5210: Fourier Optics
Prior Number – Electrical Engineering 324

Credit and Contact Hours
3 credit hours lecture (Three 50-minutes or two 75-minutes lectures are typical)

Instructor
Steve Watkins, Ph.D.

Text

Catalog Information
Applications of Fourier analysis and linear system theory to optics. Topics include scalar diffraction theory, Fourier transforming properties of lenses, optical information processing, and imaging systems.

Prerequisites
Electrical Engineering 3600 (271) or Physics 2401 (208) and Physics 4211 (321). (Co-listed with Physics 5503).

Required or Elective
Selected elective

Course Goals
General Outcomes
1. Learn to represent the directional propagation and interference of plane waves using complex phasor notation
2. Understand the two-dimensional Fourier transforms for separable and circularly symmetric functions
3. Learn to apply a linear systems approach to scalar diffraction problems
4. Learn to determine the spatial light distribution in the Fourier and image planes of diffraction-limited single lenses
5. Introduce the concepts of optical information processing and holography
### Relationship of Course to Program Outcomes

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<tr>
<th>ECE Outcome</th>
<th>Course Outcomes</th>
<th>Comments</th>
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<tr>
<td>a</td>
<td>S S S S M</td>
<td>Fourier optical analysis is compared to its traditional application for electrical systems.</td>
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<td>b</td>
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<td>e</td>
<td>S M S S M</td>
<td>Applications are linked to fundamental knowledge</td>
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<tr>
<td>i</td>
<td>W M M</td>
<td>The wave-based description of optical systems provides tools for lifelong learning.</td>
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S – strong connection; M – medium connection; W – weak connection

### Topics Covered

1. Optics, Wave Propagation, and Plane Waves (Handout) (1 1/2 weeks)
2. Decomposition of Waves and Interferometry (1 week)
3. Two-Dimensional Fourier Analysis (2 weeks)
4. Scalar Diffraction Theory including the Angular Spectrum, Fresnel Diffraction and Fraunhofer Diffraction (2 1/2 weeks)
5. Lenses, Image Formation, and Fourier Transforming Properties (3 weeks)
6. Optical Information Processing and Holography (3 weeks)
7. Laboratory Exercise (1/2 week)
8. Reviews, Examinations, and Final Examination (2 weeks)