Electrical Engineering 5220: Fiber and Integrated Optics
Prior Number – Electrical Engineering 326

Credit and Contact Hours
3 credit hours lecture (Three 50-minute or two 75-minute lectures per week).

Instructor
Steve Watkins, Ph.D.

Text(s)
Guided-Wave Photonics, A. Bruce Buckman, Saunter College Publishing, Fort Worth, TX, 1992.

Catalog Information
Introduction to optical waveguides and their applications to communication and sensing. Topics include dielectric waveguide theory, optical fiber characteristics, integrated optic circuits, coupled-mode theory, optical communication systems, and photonic sensors.

Prerequisite
Electrical Engineering 3600 (271) or Physics 2401 (208) and Physics 4211 (321). (Co-listed with Physics 5513)

Required or Elective
Selected elective

Course Goals
General Outcomes
1. Learn to represent the polarization and interface relations of plane waves using complex phasor notation
2. Understand the modal guided-wave field solutions for simple planar and cylindrical structures with dielectric-dielectric interfaces
3. Introduce the technology and terminology of optical fibers including parameters, types, measurement and fabrication techniques, and coupling approaches
4. Learn to determine power and dispersion budgets for simple communication links
5. Introduce common photonic devices for sensing
### Relationship of Course to Program Outcomes

<table>
<thead>
<tr>
<th>ECE Outcome</th>
<th>Course Outcomes</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>S S M S M</td>
<td>Wave propagation is described using phasor analysis techniques similar to phasor techniques for electrical systems.</td>
</tr>
<tr>
<td>b</td>
<td>M M M</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>W M S S W</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>S S M S M</td>
<td>Applications are linked to fundamental knowledge</td>
</tr>
<tr>
<td>f</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>W W W</td>
<td>The guided-waves description provides tools for lifelong learning.</td>
</tr>
<tr>
<td>j</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k</td>
<td>S S M M</td>
<td></td>
</tr>
<tr>
<td>l</td>
<td>W</td>
<td></td>
</tr>
</tbody>
</table>

S – strong connection; M – medium connection; W – weak connection

### Topics Covered

1. Optics, Wave Propagation, and Plane Waves (Handout) (1 1/2 weeks)
2. Polarization, Reflection, and Refraction (1 week)
3. Mode Solutions for Dielectric Slab Waveguides (1 1/2 weeks)
4. Mode Solutions for Dielectric Cylindrical Waveguides (1 1/2 weeks)
5. Loss and Dispersion Mechanisms in Waveguides (1 week)
6. Characteristics of Single-Mode and Multi-Mode Optical Fibers (1 week)
7. Fiber Fabrication and Measurement Techniques (1 week)
8. Coupled-Mode Theory and Evanescent Couplers (1 week)
9. Optical Communication Links emphasizing Loss and Dispersion (2 weeks)
10. Optical Fiber Sensors using Attenuation and Interferometry (2 weeks)
11. Reviews, Examinations, and Final Examination (2 weeks)