OPTI 100H: What is Light?

**Course Goal**
Introduce you to the fascinating field of optics and how it so important in our daily lives, how it leads to new technologies, learn about the broad and extensive careers, and how to explain and analyze light.

**Pre-requisites**
None

**Overview**
Light is an important aspect of our daily lives, from the lights that we use to see, to the displays that give us information and entertainment, to lasers that are used on optical fibers to transfer information from one place to another. This course will delve into what light is by presenting the technology, phenomena, and systems that we use on daily basis. It starts with our eyes used to view our smartphone or computer displays. The information for these displays is provided via networks, which in the long haul sector use fiber optics, lasers, and other optical subsystems. Along the way we will discuss the three interpretations of light: as a ray (geometrical), as a wave (physical), and as both known as the wave-particle duality (quantum).

**Number of Units/component**
The class is three units and comprised of lecture (50% workload); and discussions, tours, and labs (50%).

**Locations and Times:**
TR 2.00 pm – 3.15 pm  Meinel 432

**Instructor Information**
John Koshel: 403A, Academic Programs office, 621-6357
Open / by appointment (most individuals in the AP Office can access my schedule)
- Available via Zoom at https://arizona.zoom.us/my/koshel
- I get an email when you enter – wait a couple minutes to see if I can get into Zoom
- If not, I will email you back about availability (you must have your name / recognizing ID within Zoom)

**Expected Learning Outcomes**
1. Demonstrate an understanding of how light through technology, phenomena, and systems are a part of our daily lives, which is done through discussion, laboratories, problem solving, & so forth (Student Outcome 2).
2. Demonstrate an understanding of the three interpretations of light (geometrical, physical, and quantum) through discussion, solving problems, and so forth (Student Outcome 1).
3. Conduct simple experiments to be able to manipulate, measure, and use light (Student Outcome 3).
4. Learn technical communication via papers, videos, and presentation on student selected topics (Student Outcome 6).

**Required Texts**
Required: none; course notes will be provided

Recommended: SPIE Field Guides (see http://spie.org/publications/books/field-guides; free e-books online)
**Topics and/or general calendar**

Week 1: Introduction to light: description, properties, ...

- Field Trip: optics in nature around us
- Lab/discussion: optics around us, in particular sources and spectrum

**LIGHT IS A RAY**

Week 2: Start the light journey – looking at your Smartphone, computer, tablet – Intro to the human eye

- Field Trip: vision lab
- Lab/discussion: the components of the eye

Week 3: Smartphones – follow the rays (geometrical optics) back into the phone

- Field Trip: Displays labs
- Lab/discussion: components of displays

Week 4: Smartphones – the other optical systems in your phone

- Field Trip: building tour – optics museum
- Lab/discussion: look into a cell phone

Week 5: Light as a ray – how do we design these optical systems?

- Field Trip: Optical design labs
- Lab/discussion: Intro to software

Week 6: The nitty gritty of optical design

- Field Trip: maybe a trip to a local software company
- Lab/discussion: use of design software

Week 7: Forming the image – detectors

- Field Trip: Imaging Labs
- Lab/discussion: teaching labs – working with detectors

**LIGHT IS A WAVE**

Week 8: Lasers – sources powering the internet

- Field Trip: Laser Labs
Lab/discussion: looking at the properties of a laser, total internal reflection

Week 9: The internet is made up by optical fibers
   Field trip: TOAN labs
   Lab/discussion: coupling into a fiber

Week 10: Optical switches, steering light
   Field Trip: polarization or design labs
   Lab/discussion: polarization or DMD “switch”

Week 11: Interference and diffraction
   Field Trip: interferometer lab or visit to local industry
   Lab/discussion: interferometer setup

Week 12: Optics is more than the telecom components...
   Field Trip: Lithography labs
   Lab/discussion: state-of-the art systems

LIGHT IS BOTH

Week 13: Quantum optics
   Field Trip: BEC labs
   Lab/discussion: what does all of this mean...

Week 14: Quantum Information/Engineering
   Field Trip: QE labs
   Lab/discussion: continue discussion

Week 15: Course wrap up and presentations
   Field Trip: Mirror lab (optional)

NOTE: this schedule is approximate. Tours and the like depend on lab availability, so the schedule will be updated to accommodate if and when we can get to a certain lab.
Major Course Assignments

• No exams
• One short paper in each section
• One course paper and presentation
• Video presentation(s)

Course Policies

Grading Policy
All handed-in materials are due in D2L by 11.59 pm on the stated dates

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<thead>
<tr>
<th>Assignment</th>
<th>Weight</th>
<th>Duration</th>
<th>Deadline</th>
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</thead>
<tbody>
<tr>
<td>Video Presentation(s)</td>
<td>10%</td>
<td>4-5 minute video(s)</td>
<td>Friday, 9 February</td>
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<tr>
<td>Light is a Ray paper</td>
<td>10%</td>
<td>3+ page paper</td>
<td>Friday, 23 February</td>
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<tr>
<td>Light is a Wave paper</td>
<td>10%</td>
<td>3+ page paper</td>
<td>Friday, 22 March</td>
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<tr>
<td>Light is Both paper</td>
<td>10%</td>
<td>3+ page paper</td>
<td>Friday, 19 April</td>
</tr>
<tr>
<td>Course Presentation and Paper</td>
<td>30%</td>
<td>10 minutes/6+ pages</td>
<td>30 April / 3 May</td>
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<tr>
<td>Assignments</td>
<td>20%</td>
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<td>1 week following</td>
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<tr>
<td>Discussion Board/Class Participation</td>
<td>10%</td>
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<td>throughout course</td>
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<td>Total</td>
<td>100%</td>
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The grade will be determined according to the cumulative percentage earned such that 90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, below 60% = E.

University-Wide Policies

Links to the following UA policies are provided here, http://catalog.arizona.edu/syllabus-policies:

• Absence and Class Participation Policies
• Threatening Behavior Policy
• Accessibility and Accommodations Policy
• Code of Academic Integrity
• Nondiscrimination and Anti-Harassment Policy
• Subject to Change Statement

Other policies

• Confidentiality: http://www.registrar.arizona.edu/ferpa
• Safety: For a list of emergency procedures for all types of incidents, please visit the website of the Critical Incident Response Team (CIRT): https://cirt.arizona.edu/case-emergency/overview
• Safety video: https://arizona.sabacloud.com/Saba/Web_spf/NA7P1PRD161/common/learningeventdetail/crtfy00000000003560
• Classroom Behavior: To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).
Additional resources

UA Academic policies and procedures are available at http://catalog.arizona.edu/policies

Campus Health
http://www.health.arizona.edu/
Campus Health provides quality medical and mental health care services through virtual and in-person care.
Phone: 520-621-9202

Counseling and Psych Services (CAPS)
https://health.arizona.edu/counseling-psych-services
CAPS provides mental health care, including short-term counseling services.
Phone: 520-621-3334

The Dean of Students Office’s Student Assistance Program
https://deanofstudents.arizona.edu/support/student-assistance
Student Assistance helps students manage crises, life traumas, and other barriers that impede success. The staff addresses the needs of students who experience issues related to social adjustment, academic challenges, psychological health, physical health, victimization, and relationship issues, through a variety of interventions, referrals, and follow up services.
Email: DOS-deanofstudents@arizona.edu
Phone: 520-621-7057

Survivor Advocacy Program
https://survivoradvocacy.arizona.edu/
The Survivor Advocacy Program provides confidential support and advocacy services to student survivors of sexual and gender-based violence. The Program can also advise students about relevant non-UA resources available within the local community for support.
Email: survivoradvocacy@arizona.edu
Phone: 520-621-5767