

# OPTI 100H: What is Light?

## Effective Spring 2020

### Course Description:

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 display. 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).

### Pre-requisites:

None

### Number of Units/ component:

The class is three units and comprised of lecture (50% workload), discussion / laboratory (50%)

### Locations and Times:

Monday            3 pm – 5pm:    meet in Meinel 422

Wednesday      4 pm – 5pm:    meet in Meinel 422

### Instructor Information:

John Koshel (manages the course; he and other professors in Optical Sciences will be the presenters)  
403A (Meinel, Academic Programs Office, College of Optical Sciences)

- [jkoshel@optics.arizona.edu](mailto:jkoshel@optics.arizona.edu); 621-6357
- Office is always open to students; meetings can be setup through any AP staff member

### 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, and so forth.
2. Demonstrate an understanding of the three interpretations of light (geometrical, physical, and quantum) through discussion, solving problems, and so forth.
3. Conduct simple experiments to be able to manipulate, measure, and use light.
4. Write a term paper on a student selected topic.

### Required Texts:

Required: none; course notes will be provided

Recommended: SPIE Field Guides (see <http://spie.org/publications/books/field-guides>; available as 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: Ophthalmic lab

Lab/discussion: the components of the eye

Week 3: Smartphones – follow rays 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)

**Number of Exams and Papers:**

No exams

One short paper in each section

One course paper and presentation

One video presentation

**Course Policies:**

Grading Policy – all handed-in materials are due by 11.59 pm on stated date

Light is a Ray paper	10%	3+ page paper	Friday, 6 March
Light is a Wave paper	10%	3+ page paper	Friday, 10 April
Light is Both paper	10%	3+ page paper	Friday, 24 April
Video Presentation	10%	8-10 minute video	Friday, 21 February
Course Paper and Presentation	30%	6+ pages/15 minutes	4 and 6 May
Assignments	20%		1 week following
<u>Discussion Board Participation</u>	<u>10%</u>		<u>throughout course</u>
Total	100%		

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.

**Academic Integrity** (<http://web.arizona.edu/~studpubs/policies/cacaint.htm>)

According to the Arizona Code of Academic Integrity, "Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own." Unless otherwise noted by the instructor, work for all assignments in this course must be conducted independently by each student. Co-authored work of any kind is unacceptable. Misappropriation of exams before or after they are given will be considered academics misconduct.

Misconduct of any kind will be prosecuted and may result in any or all of the following:

- Reduction of grade
- Failing grade
- Referral to the Dean of Students for consideration of additional penalty, i.e. notation on a student's transcript re. academic integrity violation, etc.

**Attendance Policy**

It is important to attend all classes, as what is discussed in class is pertinent to adequate performance on assignments and exams. If you must be absent, it is your responsibility to obtain and review the information you missed. This is especially important in this course where a substantial amount of course material will emerge through class discussion.

"All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored."

**Classroom Behavior**

The Arizona Board of Regents' Student Code of Conduct, ABOR Policy 5-308, prohibits threats of physical harm to any member of the University community, including to one's self. See:

<http://policy.web.arizona.edu/threatening-behavior-students>.

**Students with Disabilities**

If a student is registered with the Disability Resource Center, he/she must submit appropriate documentation to the instructor if he/she is requesting reasonable accommodations. (<http://drc.arizona.edu/instructor/syllabus-statement.shtml>).

*The information contained in this syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.*